

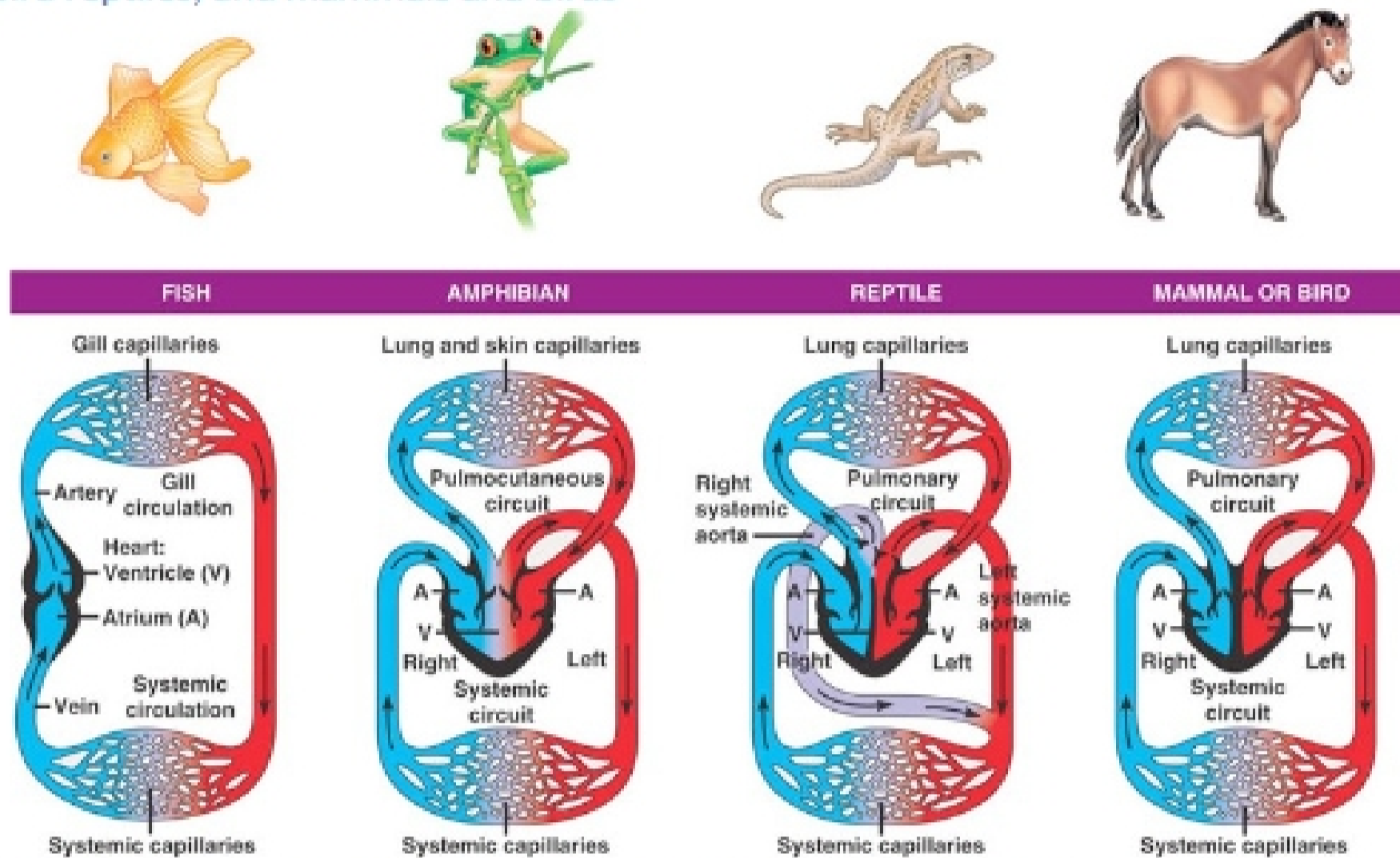
Exam 5/Final Learning Objectives

Chapter 42: Circulation and Gas Exchange

Concept 42.1: Circulatory systems link exchange surfaces with cells throughout the body

- Explain how a gastrovascular cavity functions in part as a circulatory system
 - Fluid bathes both the inner and outer tissue layers facilitating exchange of gases and cellular waste. Only the cells lining the cavity have direct access to the nutrients released by digestion but the body wall is very slim so nutrients only need to diffuse a short distance to reach the rest of the body
- Distinguish between open and closed circulatory systems. List the three basic components common to both systems
 - **Open Circulatory System:** the circulatory fluid bathes the organs directly with hemolymph, which also acts as the interstitial fluid that bathes the body cells. Allows blood and interstitial fluid to mix with each other (arthropods, mollusks)
 - **Closed Circulatory System:** blood is confined to vessels and is distinct from the interstitial fluid (annelids, cephalopods and all vertebrates).
 - 3 basic components of both:
 - 1. Circulatory fluid (blood)
 - 2. Set of tubes (blood vessels)
 - 3. Muscular pumps (heart)
- List the structural components of a vertebrate circulatory system and relate their structure to their function
 - **Arteries:** carry blood away from the heart to organs
 - Has two layers of tissue surrounding the endothelium: outer connective tissue containing elastic fibers (which allow the vessel to stretch and recoil) and a middle layer containing smooth muscle and more elastic fibers.
 - The walls of arteries are thick and strong accommodating blood pumped at high pressure by the heart. Arterial walls also have an elastic recoil that helps maintain blood pressure and flow to the capillaries when the heart relaxes between contractions.
 - **Arterioles:** small blood vessels that convey blood to the capillaries
 - **Capillaries:** microscopic vessels with very thin porous walls
 - The thin walls (which consist of endothelium and its basal lamina) of capillaries allows for diffusion between blood and interstitial fluid
 - **Capillary beds:** networks of capillaries that infiltrate every tissue (the thin wall of capillaries allows for diffusion between blood and interstitial fluid)
 - **Veins:** vessels that carry blood back to the heart
 - Has two layers of tissue surrounding the endothelium: outer connective tissue containing elastic fibers (which allow the vessel to stretch and recoil) and a middle layer containing smooth muscle and more elastic fibers.
 - Only return blood back to the heart they have a lower pressure and do not require thick walls. Veins have valves inside that maintain a unidirectional flow of blood despite the low pressure.
 - **Atria:** chambers that receive blood entering the heart

- o **Ventricles:** responsible for pumping blood out of the heart
- Using diagrams, compare and contrast the circulatory systems of fish, amphibians, non-bird reptiles, and mammals and birds



- Distinguish between pulmonary and systemic circuits and explain the functions of each
 - o **Pulmonary Circuit:** The right side of the heart delivers oxygen poor blood to capillary beds of the gas exchange tissues where there is a net movement of O₂ into the blood and CO₂ out of the blood
 - o **Systemic Circuit:** The oxygen enriched blood leaves the gas exchange tissues enters the left side of the heart contraction of the heart propels this blood to the capillary beds of tissues and organs gas exchange the now poor oxygen blood returns to the heart

Concept 42.2: Coordinated cycles of heart contraction drive double circulation in mammals

- Define a cardiac cycle and distinguish between systole and diastole
 - o **Cardiac cycle:** One complete sequence of pumping and filling
 - **Systole:** contraction phase
 - **Diastole:** relaxation phase
- List the four heart valves, describe their location, and explain their functions
 - o 1.
 - o 2.
 - o 3.
 - o 4.
- Define sinoatrial (SA) node and atrioventricular (AV) node and describe their location in the heart
 - o **Sinoatrial (SA) node:** primary pacemaker. It's a cluster of cells that sets the rate and timing at which all cardiac muscle cells contract. Gap junctions between cardiac muscle cells allow impulses generated by SA to travel along atrial cells, causing both atria to contract in unison. These cells are located in the wall of the right atrium.
 - o **Atrioventricular (AV) node:** secondary pacemaker cell cluster. Pacemaker generates wave of signals to contract. The signals from SA node are delayed

here before spreading to the heart apex, allowing the atria to empty completely before the ventricles contract. These cells are located in the wall between the right and left atria.

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- Describe the origin and pathway of the action potential (cardiac impulse) in the normal human heart
 - o 1. Impulses from SA node spread through atria → Signals are delayed at AV node (wall between left and right atria) → Bundle branches pass signals to heart apex → signals spread throughout ventricles.

Concept 42.3: Patterns of blood pressure and flow reflect the structure and arrangement of blood vessels

- Relate the structures of capillaries, arteries, and veins to their function
 - o **Arteries**- Thick walled vessels with smooth muscle and connective tissue to withstand high pressure caused by accommodation of blood pumped at high pressure by the heart. Arterioles branch off of arteries, which are smaller in diameter to help control the distribution of blood flow. Arterioles lead to the capillaries.
 - o **Capillaries**- are the smallest blood vessels with very thin porous walls. Networks of these vessels called capillary beds infiltrate every tissue. Across the thin walls of capillaries, chemicals (like dissolved gases) are exchanged by diffusion between the blood and the interstitial fluid of the tissue cells. At their "downstream" end capillaries merge to form venules, and venules merge to form veins.
 - o **Veins**: Contain smooth muscle and connective tissue with thinner walls than arteries. They do not require thick walls because they convey blood back to the heart at a lower pressure.
- Explain why the velocity of blood flow through capillaries is substantially slower than it is through arteries and veins
 - o Blood flow is slowest through capillary beds because of the large total-cross sectional area. The exchange of substances between the blood and interstitial fluid occurs only in capillaries because only capillaries have walls thin enough to permit this transfer. The slower flow of blood is necessary to provide time for diffusion to occur.
- Explain how blood returns to the heart even though it must sometimes travel from the lower extremities against gravity
 - o 1st rhythmic contractions of smooth muscles in the walls of venules and veins aid the movement of blood. 2nd the contraction of skeletal muscles during exercise squeezes blood through the veins towards the heart 3rd the change in pressure within the thoracic (chest) cavity during inhalation causes the vena cava and other large veins near the heart to expand and fill with blood
- Explain how blood flow through capillary beds is regulated
 - o Two mechanisms regulate the distribution of blood to capillaries.
 - 1. Contraction of smooth muscle layers in arterioles, which reduces the vessel's diameter and decreases blood flow to adjoining capillary beds.
 - 2. Pre-capillary sphincters - rings of smooth muscles located at the entrance to capillary beds regulate flow of the blood