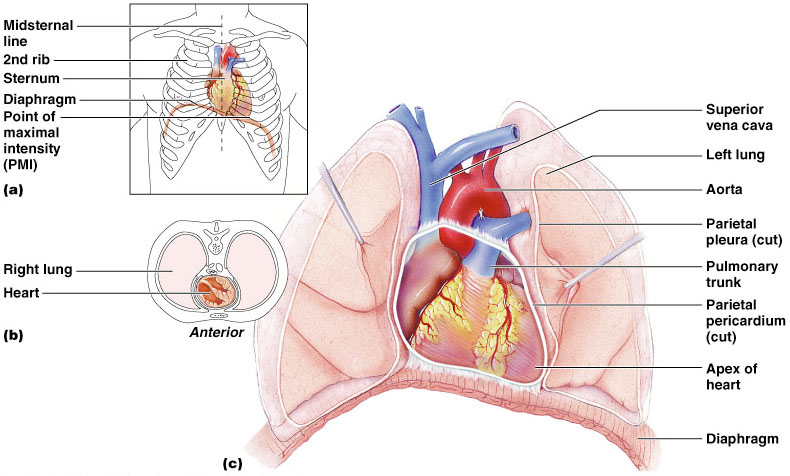
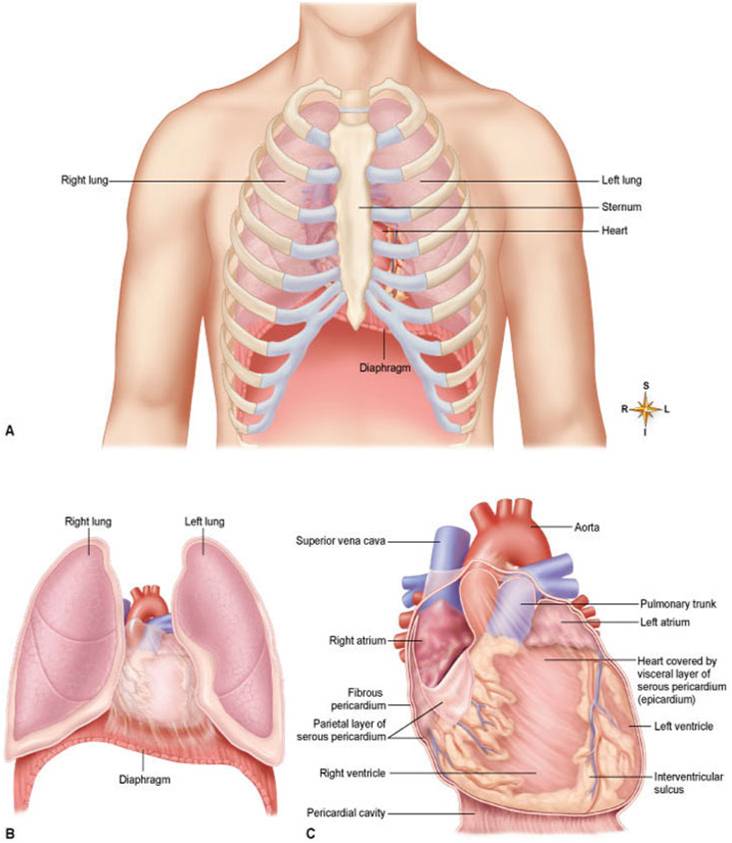
**Cardiovascular Anatomy**

**Dr. Gary Mumaugh**

**Location of Heart**

* Approximately the size of your fist
* Location
  + Superior surface of diaphragm
  + Left of the midline in mediastinum
  + Anterior to the vertebral column, posterior to the sternum
  + Posteriorly the heart rests on the bodies of vertebrae T5-T8
  + Apex lies on the diaphragm, pointing to the left
  + Base lies just below the second rib
* PMI – point of maximal intensity is the place where you feel and hear the heart the best
  + It is located between the 5th and 6th rib on the left.



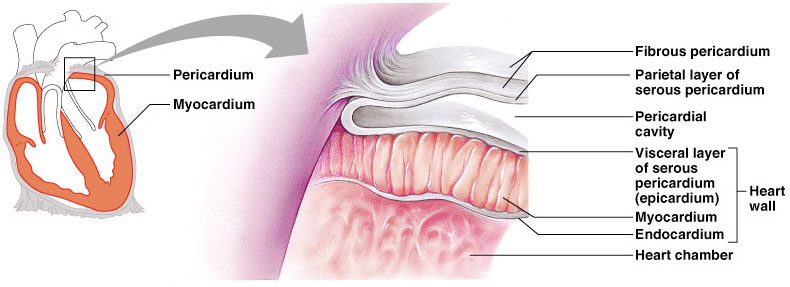
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**Coverings of the Heart: Anatomy**

* Pericardium – a double-walled sac around the heart composed of:
* A superficial fibrous pericardium
* A deep two-layer serous pericardium
  + The parietal layer lines the internal surface of the fibrous pericardium
  + The visceral layer or epicardium lines the surface of the heart
  + They are separated by the fluid-filled pericardial cavity

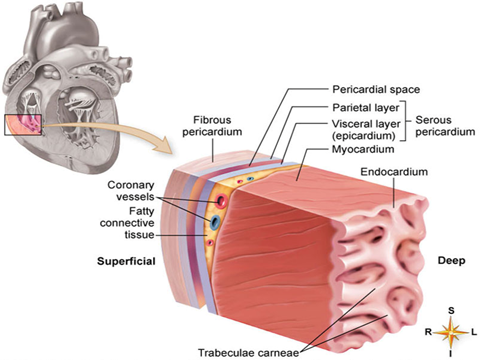
**Coverings of the Heart: Physiology**

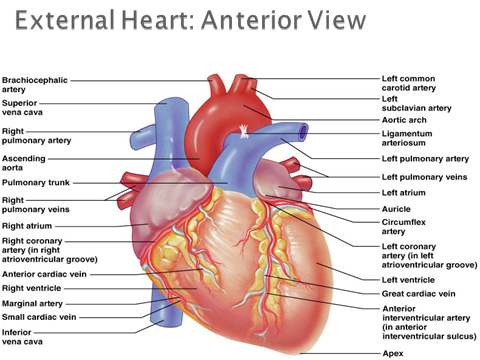
* The pericardium:
  + Protects and anchors the heart
  + Prevents overfilling of the heart with blood
  + Allows for the heart to work in a relatively friction-free environment
* Pericarditis – Inflammation of the Pericardium
  + The serous membrane is roughened up
  + When the heart beats, it rubs against the pericardial sac, creating a “grating” sound
  + Characterized by deep pain
  + In severe cases a large amount of inflammatory fluid seeps into the pericardial cavity causing a compression when the heart beats
    - Cardiac Tamponade

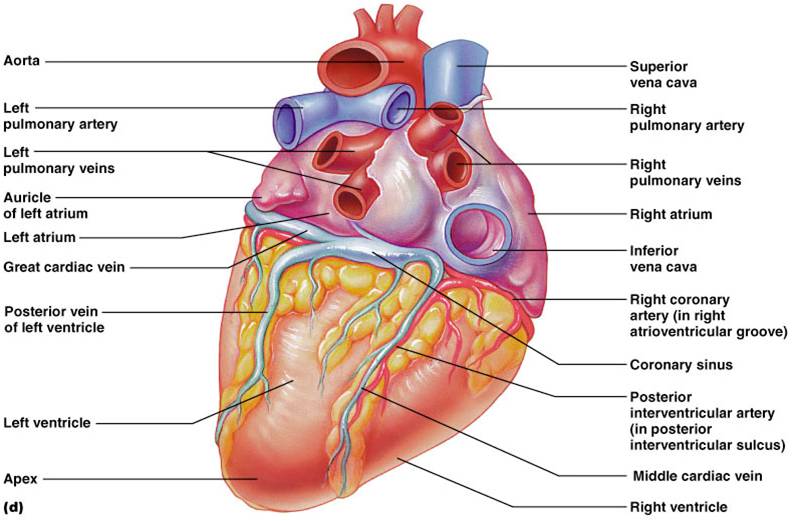
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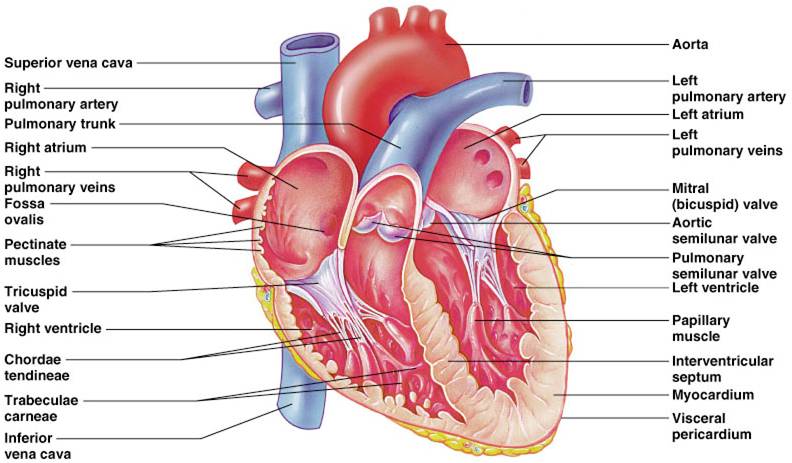
**Wall of the Heart**

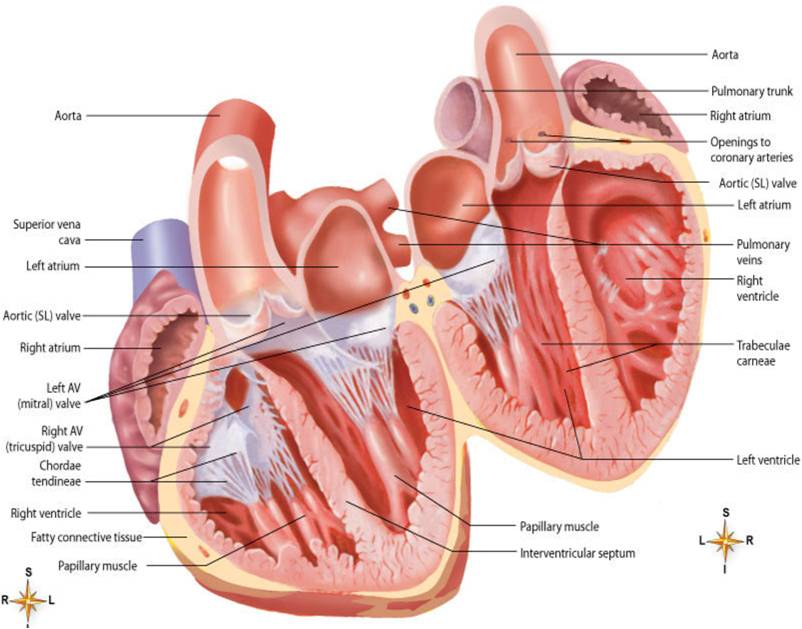
* Structure of the heart
* Wall of the heart: composed of three distinct layers
  + Epicardium: outer layer of heart wall
  + Myocardium: thick, contractile middle layer of heart wall; compresses the heart cavities, and the blood within them, with great force
  + Endocardium: delicate inner layer of endothelial tissue

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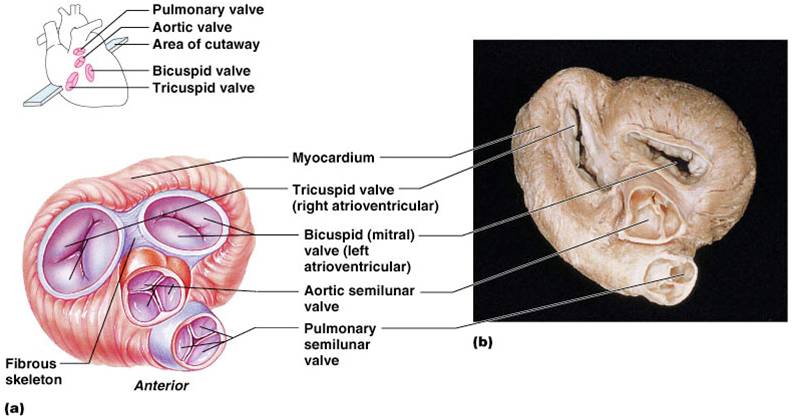
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**Heart Chambers**

* Heart is divided into four cavities with the right and left chambers separated by the septum
* Atria of the Heart - Receiving Vessels
  + Superior chambers
  + Are the receiving chambers of the heart
  + Atria alternately contract and relax to receive blood and then push it into ventricles
  + Only a minimal contraction is needed to push the blood “downstairs” to the ventricles.
  + Each atrium has a protruding auricle
  + Blood enters right atria from superior and inferior venae cavae and coronary sinus
  + Blood enters left atria from pulmonary veins
* Ventricles of the Heart - Discharging Chambers
  + Inferior chambers
  + Ventricles are the discharging chambers of the heart – The actual heart pumps
  + The ventricles make up most of the volume of the heart
  + Right ventricle pumps blood into the pulmonary trunk
  + Left ventricle pumps blood into the aorta

**Heart Valves**

* Heart valves ensure unidirectional blood flow through the heart
* Atrioventricular (AV) valves lie between the atria and the ventricles
  + Tricuspid and bicuspid
* Semilunar valve lies between the ventricles and the great vessels
  + Aortic and pulmonary

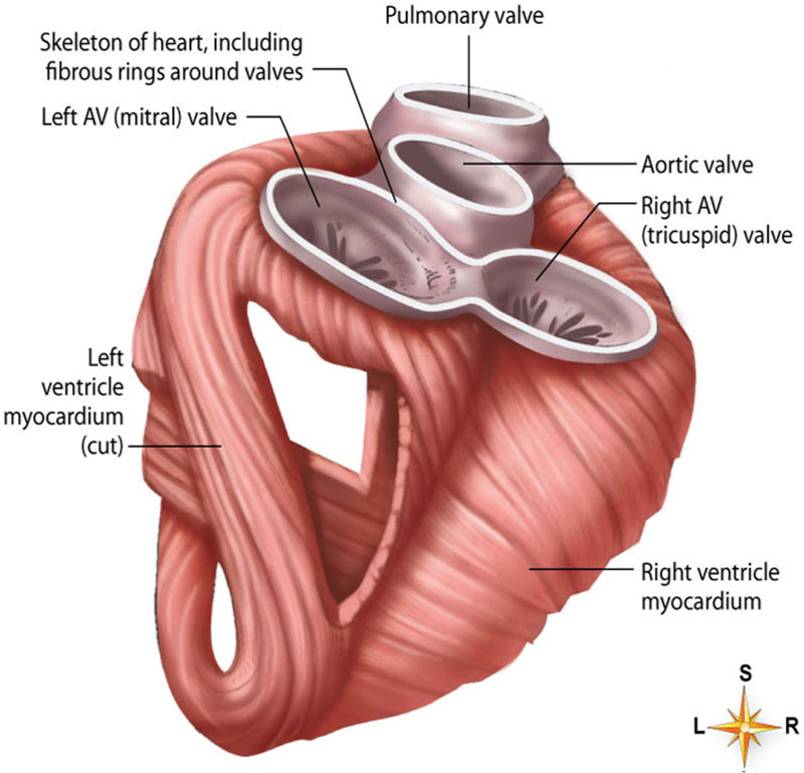
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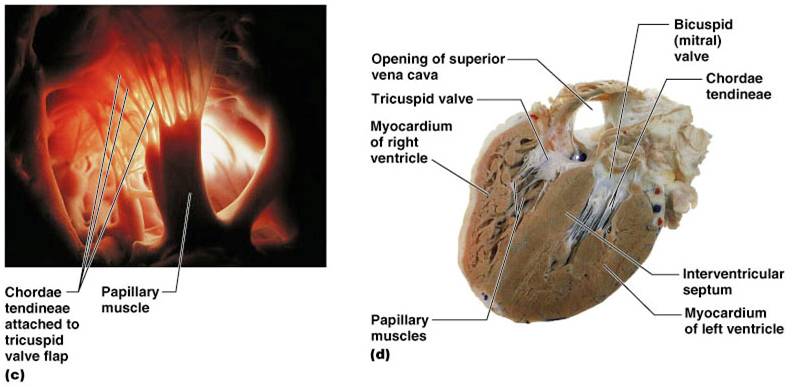
**Atrioventricular (AV) Valves**

* Atrioventricular (AV) valves: prevent blood from flowing back into the atria from the ventricles when the ventricles contract
  + Tricuspid valve (right AV valve): guards the right atrioventricular orifice; free edges of three flaps of endocardium are attached to papillary muscles by chordae tendineae
  + Bicuspid, or mitral, valve (left AV valve): similar in structure to tricuspid valve except has only two flaps

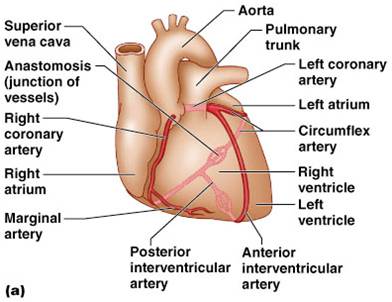
**Semilunar (SL) Valves**

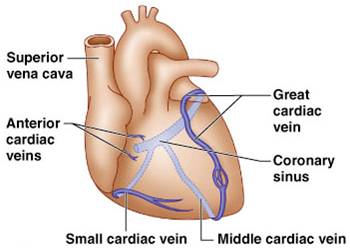
* Semilunar valves: half-moon–shaped flaps growing out from the lining of the pulmonary artery and aorta; prevent blood from flowing back into the ventricles from the aorta and pulmonary artery
  + Pulmonary valve: valve at entrance of the pulmonary artery
  + Aortic valve: valve at entrance of the aorta
* Skeleton of the heart
  + Set of connected rings that serve as a semirigid support for the heart valves and the attachment of cardiac muscle of the myocardium
  + Serves as an electrical barrier between the myocardium of the atria and that of the ventricles



**Coronary Circulation**

* Coronary circulation is the functional blood supply to the heart muscle itself
* Collateral routes ensure blood delivery to heart even if major vessels are occluded
* Angina pectoris – thoracic pain caused by blood deficiency to the heart
* MI is caused by prolonged blockage
* Blockage of the coronary artery can be fatal





**Blood supply of heart tissue**

* Coronary arteries: Myocardial cells receive blood from the right and left coronary arteries
* Veins of Coronary Circulation : As a rule, veins follow a course that closely parallels that of coronary arteries

**Nerve Supply of the Heart**

* Conduction system of the heart: composed of modified cardiac muscle, it generates and distributes the heart’s own rhythmic contractions; can be regulated by afferent nerves
* Most fibers end in the SA node, but some end in the AV node and in the atrial myocardium; the nodes are the heart’s pacemakers
* Sympathetic nerves: accelerator nerves
* Vagus fibers: inhibitory, or depressor, nerves

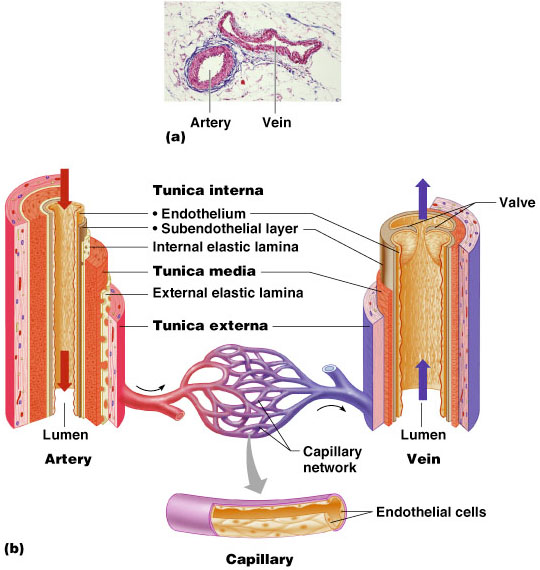


**Blood Vessels**

* Blood is carried in a closed system of vessels that begins and ends at the heart
* The three major types of vessels are arteries, capillaries, and veins
* Arteries carry blood away from the heart, veins carry blood toward the heart
* Capillaries contact tissue cells and directly serve cellular needs

**Generalized Structure of Blood Vessels**

* Layers
  + Tunica externa: found in arteries and veins (tunica adventitia)
  + Tunica media: found in arteries and veins
  + Tunica intima: found in all blood vessels
    - Lining endothelial cells
      * Only lining found in capillary
      * Line entire vascular tree
      * Provide a smooth luminal surface; protect against intravascular coagulation
* Lumen – central blood-containing space surrounded by tunics



**Blood vessels**

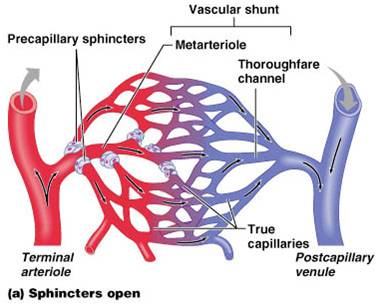
* Collagen fibers
  + Exhibit woven appearance
  + Have only a limited ability to stretch (2% to 3%) under physiological conditions
  + Strengthen and keep lumen of vessel open
* Elastic fibers
  + Form highly elastic networks
  + Fibers can stretch more than 100% under physiological conditions
  + Play important role in creating passive tension to help regulate blood pressure throughout the cardiac cycle
* Smooth muscle fibers
  + Most numerous in elastic and muscular arteries
  + Exert active tension in vessels when contracting

**Capillaries are the smallest blood vessels**

* Capillaries
  + Primary exchange vessels
  + Microscopic vessels
  + Carry blood from arterioles to venules; together, arterioles, capillaries, and venules constitute the microcirculation
  + Not evenly distributed; highest numbers in tissues with high metabolic rate; may be absent in some “avascular” tissues, such as cartilage
  + Walls consisting of a thin tunica interna, one cell thick
  + Allow only a single RBC to pass at a time

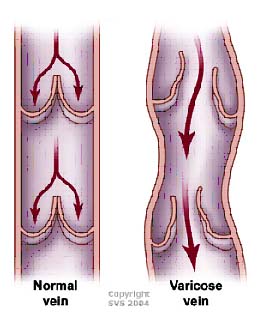
**Capillary Beds**

* A microcirculation of interwoven networks of capillaries.
* Precapillary sphincters control blood flow through the capillary beds
  + Cuff of smooth muscle that surrounds each true capillary
  + Regulates blood flow into the capillary
* Blood flow is regulated by vasomotor nerves and local chemical conditions, so it can either bypass or flood the capillary bed



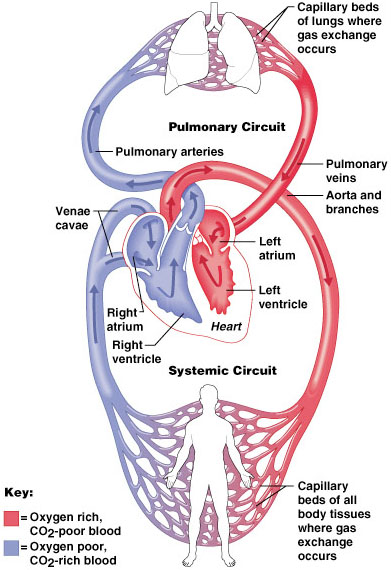
**Venous System: Veins**

* Veins are capacitance vessels (blood reservoirs) that contain 65% of the blood supply
* Veins have much lower blood pressure and thinner walls than arteries
* To return blood to the heart, veins have special adaptations
  + Large-diameter lumens, which offer little resistance to flow
  + Valves which prevent backflow of blood
* Varicose veins
  + Varicose veins are veins that are tortuous and dilated because of leaky valves
  + 15% of adult population
  + Heredity, prolonged standing, obesity, pregnancy



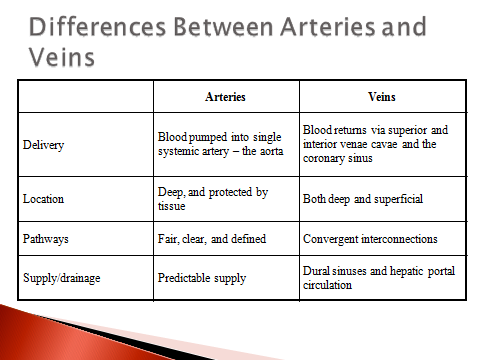
**Circulatory Pathways**

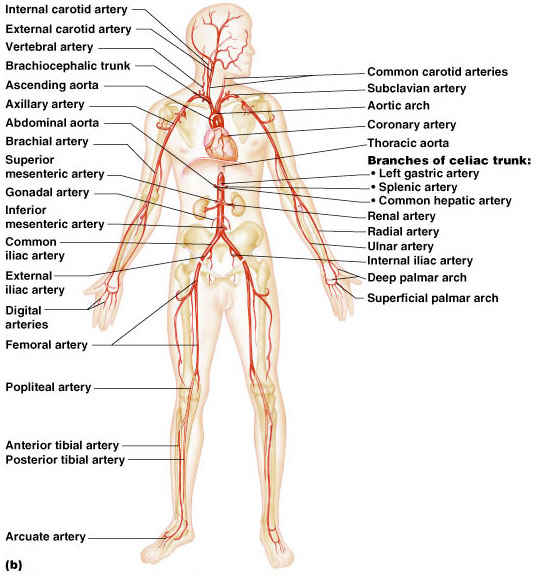
* The vascular system has two distinct circulations
  + Pulmonary circulation – short loop that runs from the heart to the lungs and back to the heart
  + Systemic circulation – routes blood through a long loop to all parts of the body and returns to the heart

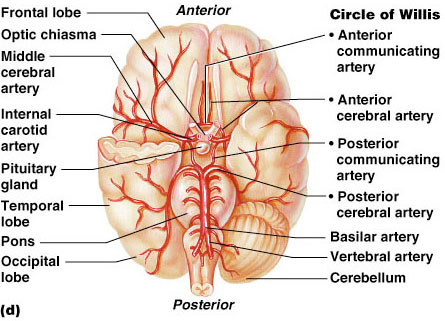


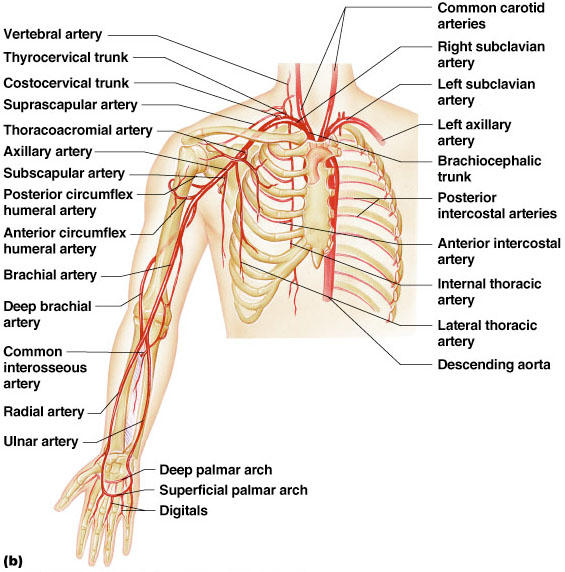
**Circulatory routes**

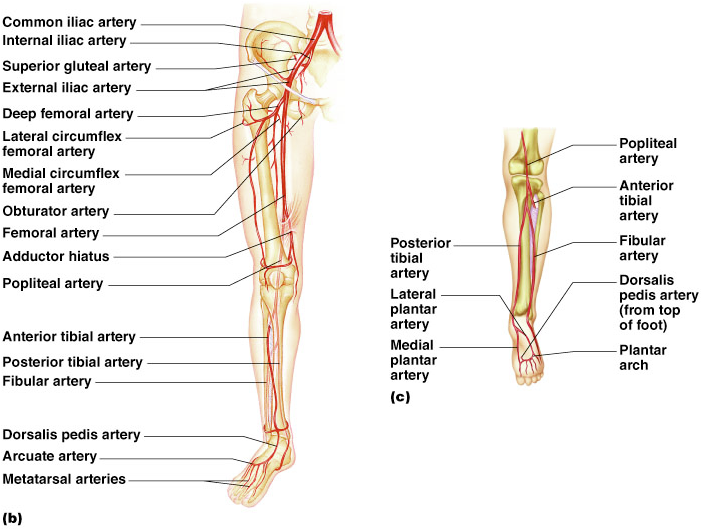
* Systemic circulation: blood flows from the left ventricle of the heart through blood vessels to all parts of the body (except gas exchange tissues of lungs) and back to the right atrium
* Pulmonary circulation: venous blood moves from right atrium to right ventricle to pulmonary artery to lung arterioles and capillaries, where gases are exchanged; oxygenated blood returns to left atrium by pulmonary veins; from left atrium, blood enters the left ventricle
* Systemic arteries
  + Main arteries give off branches, which continue to rebranch, forming arterioles and then capillaries
  + End arteries: arteries that eventually diverge into capillaries
  + Arterial anastomoses: arteries that open into other branches of the same or other arteries; incidence of arterial anastomoses increases as distance from the heart increases
  + Arteriovenous anastomoses, or shunts, occur when blood flows from an artery directly into a vein

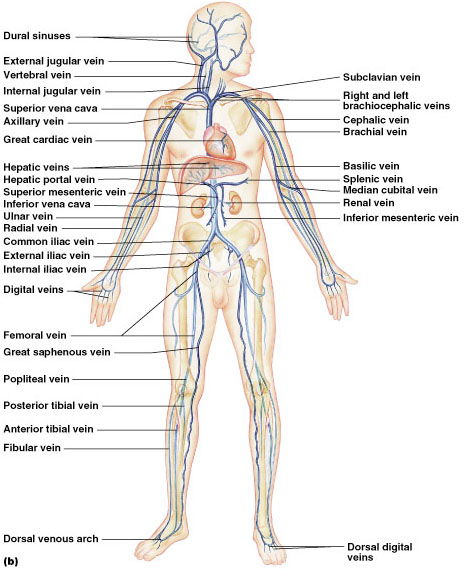






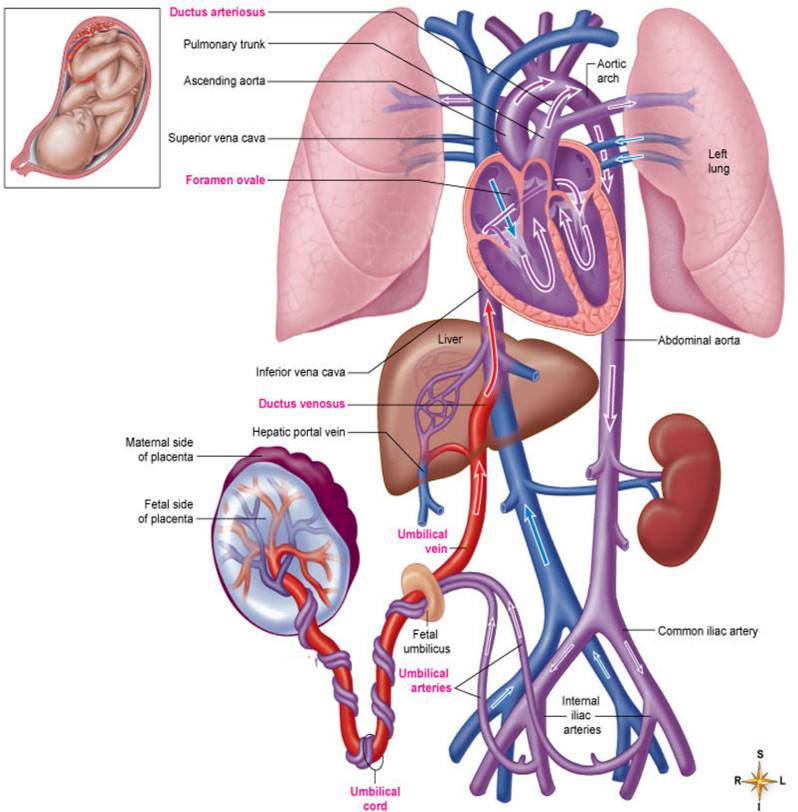






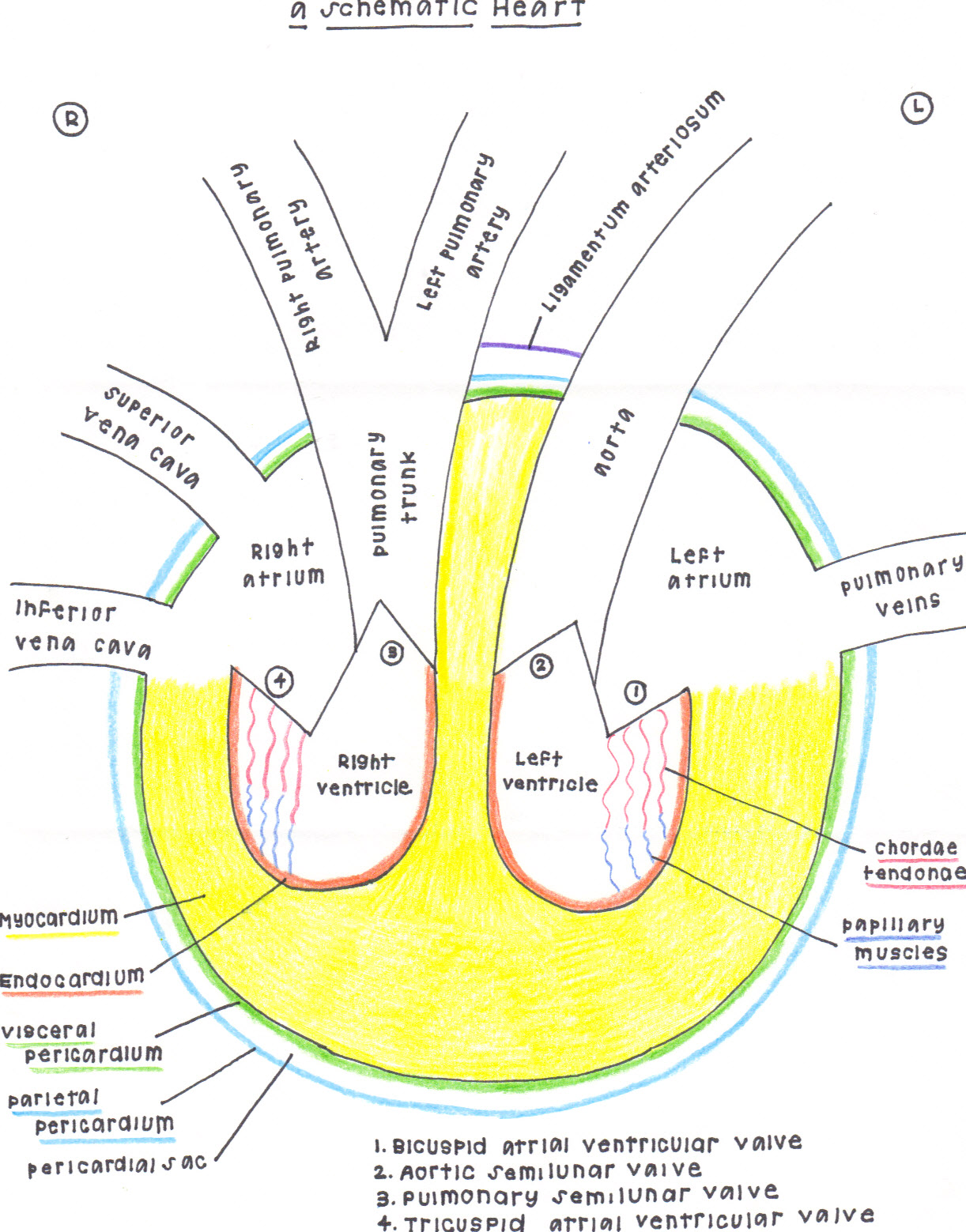
**Fetal Circulation**

* Placenta: where exchange of oxygen and other substances between the separate maternal and fetal blood occurs; attached to uterine wall
* Umbilical vein: returns oxygenated blood from the placenta to the fetus
* Ductus venosus: continuation of the umbilical vein; drains into inferior vena cava
* Foramen ovale: opening in septum between the right and left atria
* Ductus arteriosus: small vessel connecting the pulmonary artery with the descending thoracic aorta

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**Cycle of Life : Cardiovascular Anatomy**

* Birth: change from placenta-dependent system
* Heart and blood vessels maintain basic structure and function from childhood through adulthood
* Exercise thickens myocardium and increases the supply of blood vessels in skeletal muscle tissue
* Adulthood through later adulthood: degenerative changes
* Atherosclerosis: blockage or weakening of critical arteries
* Heart valves and myocardial tissue degenerate, reducing pumping efficiency

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**By Kyla Kern – OTA Student**