Anatomy and physiology

FOR 3RD YEAR MEDICAL PHYSICS STUDENTS

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Anatomy: the word anatomy is derived from a Greek word "Anatome" meaning to cut up. It is the study of structures that make up the body and how those structures relate with each other. Gross anatomy studies body structure without microscope. Systemic anatomy studies functional relationships of organs within a system whereas Regional anatomy studies body part regionally. Both systemic and regional approaches may be used to study gross anatomy.

Microscopic anatomy (Histology) requires the use of microscope to study tissues that form the various organs of the body.

Physiology: the word physiology derived from a Greek word for study of nature. It is the study of how the body and its part work or function.

Anatomy and physiology are two of the most basic terms and areas of study in the life sciences. Anatomy refers to the internal and external structures of the body and their physical relationships, whereas physiology refers to the study of the functions of those structures.

Atoms molecules and compounds: - At its simplest level, the body is composed of atoms. The most common elements in living organism are carbon, hydrogen, oxygen, nitrogen phosphorus and sulfur. Atoms → Molecule → Compounds.

Cell: The smallest independent units of life. All life depends on the many chemical activities of cells. Some of the basic functions of cell are: growth, metabolism, irritability and reproduction.

Tissue: tissue is made up of many similar cells that perform a specific function. The various tissues of the body are divided in to four groups. These are epithelial, connective, nervous and muscle tissue.

Epithelial tissue: - Found in the outer layer of skin, lining of organs, blood and lymph vessels and body cavities.

Connective tissue: Connects and supports most part of the body. They constitute most part of skin, bone and tendons.

Muscle tissue: Produces movement through its ability to contract. This constitutes skeletal, smooth and cardiac muscles.

Nerve tissue: Found in the brain, spinal cord and nerves. It responds to various types of stimuli and transmits nerve impulses.

TABLE 3.1 The Four Primary Tissue Classes

Type	Definition	Representative Locations
Epithelial	Tissue composed of layers of closely spaced cells that cover organ surfaces or form glands; serves for protection, secretion, and absorption	Epidermis Inner lining of digestive tract Liver and other glands
Connective	Tissue with usually more matrix than cell volume; often specialized to support, bind, and protect organs	Tendons and ligaments Cartilage and bone Blood and lymph
Nervous	Tissue containing excitable cells specialized for rapid transmission of information to other cells	Brain Spinal cord Nerves
Muscular	Tissue composed of elongated, excitable cells specialized for contraction	Skeletal muscles Heart (cardiac muscle) Walls of viscera (smooth muscle)

Organ: Is an integrated collection of two or more kinds of tissue that works together to perform specific function. For example: Stomach is made of all type of tissues

System: Is a group of organs that work together to perform major function. For example: Respiratory system contains several organs.

Organism level: The various organs of the body form the entire organism

Body parts Regions

The body can generally be described to have areas of:

Axial body part: It is the part of the body near the axis of the body. This includes head, neck, thorax (chest), abdomen, and pelvis.

Appendicular body part: It is the part of the body out of the axis line. This includes the upper and lower extremities. It is customary to subdivide the abdominal area into nine regions or more easily in to four quadrants.

Body planes and sections Body planes are imaginary surfaces or planes lines that divide the body in to sections. This helps for further identification of specific areas

Sagittal plane: divides the body into right and left half.

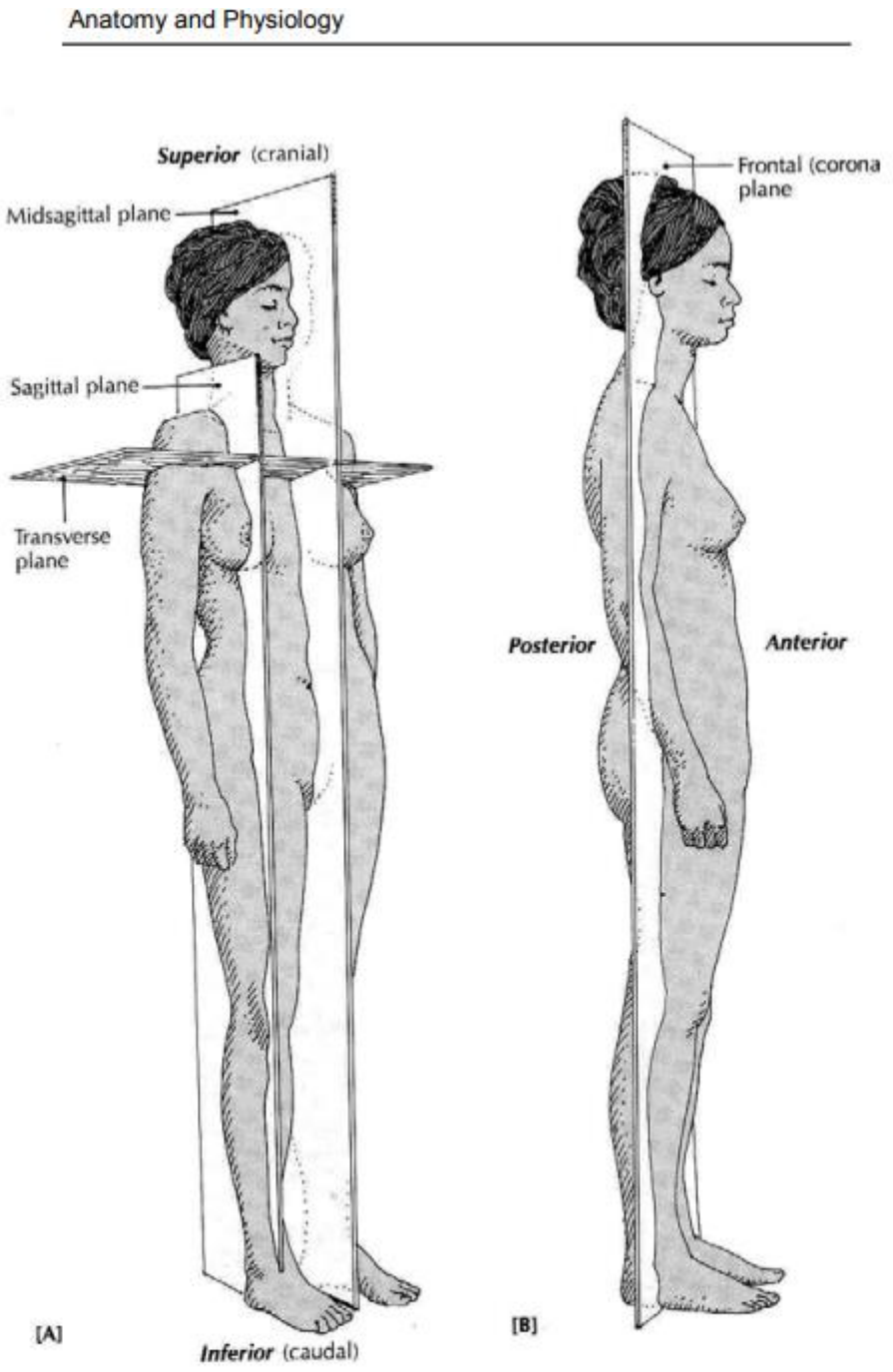
Mid sagittal plane: divides body into equal left and right halves.

Para sagittal plane: divides body into unequal left and right

Frontal plane: divides the body into asymmetrical anterior and posterior sections.

Transverse plane: divides the body into upper and lower body section.

Oblique plane: divides the body obliquely into upper and lower section.



Body planes

"There are three kinds of people; those that make things happen, those that watch things happen and those who don't know what's happening." —Bible

Cell is the basic living structural and functional unit of the body.

Cytology: It is a branch of science concerned with a study of cells

Cell Theory explains about

a) All living organisms are composed of cell and cell products.

b) Cell is the basic unit of structure & function of all living organisms.

c) All cells come from the division of preexisting cell.

d) An organism as a whole can be understood through the collective activities & interactions of its cells.

To know more about cell, we can divide the cell in to four principal parts: -

Plasma (cell) membrane: it is the outer lining, limiting membrane separating the cell internal parts from extra cellular materials & external environment.

Cytoplasm: cytoplasm is the substance that surrounds organelles and is located between the nucleus and plasma membrane

Plasma Membrane is a thin outer membrane, which maintains the integrity of the cell. It keeps the cell and its contents separate and distinct from the surrounding. It is a double layered measuring about 4.5 nm and made of phospholipids, cholesterol, glyco-lipid, & carbohydrate (oligosaccharides). The bi-layer is self-sealing. If a needle is injected and pulled out, it automatically seals.

Functions: - 1. Separate the cytoplasm inside a cell from extra cellular fluid.

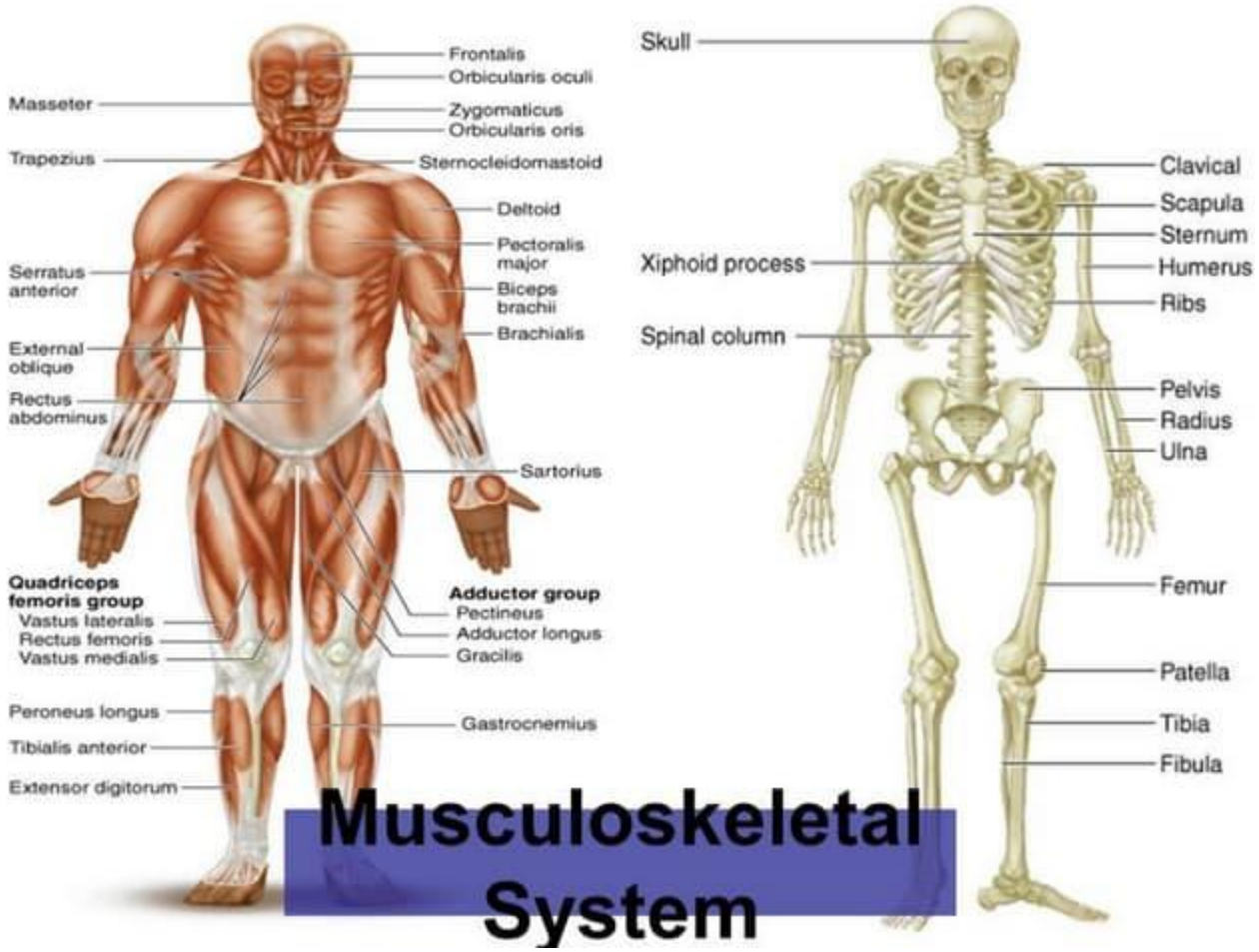
2. Separate cell from one another

3. Provide an abundant surface on which chemical reaction can occur.

4. Regulate the passage of materials in to and out of cells. It also let some things in and keeps others out. The quality selective permeability

TISSUE Cells are highly organized units. But in multicultural organisms, they do not function in isolation. They work together in-group of similar cells called tissue. Tissue is a group of similar cell and their intercellular substance that have a similar embryological origin and function together to perform a specialized activity. A science that deals with the study of a tissue is Histology. The various tissues of the body are classified in to four principal parts according to their function & structure. These are epithelial, connective, muscular, and Nervous tissue.

The Musculoskeletal System



The word skeleton comes from the Greek word skeleton meaning “dried up”. It is strong yet light adapted for its function of body protection and motion. The skeletal system includes bones, joints, cartilages and ligaments. The joint gives the body flexibility and allow movements to occur. But from structural point of view, the human skeletal system consists of two main types of supportive connective tissue, bone and cartilage.

Functions of the skeletal system:

1. Support: it forms the internal framework that supports and anchors all soft organs.
2. Protection: bones protect soft body organs.
3. Movement: skeletal muscles attached to the skeletal system use the bone to levers to move the body and its part.
4. Storage: fat is stored in the internal cavities of bones. Bone it self-serves as a storehouse of minerals. The most important being calcium and phosphors.

Success means having the courage, the determination, and the will to become the person you believe you were meant to be.” —George

5. Blood cell formation: it occurs within the marrow cavities of certain bones.

Bone

Bone (osseous) is specialized connective tissue that has the strength of cast iron and lightness of pinewood. Living bone is not dry, brittle or dead. It is a moist changing, productive tissue that is continually resorbed, reformed and remodeled.

Types of bone Long bone, are called long as its length is greater than its width. The most obvious long bones are in the arm and leg. They act as levers that pulled by contraction of muscles. **Short bones** are about equal in length, width and thickness, which are shaped with regular orientation. They occur in the wrist and ankle. Flat bones are thin or curved more often they are flat. This includes ribs, scapulae, sternum and bone of cranium. Irregular bones, they do not fit neatly into any other category. Examples are the vertebral, facial, and hipbone

Sesamoid bones are small bones embedded within certain tendons, the fibrous cord that connects muscle to bones.

Bone Cells Bone contain five types of cells

a) Osteogenic cells: these are small spindle shaped cell. They found mostly in the deepest layer of periosteum and endosteum. They have high mitotic potential and can be transformed into bone forming cells (osteoblasts).

b) Osteoblasts are found in the growing portion of bone including periosteum. They are able to synthesize and secrete un-mineralized ground substance, act as pump cell to move calcium and phosphate in and out of bone tissue.

c) Osteocytes are the main cell of fully developed bones. They have a cell body that occupies a lacuna. Osteocytes are derived from osteoblasts. They together with osteoclasts play an important role of homeostasis by helping to release calcium.

d) Osteoclasts are multinuclear giant cell, which are found where bone is resorbed during its normal growth. Osteoclasts are derived from white blood cells called monocytes.

e) Bone - lining cells are found on the surface of most bones in the adult skeleton. They are believed to be derived from osteoblast that ceases their physiological activity.

Function of bone

• Supportive and protection of internal organs.

• The store house and main supply of reserve calcium and phosphate.

• The manufacture of red and white blood cell.

The muscular system The term muscle tissue refers to all the contractile tissues of the body: skeletal, cardiac, and smooth muscle. The muscular system, however, refers to the skeletal muscle system: the skeletal muscle tissue and connective tissues that makeup individual muscle organs. Cardiac muscle tissue is located in the heart and is therefore considered part of the cardiovascular system. Smooth muscle tissue of the intestines is part of the digestive system, whereas smooth muscle tissue of the urinary bladder is part of the urinary system and so on.

Functions of muscle tissue Through sustained contraction or alternating contraction and relaxation, muscle tissue has three key functions:

producing motion, **providing stabilization**, and **generating heat.**

Physiologic Characteristics of muscle tissue Muscle tissue has four principal characteristics that enable it to carry out its functions and thus contribute to homeostasis.

1. Excitability a property of both muscle and nerve cells (neurons), is the ability to respond to certain stimuli by producing electrical signal called action potentials (impulses)
2. Contractility is the ability of muscle tissue to shorten and thicken (contract), thus generating force to do work. Muscles contract in response to one or more muscle action potentials
3. Extensibility means that the muscle can be extended (stretched) without damaging the tissue
4. Elasticity means that muscle tissue tends to return to its original shape after contraction or extension.

The musculoskeletal system is a system of bones and muscles working together. The musculoskeletal system provides structure to the body, allows for movement, and physically protects the body's other systems.

The **skull** consists of multiple flat bones that interlock and form a protective space for the brain. They also create the structure of the face and mouth with many attachments for the muscles that allow for all head movement.

The **spine** is made of multiple interlocking vertebrae with a central channel for the spinal cord and exit points for the nerves. Like the skull, it protects the spinal cord and provides attachment points for both muscles and ribs.

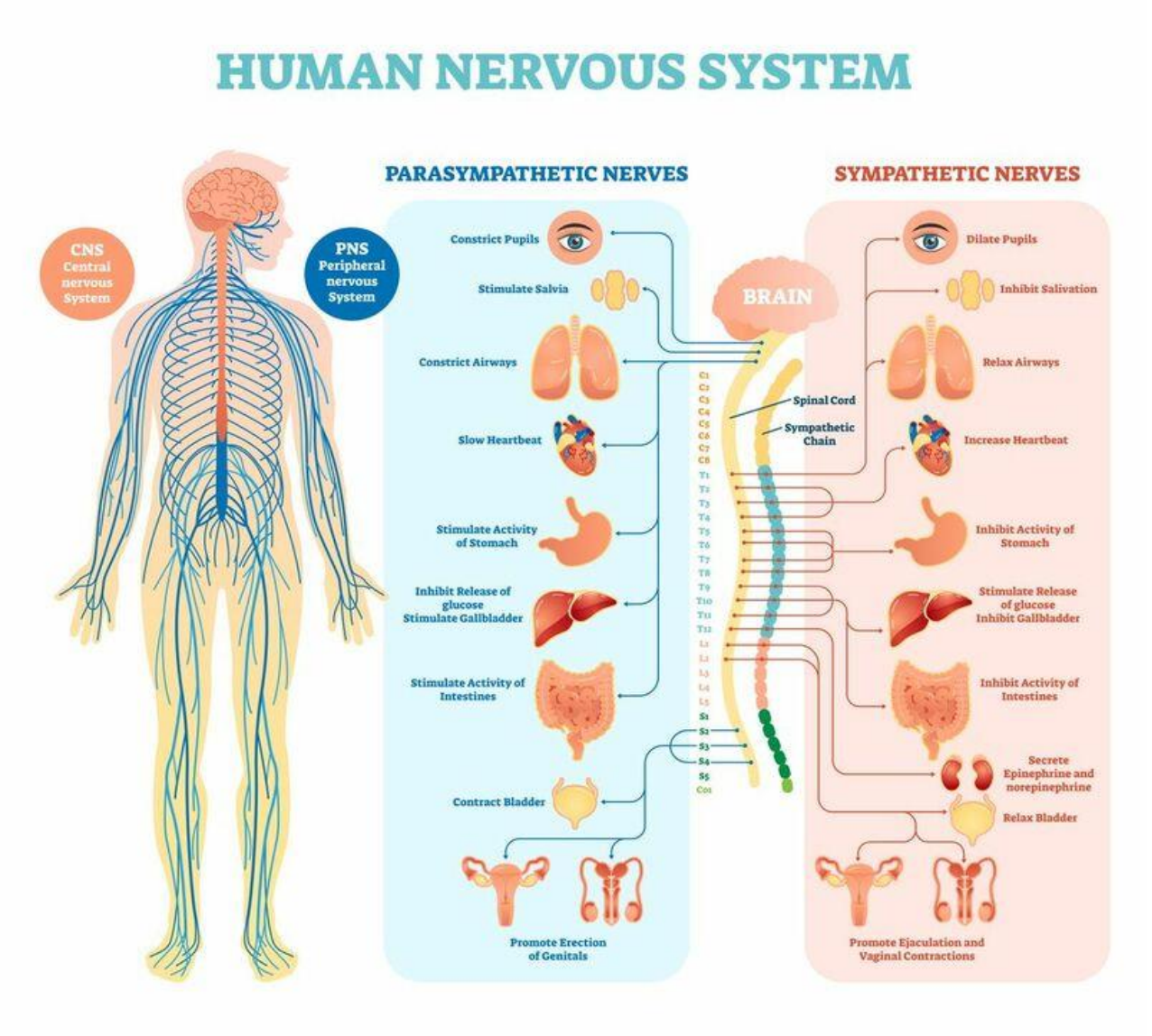
The **thoracic cage** or "rib cage" provides the rigidity of the chest, which is vital to the expansion and contraction of the lungs, making the rib cage vital to the respiratory system. It also serves to protect the vital organs within the chest.

The **pelvic girdle** is one of the most complex anatomical structures in the body. It transfers the upper body's weight from the spine to the legs and has a massive number of attachment points for various large muscle groups of both the trunk and the legs.

Like the pelvis, the limbs are complex and have many different joints and attachment points to allow for precise and varied movement.

The **muscles** consist of bundles of smaller fibers (myofibrils) that are anchored to a bone via a tendon and have one or more nerves from the peripheral nervous system that allows for voluntary and involuntary contraction. All bodily movements stem from the muscles pulling against the bones across the joints. This type of muscle is known as "Skeletal muscle" or "Striated" muscle due to the arrangement of the muscle fibers. There is another type of muscle in the body known as "smooth muscle, " a component of many bodily systems. This form of muscle is loosely arranged and does not have the characteristic striations of the previously mentioned skeletal muscle.

The Nervous System



General Function None of the body system is capable of functioning alone. All are interdependent and work together as one unit so that normal conditions within the body may prevail. Control of the body's billions of cells is accomplished mainly by two communication systems: the nervous system and the endocrine system. Both systems transmit information from one part of the body to another, but they do it in different ways. The nervous system transmits information very rapidly by nerve impulses conducted from one body area to another. The endocrine system transmits information more slowly by chemicals secreted by ductless glands into blood steam and circulated from glands to other parts of the body. The nervous system serves as the chief coordinating agency. Conditions both within and outside the body are constantly changing; the purpose of the nervous system is to respond to these internal and external changes (known as stimuli) and so cause

the body to adapt to new conditions. It is through the nerve impulse sent to the various organs by the nervous system that a person's internal harmony and the balance between the person and the environment are maintained.

Cells of nervous system and their functions The two types of cells found in the nervous system are called neurons or nerve cells and neuroglia, which are specialized connective tissue cells. Neurons conduct impulses, whereas neuroglia supports neurons.

The nervous system controls the entire body. It has fibers that run across every inch of the body, controlling muscles, organs, and glands; while returning information to the spinal cord and brain to allow them to make decisions. Neurons have several parts, dendrites that receive signals, axons that transmit them, and the cell body, which maintains the nerve cell. The anatomy of the nervous system is divided into the **central** and **peripheral** systems, with the central nervous system acting as the control system for the body and the peripheral as communication lines that relay information to and from the central system.

The **central nervous system (CNS)** is made up of the brain and spinal cord; both of these structures are made up of a large number of neurons and support cells, with both large blood vessels and capillaries supplying the large amount of energy the neurons require.

The **peripheral nervous system (PNS)** is extensive and covers all areas of the body. These nerves have a myriad of functions controlling movement in the body, controlling the function of the organs, and returning sensory information from all across the body to the spinal cord and brain. The nerves of the PNS branch off of the spinal cord. The **somatic nervous system (SNS)**, a branch of the PNS, is responsible for controlling voluntary muscle movements.

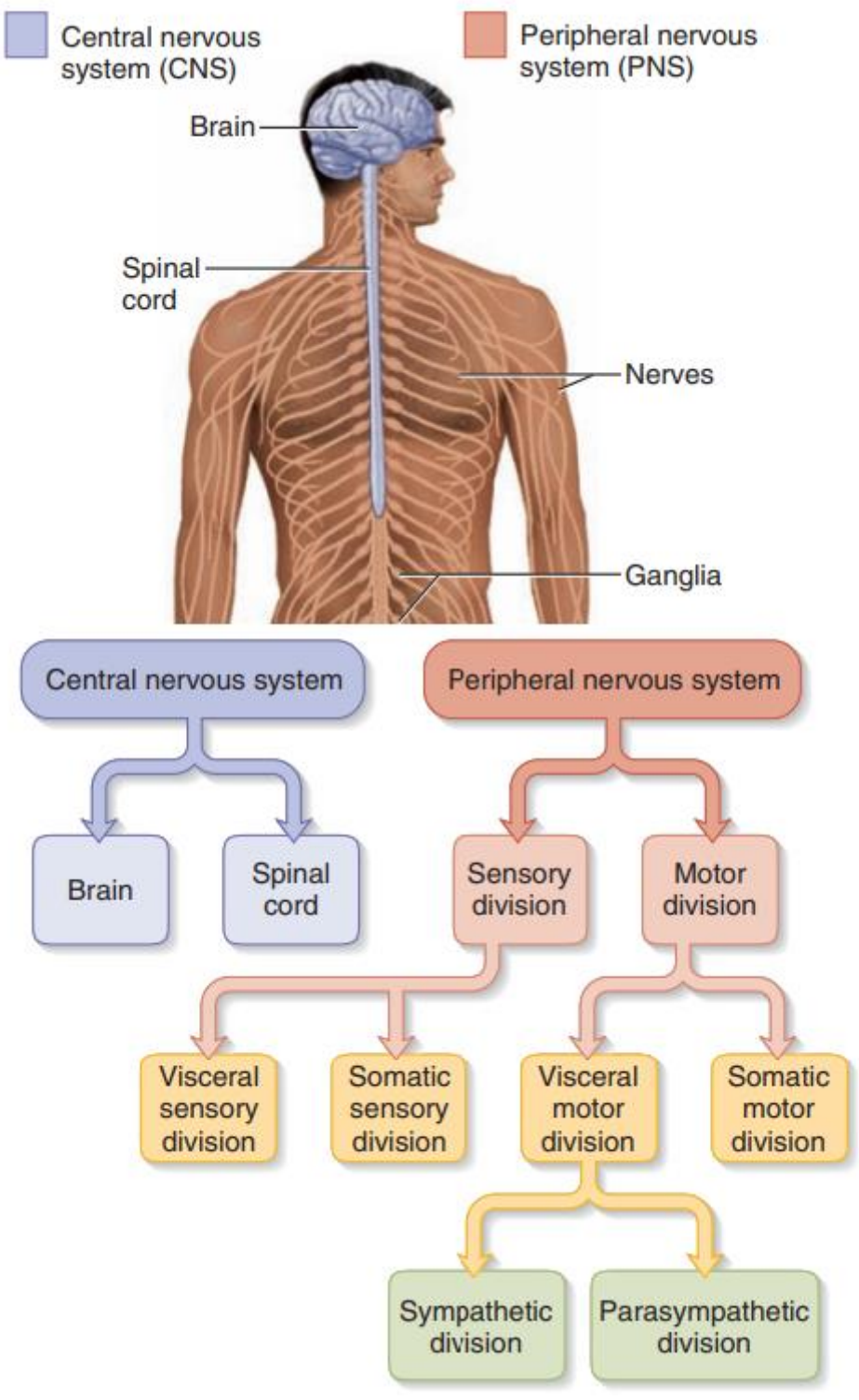
The **autonomic nervous system (ANS)** is a division of the peripheral nervous system (PNS) that controls and regulates the involuntary functions of the body. It plays a crucial role in maintaining internal homeostasis by regulating various physiological processes, such as heart rate, blood pressure, digestion, respiratory rate, and body temperature, among others.

The ANS is further divided into **two main branches**:

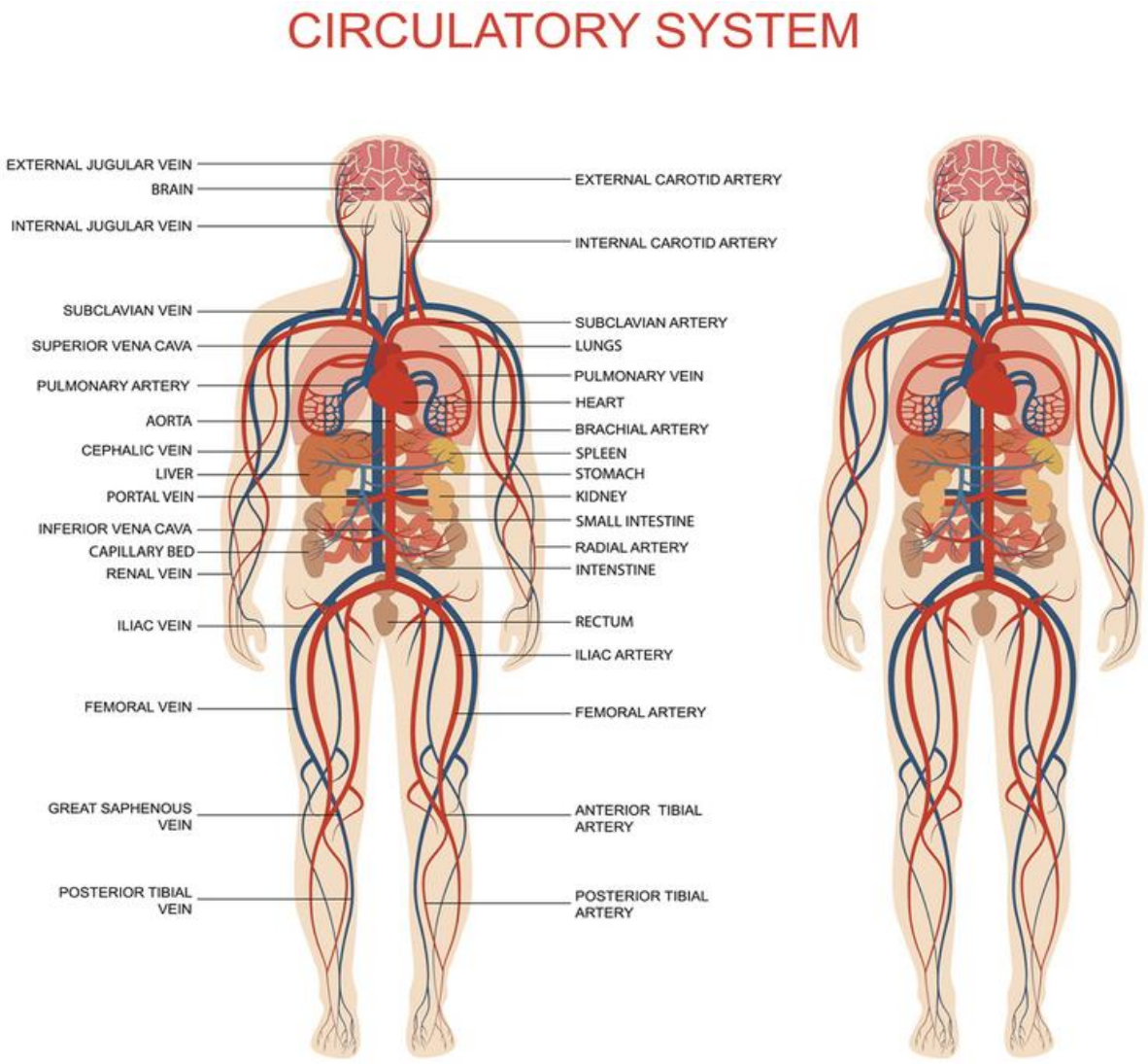
1. **Sympathetic Nervous System:** The sympathetic nervous system is often referred to as the "fight or flight" system because it prepares the body to respond to stressful or

threatening situations. When activated, it increases physiological arousal and mobilizes energy reserves to help the body deal with perceived threats.

2. **Parasympathetic Nervous System:** The parasympathetic nervous system is often referred to as the "rest and digest" system because it promotes relaxation and conserves energy.



The Circulatory System



The cardiovascular system is the transport system of the body by which food, oxygen, water and all other essentials are carried to the tissue cells and their waste products are carried away.

It consists of three parts:

1. The blood, which is the fluid in which materials are carried to and from the tissue
2. The heart, which is the driving force which propels the blood
3. The blood vessels, the routes by which the blood travels to and through the tissues and back to the heart.

The Heart is a muscular pump that drives the blood through the blood vessels. Slightly bigger than a fist, this organ is located between the lungs in the center and a bit to the left on the midline of the body. The importance of the heart has been recognized for centuries. The fact that its rate of beating is affected by the emotions may be responsible for the very

frequent references to the heart in song and poetry. However, the vital functions of the heart and its disorders are of more practical importance to us.

Structure of the Heart The heart is a hollow organ the walls of which are formed of three different layers. The heart wall has three tissue layers

1. The endocardium is a very thin smooth layer of cells that resembles squamous epithelium. This membrane lines the interior of the heart. The valves of the heart are formed by reinforced folds of this material.

2. The myocardium, the muscle of the heart, is the thickest layer.

3. The epicardium forms the thin outermost layer of the heart wall and is continuous with the serous lining of the fibrous sac that encloses the heart. These membranes together make up the pericardium. The serous lining of the pericardial sac is separated from the epicardium on the heart surface by a thin fluid- filled space.

The **blood vessels** carry blood and regulate its flow to different areas of the body. The vessels are smooth muscle tubes that can expand and contract based on signals from hormones and the nervous system. Vessels are present in varying sizes, with the largest ones being near the heart and the smallest within the body's various tissues. There are different types of vessels; arteries, arterioles, veins, and capillaries all have unique functions.

The **blood** is not traditionally considered to have anatomy, but know that it has many parts in the form of different cells, red blood cells, white blood cells, platelets, and a variety of proteins/hormones/chemicals all have different roles.

The Physiology of the circulatory system is complicated by the many types of cells in the heart and blood.

Functions of the Circulatory System

The circulatory system consists of the heart, blood vessels, and blood. The term cardiovascular system refers only to the heart and blood vessels.

The fundamental purpose of the circulatory system is to transport substances from place to place in the blood. Blood is the liquid medium in which these materials travel; blood vessels ensure the proper routing of blood to its destinations; and the heart is the pump that keeps the blood flowing. More specifically, the functions of the circulatory system are as follows:

Transport

● The blood carries oxygen from the lungs to all of the body's tissues, while it picks up carbon dioxide from those tissues and carries it to the lungs to be removed from the body. ● It picks up nutrients from the digestive tract and delivers them to all of the body's tissues. ● It carries metabolic wastes to the kidneys for removal. ● It carries hormones from endocrine cells to their target organs. ● It transports a variety of stem cells from the bone marrow and other origins to the tissues where they lodge and mature.

Protection

● The blood plays several roles in inflammation, a mechanism for limiting the spread of infection. ● White blood cells destroy microorganisms and cancer cells. ● Antibodies and other blood proteins neutralize toxins and help to destroy pathogens (disease agents). ● Platelets secrete factors that initiate blood clotting and other processes for minimizing blood loss.

Regulation

● Blood helps maintain optimal fluid balance and distribution in the body by absorbing or giving off fluid under different conditions. ● Blood proteins stabilize the pH of extracellular fluids by buffering acids and bases. ● Shifts in blood flow help to regulate body temperature by routing blood to the skin for heat loss or retaining blood deeper in the body for heat retention.

The Work of the Heart

Although the right and left side of the heart are separated from each other, they work together. The blood is squeezed through the chambers by a contraction of heart muscle beginning in the thin-walled upper chambers, the atria, followed by a contraction of the thick muscle of the lower chambers, the ventricles. This active phase is called systole, and in each case it is followed by a resting period known as diastole. The contraction of the walls of the atria is completed at the time the contraction of the ventricles begins. Thus, the resting phase (diastole) begins in

the atria at the same time as the contraction (systole) begins in the ventricles. After the ventricles have emptied, both chambers are relaxed for a short period of time as they fill with blood. Then another beat begins with contraction of the ventricles. This sequence of heart relaxation and contraction is called the cardiac cycle. Each cycle takes an average of 0.8 seconds.

Blood Vessels

Functional classification The blood vessels, together with the four chambers of the heart, from a closed system for the flow of blood; only if there is an injury to some part of the wall of this system does any blood escape. On the basis of function, blood vessels may be classified into three groups:

1. Arteries carry blood from the ventricles (pumping chambers) of the heart out to the capillaries in organs and tissue. The smallest arteries are called arterioles.
2. Veins drain capillaries in the tissues and organs and return the blood to the heart. The smallest veins are the venues.
3. Capillaries allow for exchanges between the blood and body cells, or between the blood and air in the lung tissues. The capillaries connect the arterioles and venues.

Circulatory Routes or Circuits

All the vessels together may be subdivided into two groups or circuits: pulmonary and systemic.

1. Pulmonary circulation: carry blood to and from the lungs. They in include the pulmonary artery and its branches to the capillaries in the lungs, as well as the veins that drain those capillaries. The pulmonary arteries carry blood low in oxygen from the right ventricle, while the pulmonary veins carry blood high in oxygen from the lungs into the left atrium. This circuit functions to eliminate carbon dioxide from the blood and replenish its supply of oxygen.
2. Systemic circulation: it is the largest circulatory route. It takes oxygenated blood from the left ventricle through the aorta to all parts of the body, including some lung tissue (not air sac or alveolus) and returns the deoxygenated blood to the right atrium,

through the systemic veins; the superior vena cava, the inferior vena cava, and the coronary sinus. It has several subdivisions. Two of the several subdivisions are the coronary circulation and the hepatic portal system or circulation.

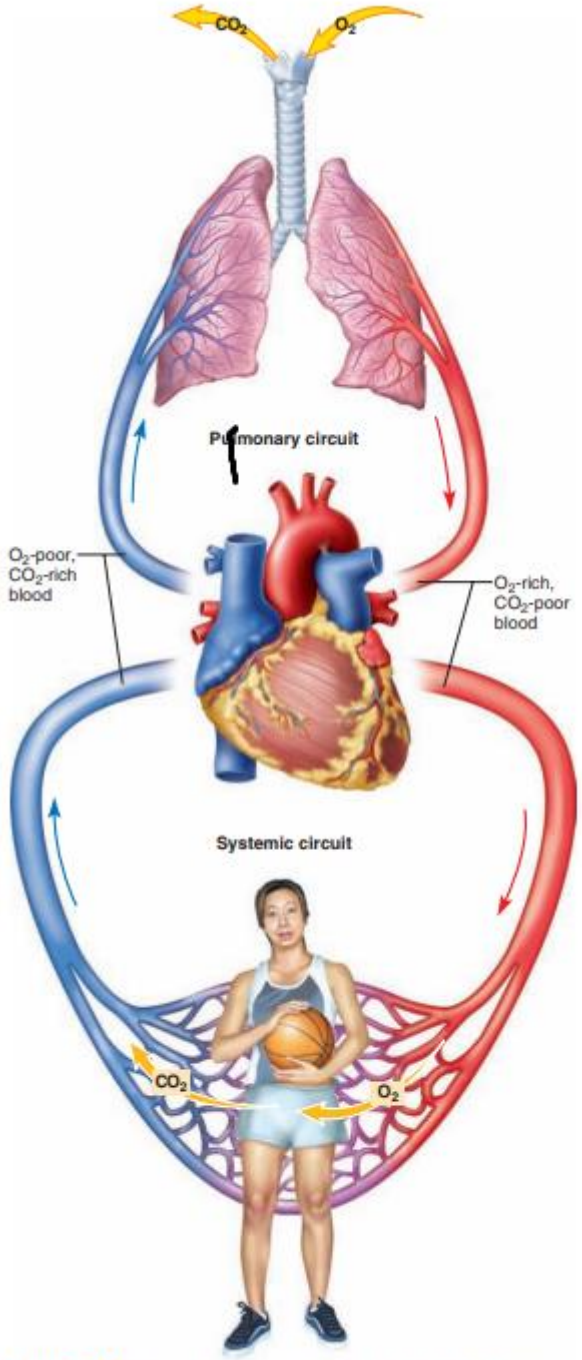


Figure 20.1 General Schematic of the Cardiovascular System.
• *Are the lungs supplied by the pulmonary circuit, the systemic circuit, or both? Explain.* AP R

The Digestive System

General Function Every body cell needs a constant supply of nutrients to provide energy and building blocks for the manufacture of body substances. Food as we take it in, however, is too large to enter the cells. It must first be broken down into particles small enough to pass through the cell membrane. This process is known as digestion. After digestion, food must be carried to the cells in every part of the body by the circulation. The transfer of food into the circulation is called absorption. Digestion and absorption are the two chief functions of the digestive system.

Structure and Function of Organs of Digestion and Accessory Organs for our purpose the digestive system may be divided into two groups of organs:

1. The digestive tract, a continuous passageway beginning at the mouth, where food is taken in, and terminating at the anus, where the solid waste products of digestion are expelled from the body

2. The accessory organ, which are necessary for the digestive process but are not a direct part of the digestive tract. They release substances into the digestive tract through ducts.

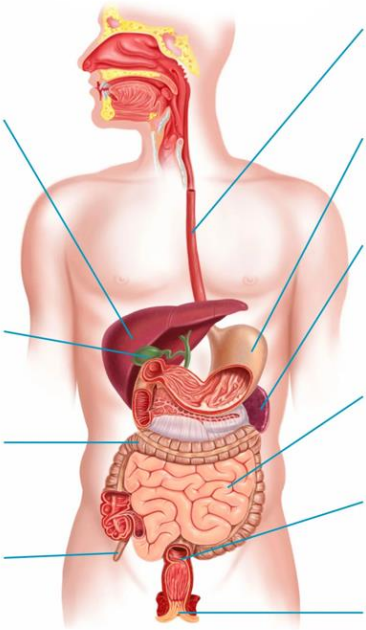
You can divide the anatomy of the digestive system into the **hollow** and **solid organs**. The hollow organs convey food matter and process it, while the solid organs act as support systems, ensuring the process of digestion can proceed smoothly.

The **hollow organs** are the esophagus, stomach, and intestines: The **esophagus** is the physical tube that connects the mouth to the stomach. The stomach both physically grinds up food and chemically digests it with acid. The **intestines** then absorb the nutrients and water from ground up food with help from liver bile and pancreatic enzymes.

The **solid organs** are the liver and the pancreas: The **liver** serves the dual purpose of producing bile, which helps with the absorption of fats by the intestines and detoxifies the blood. The **pancreas**, like the liver, has a dual role. It produces enzymes that break down protein and hormones, balancing blood glucose.

The physiology of the digestive system is heavily dependent upon the organ in question, and many have multiple roles. The hollow organs tend to be specialized in the mechanical breakdown and absorption of food. In contrast, the solid organs create and secrete substances that assist with the chemical breakdown of food.

Digestive System



Liver
The largest organ inside the body. Makes bile (fluid that helps break down fats and gets rid of wastes in the body); changes food into energy; and cleans alcohol, some medicines, and poisons from the blood.

Gallbladder
Stores the bile made in the liver, then empties it to help digest fats.

Large Intestine
Also called the colon. It absorbs water and sodium from stool.

Appendix
A pouch attached to the first part of the large intestine. No one knows its function.

Esophagus
Carries food from the mouth to the stomach.

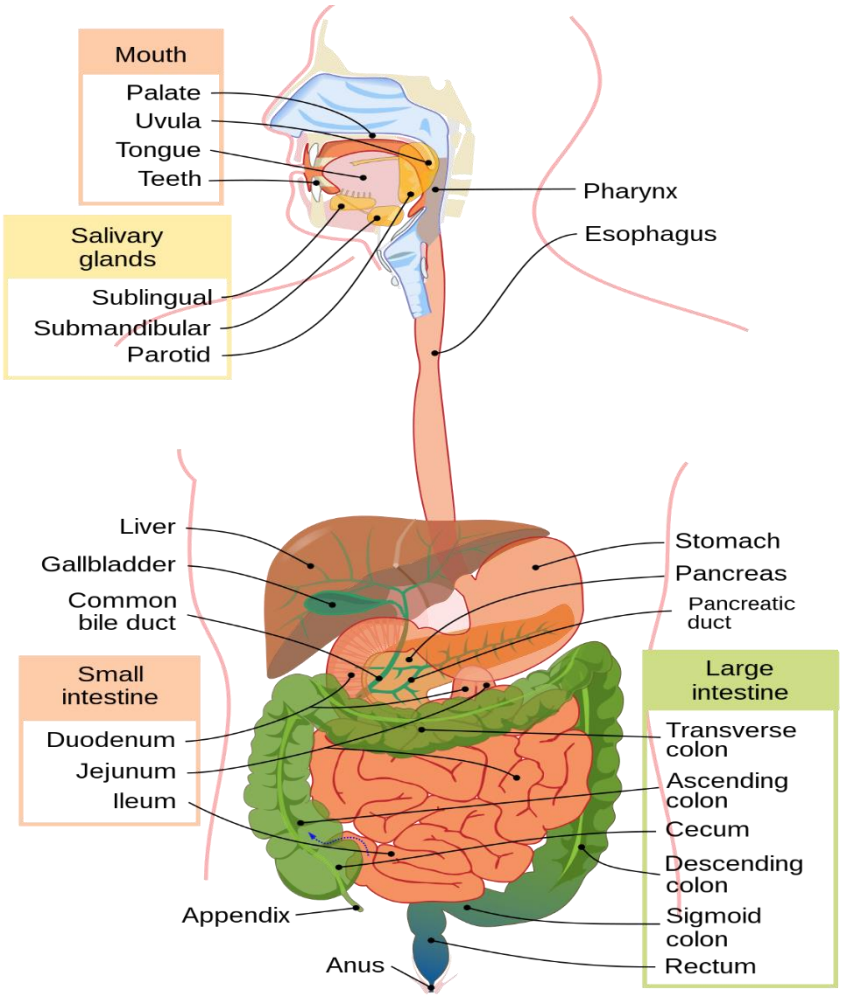
Stomach
The organ where digestion of protein begins.

Pancreas
A gland that makes enzymes for digestion and the hormone insulin (which helps the body turn food into energy).

Small Intestine
The organ where most digestion occurs.

Rectum
The lower end of the large intestine, leading to the anus.

Anus
The opening at the end of the digestive tract where bowel movements leave the body.



Don't wait. The time will never be just right."
Napolean Hill

The **liver** cells, known as hepatocytes, produce bile from the body's waste, which helps absorb fat in the intestines. These same hepatocytes are filled with complex enzymes that break down countless toxins the body produces. It is located in the upper right portion of the abdominal cavity under the dome of the diaphragm. The lower edge of a normal-sized liver is level with the lower margin of the ribs. The human liver is the same reddish brown color as the animal liver seen in the supermarket. It has a large right lobe and a smaller left lobe; the right lobe includes two inferior smaller lobes. The liver is supplied with blood through two vessels: the portal vein and the hepatic artery. These vessels deliver about 11 /2 quarts of blood to the liver every minute. The hepatic artery carries oxygenated blood, whereas the portal system of veins carries blood that is rich in the end products of digestion. This most remarkable organ has so many **functions** that only some of its major activities can list here:

1. The storage of glucose (simple sugar) in the form of glycogen, in animal starch. When the blood sugar level falls below normal, liver cells convert glycogen to glucose and release it into the bloodstream; this serves to restore the normal concentration of blood sugar.

2. The formation of blood plasma proteins, such as albumin, globulins, and clotting factors

3. The synthesis of urea, a waste product of protein metabolism. Urea is released into the blood and transported to the kidneys for elimination.

4. The modification of fats, so cells all over the body can use them more efficiently

5. The manufacture of bile

6. The destruction of old red blood cells. The pigment released from these cells in both the liver and the spleen is eliminated in the bile. This pigment (bilirubin) gives the stool its characteristic dark color.

7. The detoxification (removal of the poisonous properties) of harmful substances such as alcohol and certain drugs

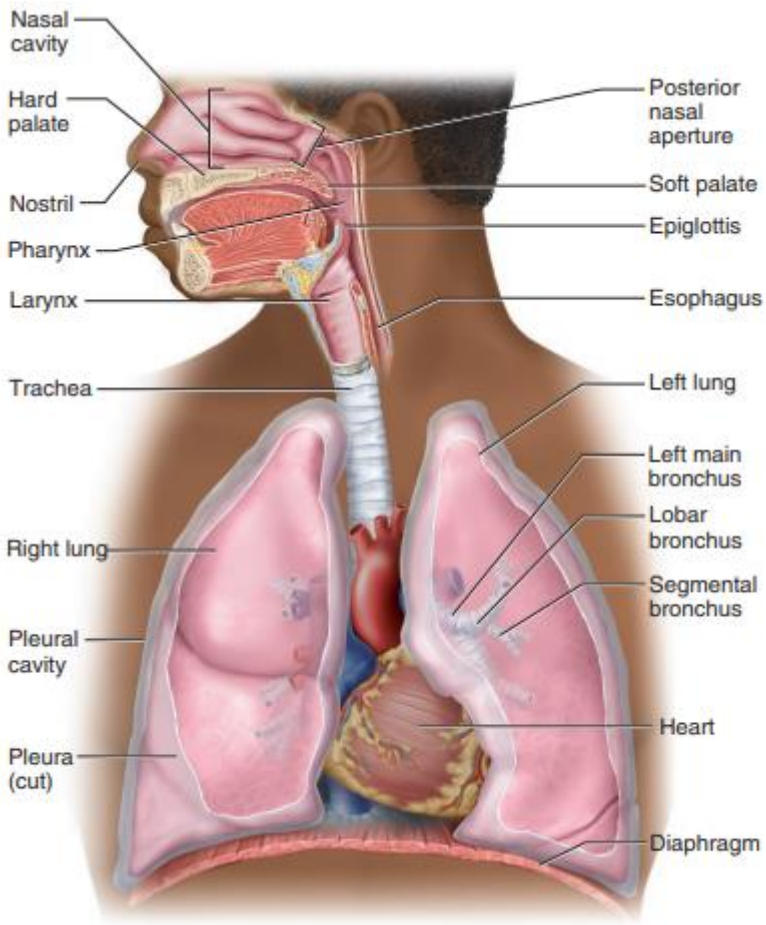
8. The storage of some vitamins and iron

The main digestive function of the liver is the production of bile. The salts contained in bile act like a detergent to emulsify fat, that is, to break up fat into small droplets that can be acted on more effectively by digestive enzymes. Bile also aids in the absorption of fat from the small intestine. Bile leaves the lobes of the liver by two ducts that merge to foln1 the common hepatic duct. After collecting bile from the gallbladder, this duct, now called common bile duct, delivers bile into the duodenum.

The Gallbladder is a muscular sac on the inferior surface of the liver that serves as a storage pouch for bile. Although the liver may manufacture bile continuously, the body is likely to need it only a few times a day. Consequently, bile from the liver flows into the hepatic ducts and then up through the cystic duct connected with the gallbladder

The Pancreas is a long gland that extends from the duodenum to the spleen. The pancreas produces enzymes that digest fats, proteins, carbohydrates, and nucleic acids. The protein digesting enzymes are produced in inactive forms, which must be converted to active forms in the small intestine by other enzymes. The pancreas also functions as an endocrine gland, producing the hormones insulin and glucagons that regulate sugar metabolism. These secretions of the islets cells are released directly into the blood

The Respiratory System

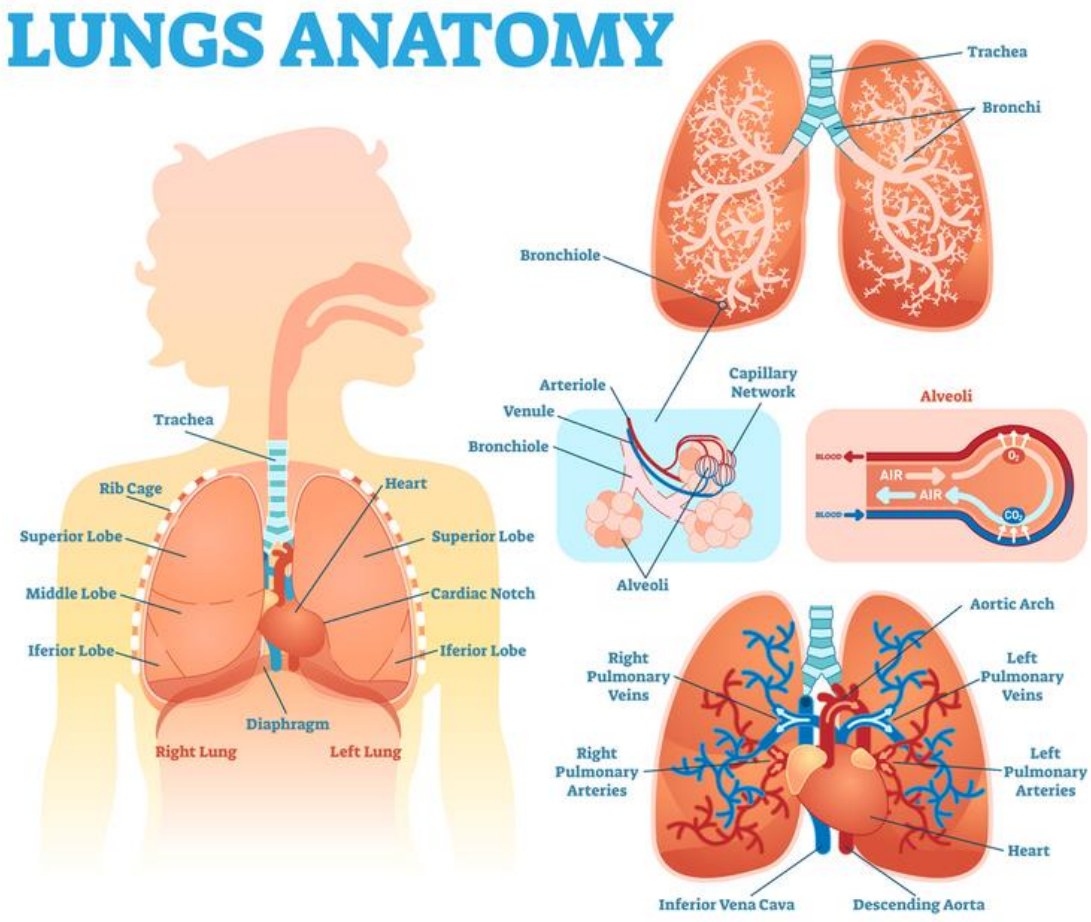


General Function A primary requirement for all body cell activities and growth is oxygen, which is needed to obtain energy from food. The fundamental purpose of the respiratory system is to supply oxygen to the individual tissue cells and to remove their gaseous waste product, carbon dioxide. Breathing, or ventilation, refers to the inhalation and exhalation of air. Air is a mixture of oxygen, nitrogen, carbondioxide and other gases; the pressure of these gases varies, depending on the elevation above sea level. The first, called external expiration, takes place only in the lungs, where oxygen from the outside air enters the blood and carbondioxide leaves the blood to be breathed into the outside air. In the second, called internal respiration, gas exchanges take place between the blood and the body cells, with oxygen leaving the blood and entering the cells at the same time that carbon dioxide leaves the cells and enters the blood.

The respiratory system is an intricate arrangement of spaces and passageways that conduct air into the lungs. These spaces include the nasal cavities; the pharynx, which is common to the digestive and respiratory systems; the voice box, or larynx; the windpipe, or trachea; and

the lungs themselves, with their conducting tubes and air sacs. The entire system might be thought of as a pathway for air between the atmosphere and the blood.

The Lungs are the organs in which external respiration takes place through the extremely thin and delicate lung tissues. The two lungs, set side by side in the thoracic cavity, are constructed in the following manner: Each bronchus enters the lung at the hilus and immediately subdivides. Because the subdivision of the bronchi resembles the branches of a tree, they have been given the common name bronchial tree. The bronchi subdivide again and again, forming progressively smaller divisions, the smallest of which are called bronchioles. The bronchi contain small bits of cartilage, which give firmness to the walls and serve to hold the passageways open so that air can pass in and out easily. However, as the bronchi become smaller, the cartilage decreases in amount. In the bronchioles there is no cartilage at all; what remains is mostly smoothly muscle, which is under the control of the autonomic nervous system.



Arise, Awake and Stop not until the goal is reached."
Swami Vivekananda

Physiology of Respiration Pulmonary Ventilation

Ventilation is the movement of air into and out of the lungs, as in breathing. There are two phases of ventilation

1. Inhalation is the drawing of air into the lungs.
2. Exhalation is the expulsion of air from the lungs.

In inhalation, the active phase of breathing, the respiratory muscles contract to enlarge the thoracic cavity. The diaphragm is a strong dome-shaped muscle attached around the base of the rib cage. The contraction and relaxation of the diaphragm cause a piston-like downward motion that result in an increase in the vertical dimension of the chest. The rib cage is also moved upward and outward by contraction of the external intercostal muscles and, during exertion, by contraction of other muscles of the neck and chest. During quiet breathing, the movement of the diaphragm accounts for most of the increase in thoracic volume. As the thoracic cavity increases in size, gas pressure within the cavity decreases. When the pressure drops to slightly below atmospheric pressure, air is drawn into the lungs.

In exhalation, the passive phase of breathing, the muscles of respiration relax, allowing the ribs and diaphragm to return to their original positions. The tissues of the lung are elastic and recoil during exhalation. During forced exhalation, the internal intercostal muscles and the muscles of the abdominal wall contracts, pulling the bottom of the rib cage in and down. The abdominal viscera are also pushed upward against the diaphragm.

The respiratory system is a close counterpart to the circulatory system. Its role is to bring oxygen from the air in contact with the blood inside microscopic capillaries. It interacts closely with the cardiovascular and musculoskeletal systems. Some of the largest blood vessels in the body are associated with the lungs, and the chest wall is vital in the inspiration and expiration of air.

The anatomy of the respiratory system is divided into the **upper and lower respiratory tract**. The division occurs at the level of the larynx. The **upper respiratory tract** consists of the nasopharynx and oropharynx. In comparison, the **lower respiratory tract** is made up of the trachea, bronchi, bronchioles, and lungs, with the movement of air through the system provided by the **diaphragm**.

The **upper respiratory tract** is responsible for the initial cleaning and warming of air before it is transmitted to the lower airways. The upper respiratory tract also carries food and fluids to the esophagus and is instrumental in producing speech.

The **larynx** is a cartilage "box" that divides the GI and respiratory systems. It has a physical flap, "the epiglottis," that protects the airway from food and fluids. The rest of the larynx is specialized to allow for speech production; the vocal cords and various cartilages can change shape to allow air to pass over them to create speech.

The **lower respiratory tract** transfers air through a branching inverted tree made up of the trachea, bronchi, and bronchioles until it reaches the alveoli. These microscopic sacks have thin walls that are covered in thin-walled capillaries. These allow for blood to come in close contact with air.

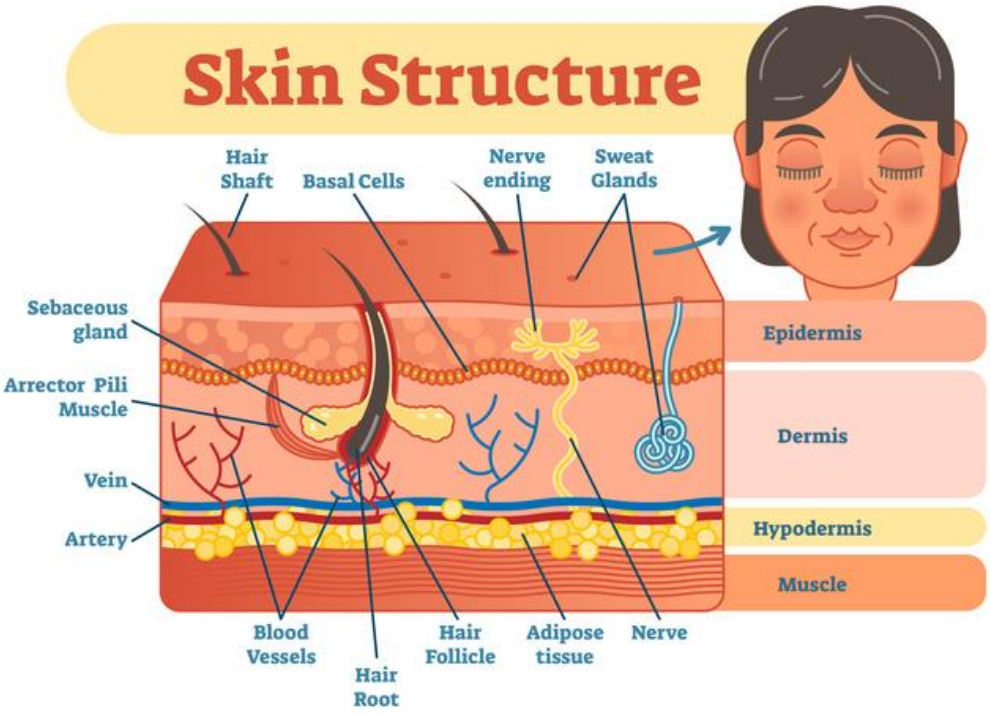
The **diaphragm** is a sheet of muscle at the base of the lungs that pulls air into the airways by creating negative pressure in the chest. Remember that when the diaphragm contracts, air is drawn into the chest, which is known as inspiration.

The physiology of the respiratory system is best divided into the **airways** and the **lungs**.

The **airways** have physiologic mechanisms that protect them from the countless viruses and bacteria in the environment. Countless mucus-secreting cells coat the inner nose/mouth, trachea, and bronchi/bronchioles in a protective layer that inhibits bacterial growth and traps inhaled contaminants. These musocal cells are paired with cilial cells in the lower airway (trachea, bronchi, etc.) They are mobile and work to push mucus and contaminants up and out of the lower airways.

The **lung's** chief physiologic function is the exchange of gases between the blood and the air. They do so through the incredibly thin walls of the alveoli, which allow diffusion to naturally move gases from areas of high concentration to those of low concentration.

The Integumentary System



The Integumentary system consist the skin and its derivatives. These include hair, nails, and several types of glands. The system functions in protection, in the regulation of body temperature, in the excretion of waste materials, in the synthesis of vitamin D3 with the help of sunrays, and in the reception of various stimuli perceived as pain, pressure and temperature.

Skin

Skin is the largest organ in the body occupying almost 2m2 of surface area thickens of 2mm. Skin has 3 main parts. These are the epidermis, dermis and hypodermis.

Functions of Skin

1. Protection: against harmful microorganisms, foreign material and it prevents excessive loss of body fluid.
2. Temperature regulation: with the sweat, heat leaves the body
3. Excretion: Small amount of waste products from the body such as urea
4. Synthesis: By the action of UV. Vitamin D is synthesized in the skin. Vitamin D is necessary for absorption calcium from intestine.

"The greatest barrier to success is the fear of failure."
Seven Goran Eriksson-

5. Sensory reception: it contains sensory receptors of heat, cold, touch, pressure, and pain.

The integumentary system provides the physical barrier between the inner systems of the body and the outside world. It is vital to regulate the body's internal environment, holding in fluids, keeping out bacteria, and providing a regenerating layer that prevents permanent damage to the more fragile cells of the body.

The anatomy of the integumentary system is more complex than it would first appear. It has three main layers, the **epidermis**, **dermis**, and **subcutaneous** layers.

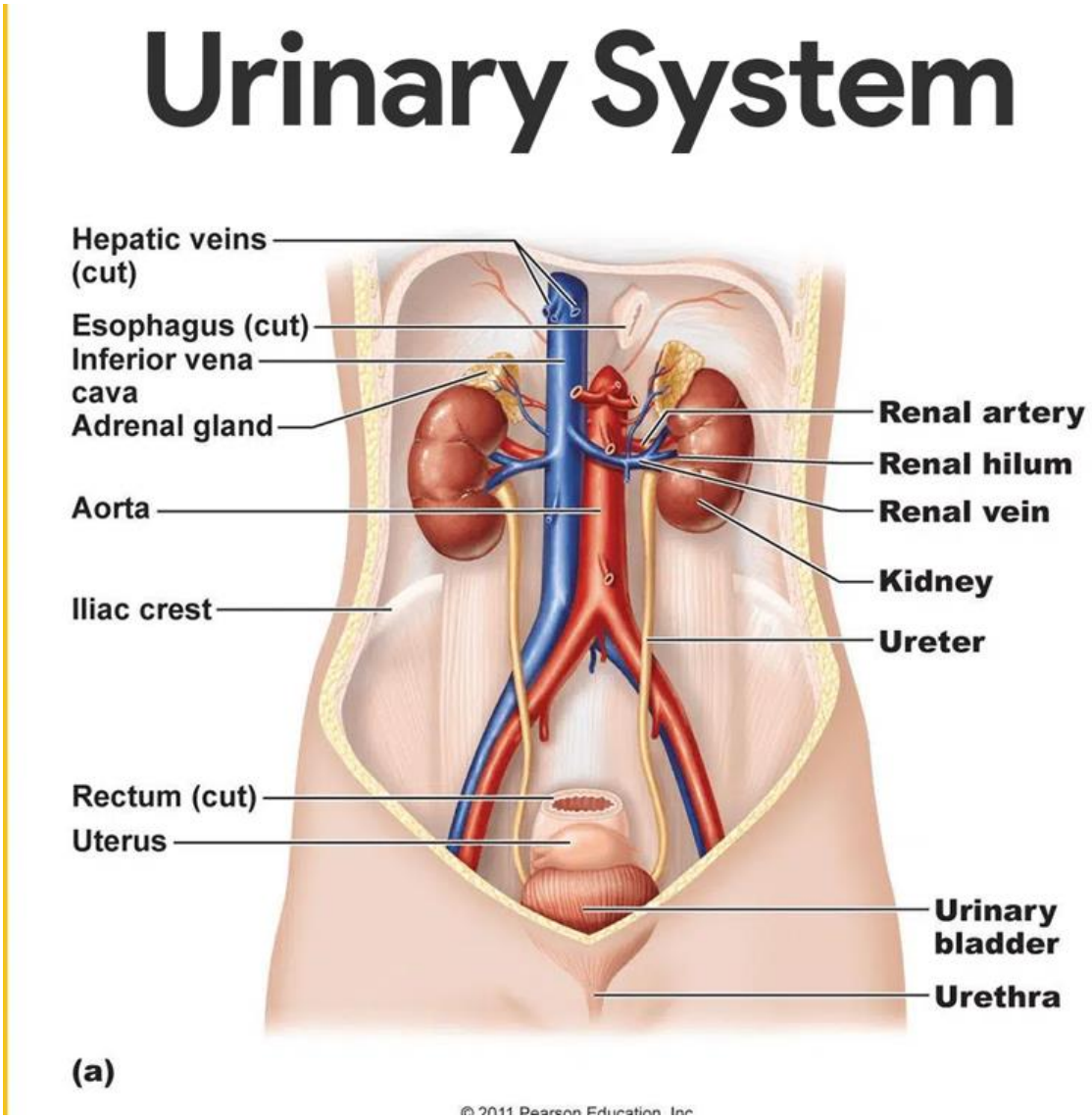
The **epidermis** is a thick layer of dead cells that acts as a "sacrificial layer" for the body. This layer of cells gradually rubs off and protects the more fragile layers below. The **dermis** is the living skin layer with cells that continuously multiply and divide; it holds nerves, blood vessels, sweat glands, and oil glands. The **subcutaneous** layer is one of the main areas of fat storage, also acting as a significant insulating layer for the body.

The physiology of the integumentary system is based on the continuously dividing stem cells in the dermis that create the thick epidermis. The dermis also contains countless capillaries, nerves, and glands that act to regulate the temperature through the mechanisms of vasoconstriction/vasodilation and diaphoresis (sweating).

The Urinary System

The urinary system is also called the excretory system of the body because one of its functions is to remove waste products from the blood and eliminate them from the body. The urinary system consists of: - Two kidneys: this organ extracts wastes from the blood, balance body fluids and form urine. - Two ureters: this tube conducts urine from the kidneys to the urinary bladder. - The urinary bladder: this reservoir receives and stores the urine brought to it by the two ureters. - The urethra: this tube conducts urine from the bladder to the outside of the body for elimination. Major functions of the urinary system:

1. Excretion of wastes
2. Hormonal production (rennin-angiotensin and erythropoietin)
3. Acid base balancing



The kidney External Anatomy of the kidney A pair of reddish brown, bean shaped organ located in the posterior wall of the abdominal region, one in each side of the vertebral column. they are protected at least partially by the last pair of ribs and capped by the adrenal gland. The bean shape of the kidney is medially concave and laterally convex. On the medial concave border is the hilus (small indented area) where blood vessels, nerves & ureters enter and leave the kidney. Covering and supporting each kidney are three layers of tissue: • Renal capsule – innermost, tough, fibrous layer

Internal Anatomy of the kidney A sagittal section of the kidney reveals three distinct regions called pelvis, medulla and cortex (from inside out).

The function of the kidneys are as follows:

1. **Filter.** Every day, the kidneys filter gallons of fluid from the bloodstream.
2. **Waste processing.** The kidneys then process this filtrate, allowing **wastes** and **excess ions** to leave the body in urine while returning needed substances to the blood in just the right proportions.
3. **Elimination.** Although the lungs and the skin also play roles in excretion, the kidneys bear the **major responsibility** for eliminating nitrogenous **wastes**, **toxins**, and **drugs** from the body.
4. **Regulation.** The kidneys also regulate the blood's volume and chemical makeup so that the proper balance between **water** and **salts** and between **acids** and **bases** is maintained.
5. **Other regulatory functions.** By producing the enzyme **renin**, they help regulate blood pressure, and their hormone **erythropoietin** stimulates red blood cell production in the bone marrow.
6. **Conversion.** Kidney cells also convert **vitamin D** to its active form