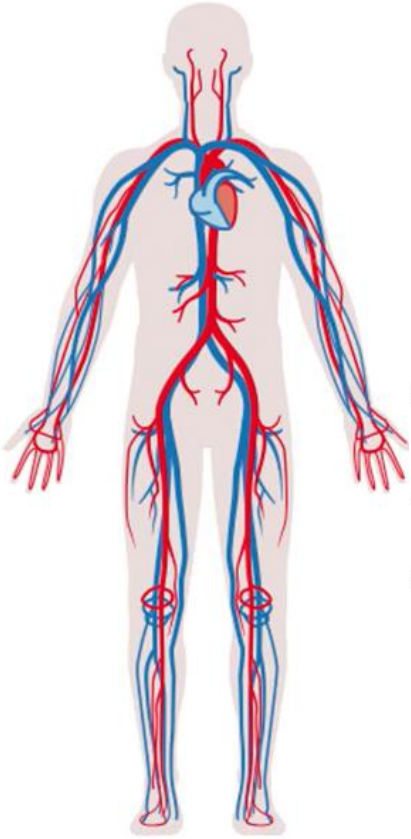
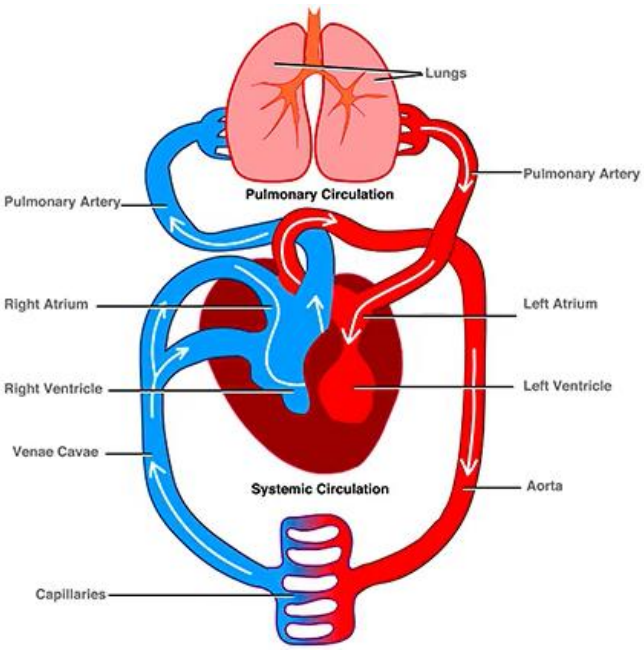
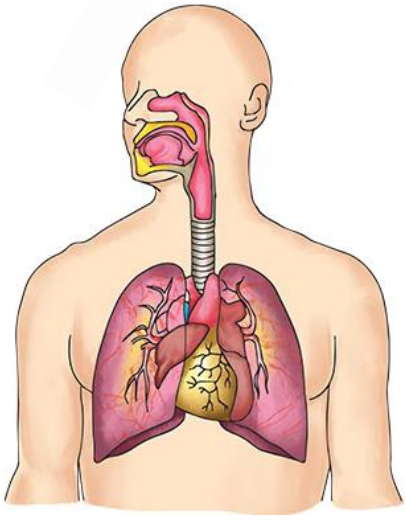
CONCEPT: GAS EXCHANGE AND CIRCULATION

- ***Respiratory system*** – draws in gases from the environment, intakes O_2 and outputs CO_2
- ***Circulatory system*** – transports O_2, CO_2, nutrients, hormones, and blood cells
  - □ Delivers O_2 to cells for cellular respiration, and removes waste CO_2
- ***Ventilation*** – movement of air, or water, through organs of gas exchange, like lungs or gills
- ***Gas exchange*** – diffusion of O_2 and CO_2 at respiratory tissue surface
- ***Circulation*** – transport of diffused gases throughout the body
- ***Cellular respiration*** – O_2 is final electron acceptor of ETC, and CO_2 is byproduct of glycolysis and citric acid cycle

EXAMPLE:





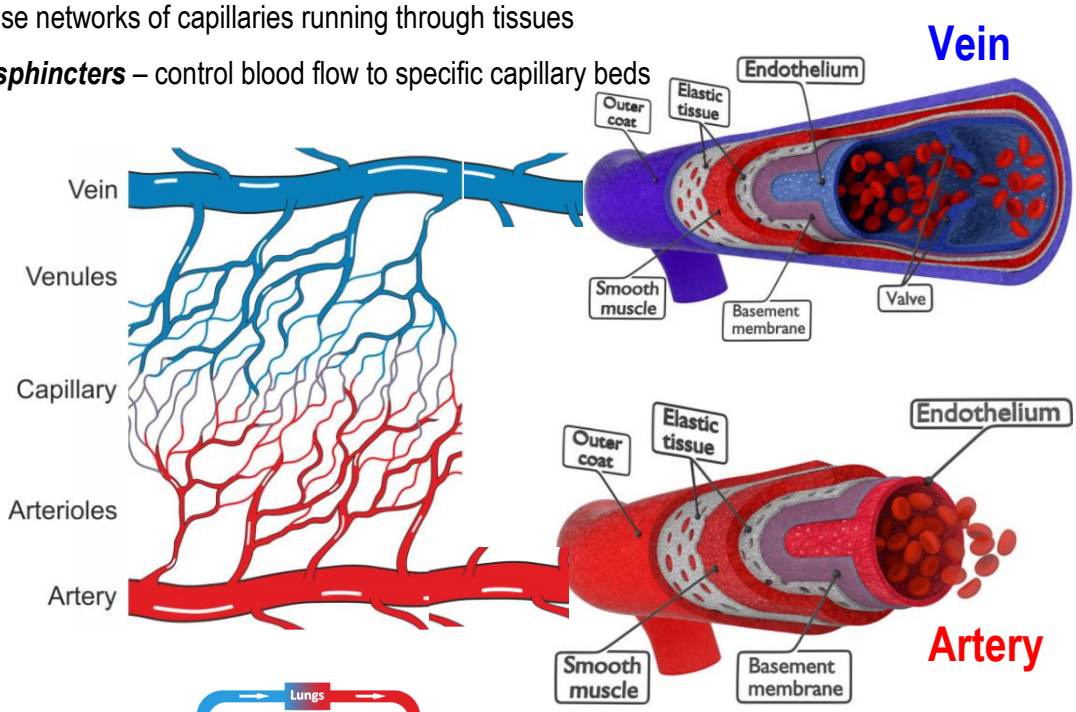


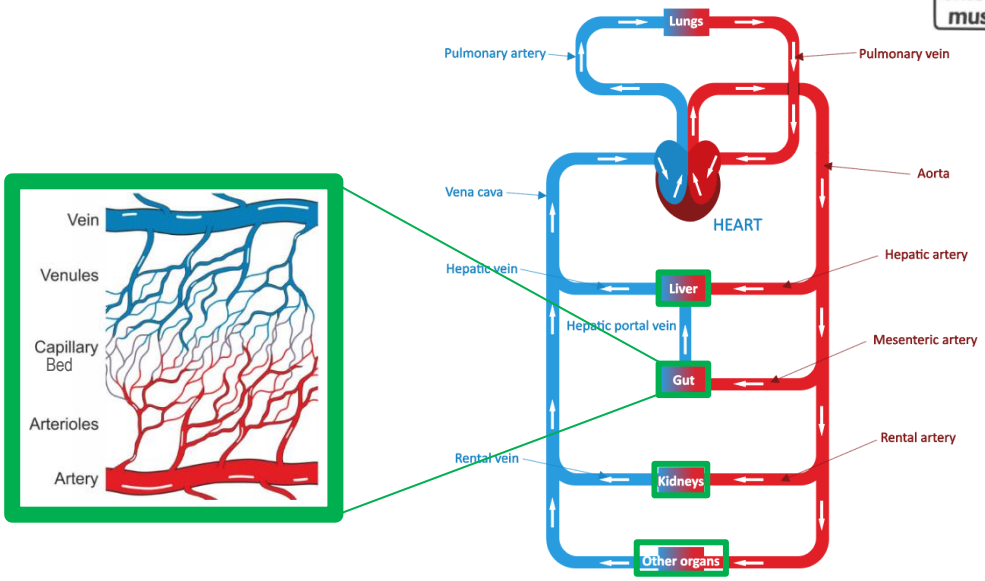
- ***Pulmonary circulation*** – carries deoxygenated blood from the heart to the lungs, and oxygenated blood to the heart
  - □ Deoxygenated blood carrying CO_2 from tissues is moved from the heart to the lungs
  - □ Waste CO_2 diffuses into the lungs, where it is exhaled
  - □ Inhaled O_2 diffuses into the blood, and the oxygenated blood return to the heart
- ***Systemic circulation*** – oxygen-rich blood moves through arteries to tissues throughout the body
  - □ O_2 diffuses into cells, to be used in the mitochondrial matrix
  - □ Delivers nutrients and carries away waste from tissues
  - □ Deoxygenated blood carrying CO_2 returns to the heart from the tissues

CONCEPT: VASCULATURE

- ***Endothelium*** – epithelial tissue that lines the interior surface of blood vessels and lymphatic vessels
- ***Arteries*** – transport blood away from the heart, oxygenated in systemic loop, deoxygenated in pulmonary loop
  - Have elastic walls, and are wrapped in smooth muscle allowing them to change their diameter
  - ***Arterioles*** – small arteries that branch off by capillary beds, have smooth muscle, and smaller diameter
- ***Veins*** – transport blood to the heart, deoxygenated in systemic loop, oxygenated in pulmonary loop
  - Have less smooth muscle than arteries, but many veins run through skeletal muscles
  - Contain valves to prevent backflow of blood, since pressure is lower than in arteries
  - ***Veinules*** – converge to form veins, formed from capillaries converging
- ***Capillaries*** – tiny vessels with walls only one-cell thick with a diameter roughly equivalent to that of a red blood cell
  - □ Only site of exchange between blood and tissues, endothelial tissue with no smooth muscle
  - □ ***Capillary beds*** – diffuse networks of capillaries running through tissues
    - ***Pre-capillary sphincters*** – control blood flow to specific capillary beds

EXAMPLE:

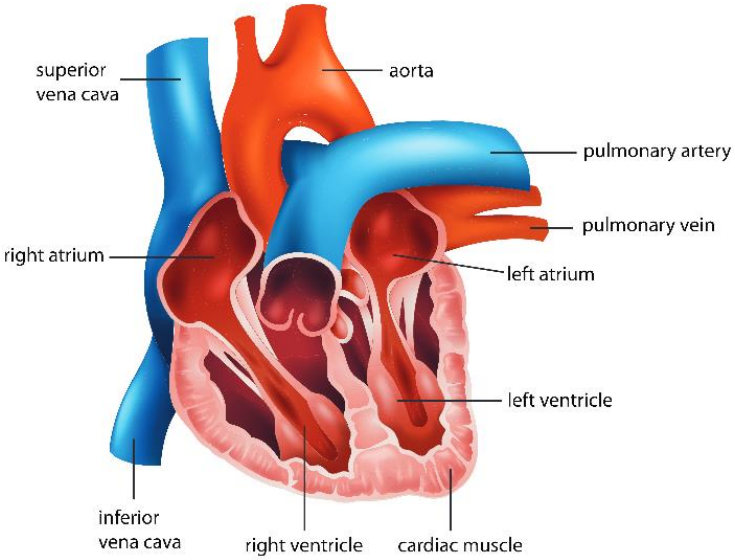


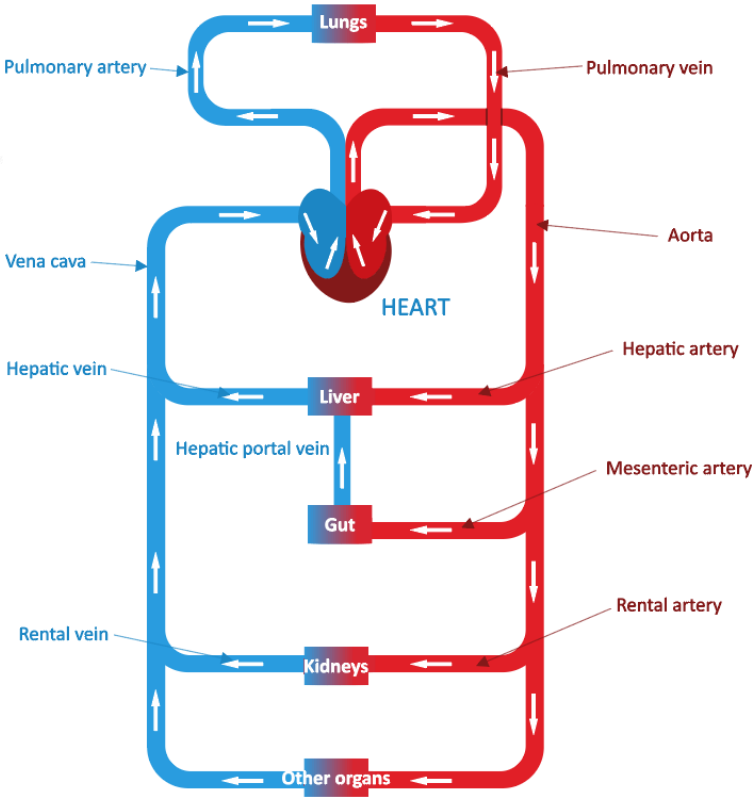


CONCEPT: HEART ANATOMY

- ***Heart*** – muscular organ that contracts to generate pressure waves that push blood through blood vessels
    - □ ***Atria*** – receive blood from veins
    - □ ***Ventricles*** – receive blood from atria, and pump blood into arteries
    - □ ***Atrioventricular valves*** – prevent backflow from ventricle to atrium, tricuspid valve on right, mitral valve on left
    - □ ***Semilunar valves*** – prevent backflow from arteries to ventricles, pulmonary valve on right, aortic valve on left
        - Heart murmur – blood moves back across a valve, often due to damage or infection in valve
- ***Pulmonary artery*** – delivers deoxygenated blood from the heart to the capillary beds in the lungs
- ***Pulmonary veins*** – delivers oxygenated blood from the lungs back to the heart
- ***Aorta*** – delivers oxygenated blood from the heart to the tissues
- ***Venae cava*** (***superior*** and ***inferior***) – delivers deoxygenated blood to the heart from capillary beds in the body's tissues

EXAMPLE:



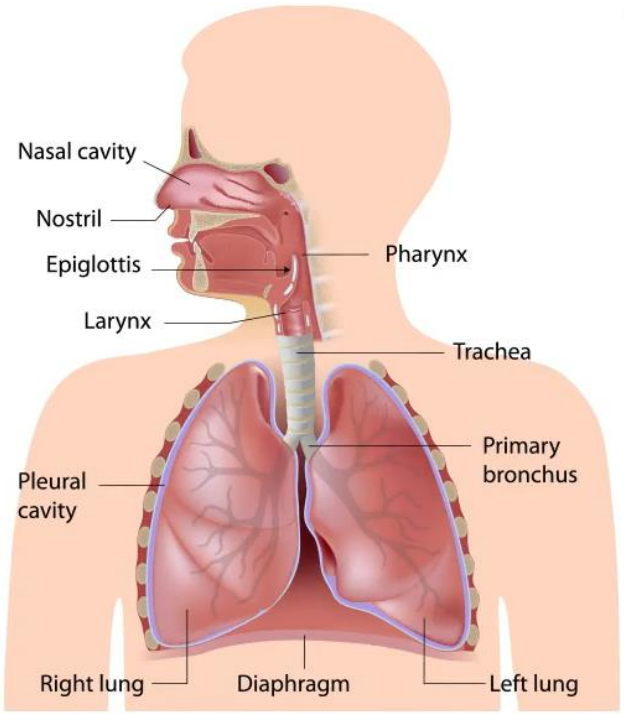


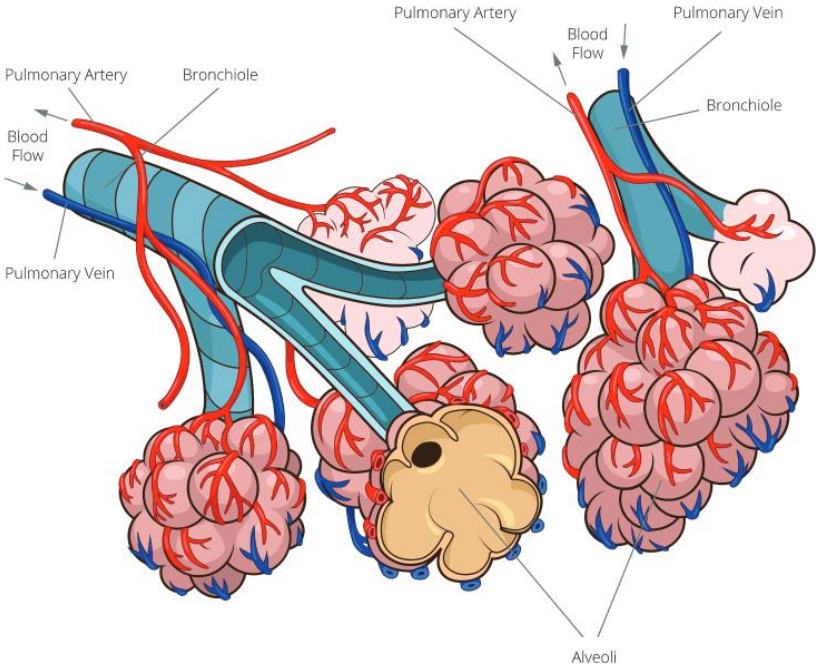
- Pulmonary circulation – right atrium → right ventricle → pulmonary artery → lungs → pulmonary vein → left atrium
    - □ Oxygenates the bloods in capillary beds at the alveoli of the lungs, gets rid of waste CO_2
- Systemic circulation – left atrium → left ventricle → aorta → body tissues → venae cava → right atrium
    - □ Delivers O_2 to tissues via capillary beds throughout the body, and picks up waste CO_2

CONCEPT: LUNG ANATOMY

- ***Pharynx*** – throat area behind the mouth, shared passage way for air, food, and water
- ***Trachea*** – brings air from pharynx to lungs, supported by c-shaped cartilage rings
  - □ ***Larynx*** – beginning of the trachea, contains the vocal folds
  - □ Primary bronchi – first branches into the lungs
- ***Bronchi*** – branches from the primary bronchi that diffuse through the lungs, supported by cartilage
  - □ ***Bronchioles*** – smallest branches of the bronchi, supported by smooth muscle
- ***Lungs*** – organs of respiration that inhale air to absorb O_2, and exhale waste CO_2 from cellular respiration
  - □ ***Alveoli*** – grape-like ends of the smallest bronchioles where gas exchange occurs between air and blood
    - Thin, aqueous interface between air and surrounding capillary bed
    - Surfactant – mix of phospholipids and proteins produced by some alveoli to reduce surface tension
- ***Diaphragm*** – sheet of muscle that separates thoracic (chest) and abdominal (belly) cavities

EXAMPLE:

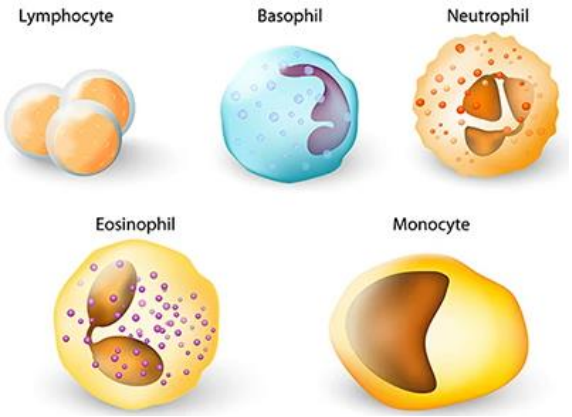


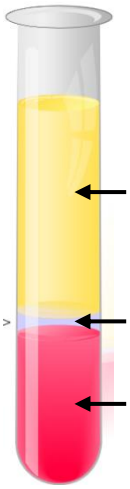


CONCEPT: BLOOD COMPOSITION

- ***Blood*** – fluid that flows through blood vessels, transports nutrients and wastes, and performs gas exchange with tissues
- ***Plasma*** – special extracellular matrix that composes the liquid part of blood
    - □ Made of water, electrolytes, organic compounds, and dissolved gases
- ***Platelets*** – small cell fragments that are involved in the ***blood clotting*** wound response
    - □ Rapidly plug holes, while other factors are recruited to help seal the wound site
    - □ ***Thrombus*** – clot that forms in a blood vessel blocking blood flow
- ***White blood cells*** (***leukocytes***) – immune system cells that help identify and fight infections
- ***Red blood cells*** (***erythrocytes***) – carry O_2 from the lungs via hemoglobin, lack nuclei and organelles at maturity
    - □ ***Erythropoietin*** – hormone secreted by the kidney to stimulate RBC production in bone marrow

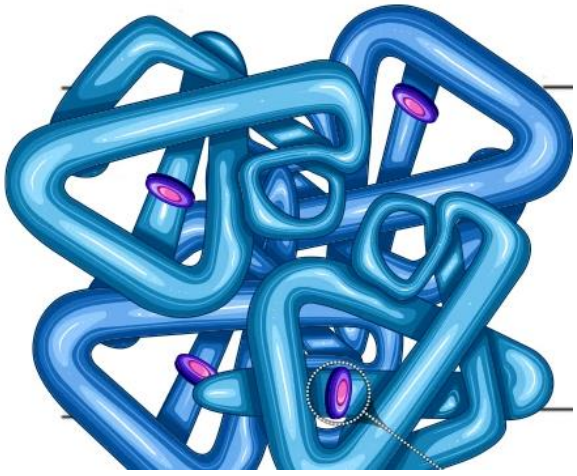
EXAMPLE:

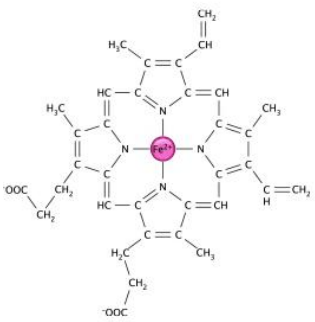




- Respiratory pigments – molecules that increase the oxygen-carrying capacity of blood, change color from O_2 binding
    - □ ***Hemoglobin*** – protein made of 4 polypeptide subunits that contain hemes to bind oxygen
        - ***Heme*** – iron-containing cofactor with porphyrin ring that is reduced/oxidized to transport O_2 in RBCs
    - □ ***Myoglobin*** – primary pigment of skeletal muscles, contains only 1 heme, binds O_2 tighter than hemoglobin
- ***Sickle-cell disease*** – abnormal form of hemoglobin aggregates in RBCs, distorting shape, and inhibiting functions

EXAMPLE:





CONCEPT: LYMPHATIC SYSTEM

- ***Lymphatic system*** – network of lymphatic vessels that carry lymph toward the heart
    - □ Drains plasma from interstitial fluid, and plays important role in the immune system
    - □ ***Lymph*** – clear fluid that circulates through lymphatic system, forms when interstitial fluid enters lymphatic ducts
    - □ ***Lymph nodes*** – organs of the lymphatic system that are critical to immune function
    - □ Spleen and thymus important organs of lymphatic system

EXAMPLE: