

Cardiovascular
System,
Respiratory System,
Lymphatic System,
Immune System,
Digestive System,
And Urinary System

Anatomical Positions

Medial = Towards the midline

Lateral = Away from the midline

Proximal = Towards the trunk (main body)

Distal = Away from the trunk

Superior = Above

Inferior = Below

Anterior = Front

Posterior = Back

Anatomical Planes

- Transverse runs parallel to the ground and divides sections into superior and inferior

- Coronal (Frontal) runs up and down, divides sections into anterior and posterior

- Sagittal runs up and down, divides sections into left and right. Mid-sagittal plane divides sections into symmetrical left and right parts.

- Oblique cross sections diagonally

Cardiovascular System

- Responsible for movement of blood around the body, transport waste, hormones, ions, fluids, nutrients, immune materials

- Arteries = Away from the heart (carries oxygenated blood to organs/tissues)

- Walls lining arteries are thick to accommodate for pressure

- Veins = Toward the heart (carries de-oxygenated blood back to the heart)

* Exceptions to this are the pulmonary veins and arteries. Pulmonary arteries bring DEOXYGENATED blood away from the heart. Pulmonary veins carry OXYGENATED blood towards the heart.

- Capillaries connect arteries and veins together

Blood flow through the heart

Body/ Brain —> Superior/Inferior Vena Cava —> Right atrium —> Tricuspid Valve/Right AV Valve —> Right Ventricle —> Pulmonic Valve/Semilunar Pulmonary Valve —> Pulmonary Artery —> Lungs —> Pulmonary Vein —> Left Atrium —> Bicuspid/Mitral Valve/Left AV Valve —> Left Ventricle —> Aortic Valve/Aortic Semilunar Valve —> Aorta —> Body/Brain

Systole = contractions of the heart muscle

Diastole = relaxation of the heart muscle

Epicardium = Outermost layer of the heart, secretes fluid to lubricate (serous)

Myocardium = Middle layer of the heart, contracts to pump blood

Endocardium = Innermost layer, lines the chambers and valves

Atria receive blood, ventricles push blood to other places (pulmonary trunk and aorta)

AV Valves closing make “Lub” sound

Semilunar Valves closing make “Dub” sound

Sinoatrial node sends electrical signals to control heart contractions

Red blood cells (erythrocytes) carries hemoglobin, a protein that binds to oxygen

Plasma is made up mostly of water, carries clotting proteins, antibodies, nutrients (macromolecules), waste products, hormones, etc

White blood cells = defense against pathogens (Leukocytes and Lymphocytes)

Capillaries drain the fluid between cells (interstitial fluid), filters it through lymph nodes.

Lymph nodes “recharge” white blood cells

Lymph (newly recharged white blood cells) drains into veins so they can be pumped out by the heart.

Pulmonary circuit/loop carries blood from heart, to lungs, back to heart

Systemic circuit/ loop carries blood from heart, to body, back to heart

*As blood moves in the systemic loop, it loses oxygen and brings back carbon dioxide. As blood moves in the pulmonary loop, it loses carbon dioxide and gets oxygen.

Hypertension = high blood pressure

Aneurysm = weakened blood vessels cause blood to bulge, forming a balloon of blood that could burst

Heart Attack = heart muscle is not getting enough blood (sometimes caused by a blood clot)

Atherosclerosis = Build up of cholesterol plaque in the walls of arteries

Bradycardia = heart rate too slow

Tachycardia = heart rate too fast

The Respiratory System

- Responsible for transporting oxygen and removing carbon dioxide from the blood/cells

Movement of air through the respiratory system

Nasal opening/mouth → Pharynx → Trachea → Left and Right Bronchus → Bronchioles → Alveoli (sites of gas exchange)

Capillaries from the cardiovascular system interact with alveoli exchange gases.

- The thin walls of the alveoli allow for the diffusion of gases to happen.

- Carbon dioxide is exchanged with oxygen through diffusion. Alveoli are high in O₂, low in CO₂.

- Capillaries are high in CO₂, low in O₂, so both gasses diffuse from higher to lower concentrations.

- Diffusion increases with higher surface area, decreases when there is a higher distance between alveoli and capillaries.

*The left lobe of the lung is smaller than the right because it needs to leave space for the heart. The left lung has two lobes and the right lung has three. Lobes are divided into bronchopulmonary segments. Segments get blood from their own arteries and gets air from their own bronchi. Lobes are surrounded by the protective membrane (Pleura) and pleural fluid

Inhalation:

-Brings in oxygen

- Diaphragm + rib muscles contract

- Lungs get negative pressure, volume gets bigger

✓ ventilation is
the result of
muscular action +
negative pressure

Exhalation

- Releases carbon dioxide into the air

- rib muscles + diaphragm relax

- Lungs get pressure from the intercostal muscles pushing on them, volume gets smaller

Medulla Oblongata in brainstem controls respiration rate by monitoring CO₂ levels in blood and blood pH

Asthma = airways narrow

Environmental pollutants (pollen, chemicals, smoke) damage cilia and can cause inflammation and emphysema, or allergies

The Urinary System

- Main function is to filter blood, maintain salt/water balance, get rid of nitrogenous waste
- Comprised of Kidneys, Ureters, Bladder, Urethra
- Kidneys have two layers
 - Renal Cortex outer layer where the blood vessels are, secretes erythropoietin (produces RBC)
 - Renal Medulla is the inner region of the kidney, where concentration of urine is regulated
- Nephron is the functional unit of the kidney where the blood is filtered and urine is manufactured through a systems of capillaries (glomerulus) Tubules in the nephron absorb the filtrate from the capillaries. Glucose, water, amino acids are reabsorbed into the bloodstream. Everything else (urine) is sent through the collecting duct to the ureters
- Kidneys also produce the active form of Vitamin D
- Kidneys maintain blood pressure by balancing volume of the blood (vasoconstriction/vasodilation)
- Renin = hormone secreted by kidneys that regulates BP by removing water and salt
- Ureters carry urine from kidney to bladder
- Bladder stores urine until it is ready to be eliminated, hold between 400-800ml of fluid
- Urethra carries urine from bladder to outside of body
- Urine is composed of 95% water, along with urea, salts, and organic waste molecules.
- Anti-diuretic hormone (ADH) concentrates urine, causes more water to be reabsorbed. Diabetes insipidus = absent ADH, frequent thirst and urination because water is not being reabsorbed

The Digestive System

- Responsible for breaking down food for distribution and absorption of nutrients
- Controlled by parasympathetic nervous system

Movement through the gastrointestinal system

Mouth → Esophagus → Stomach → small intestine (duodenum, ileum, cecum) → large intestine/colon → rectum → anus

- mechanical digestion occurs in the mouth (chewing)
- chemical digestion also occurs in the mouth (saliva contains enzymes that break down food)
 - Amylase breaks down carbs
 - Salivary lipase breaks down fats
- mechanical digestion occurs in the stomach (stomach muscle contractions break down chime)
- chemical digestion in the stomach
 - Pepsin digests chime proteins in stomach acid (hydrochloric acid), mucus lines the inside of the stomach to protect it from the acid
- basic (alkaline) bile juices from the gall bladder + biocarbonate from the pancreas neutralizes chime in the small intestine
- More chemical digestion occurs in small intestine
 - Brush border enzymes break down chime, carbs break down into monomers
 - Sucrase = breaks sucrose into glucose
 - lactase = breaks down lactose into glucose
- Microvilli and Villi in the small intestine (ileum) absorb nutrients *vitamin B12
- Pancreas puts its enzymes into the small intestine
 - Pancreatic Amylase = breaks down starch/carbs
 - Trypsin = break down protein
 - Lipase = breaks down lipids
- Large intestine absorbs water and salt from digested food, forms fecal matter (stool)
- Bacterial fermentation happens in the large intestine

*Ghrelin = hunger hormone, Leptin = fullness feeling hormone

Insulin = hormone that induces cellular uptake of glucose (lowers blood sugar)

Glucagon = hormone that stimulates breakdown of stored glycogen (raises blood sugar)

*Bile = chemical that is released by liver into the small intestine to break down lipids

*Peristalsis = muscle contractions that move food through the digestive tract

The Immune System

- Protects the body from pathogens (diseases)

Innate Immune System

- First to act

- Skin, mucus membranes, macrophages, acid in stomach, inflammatory response (histamines), fever, phagocytes (neutrophils), natural killer cells

- Skin and mucus membranes act as a physical barrier, first line of defense

- After that is inflammatory response, which increases blood flow to the area (thus exposes area with more phagocytes.

- Mast cells and basophils release histamine, also heparin (keeps blood from clotting)

- Macrophages engulf pathogens (phagocytosis)

- Macrophages wear parts of the eaten pathogen on them (Antigen-Presenting Cell, APC)

- Fever (increased temperature) speeds up the rate of immune response

- Natural killer cells bind to cells infected with pathogens and release granzymes that tell the cell to kill itself (apoptosis)

Adaptive Immune System

- Has two systems, cellular and humoral.

- Cellular = destroys infected cells

- Antigens = molecular signature on a pathogen aka the ID tag so the body can identify a disease

- Macrophages present antigens to helper T cells

- Helper T cell = Sends signals to WBC that antigen is present, secreted cytokines to activate killer T cell, activates B cells

- Killer T cells (cytotoxic T cell) kill infected or abnormal cells

- Memory T cells remember antigens for future infections

-humoral = destroys pathogen

- B cells are activated by helper T cells

- B cells mark pathogens for destruction

- B cells (plasma cells) secrete antibodies

- Antibodies can block antigen receptors, keeping them from invading cells, or clump antigens together, making phagocytosis easier

* Lymphatic system and red bone marrow makes WBCs. B cells grow and mature in the bone marrow, T cells grow in the thymus. Innate immunity is considered to be non-specific and fast-acting, adaptive immunity is considered to be specific and slower to react

Active immunity = body makes its own antibodies

Passive immunity = body gets antibodies the "easy" way (from another source)

AIDS is caused by HIV, infects helper T cells, preventing them from activating B and killer T cells.
Autoimmune disease is an overactive immune system, the body mistakes its own cells as antigens.
Examples = Type 1 diabetes (body attacks the cells in the pancreas that secrete insulin), Multiple sclerosis (body attacks the Myelin Sheath surrounding the axons of a nerve cell), rheumatoid arthritis (joint damage)