BIOL 1002-Exam #3 Learning Objectives
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Chapter 32-Circulation

- ~~Understand the 3 basic parts of all circulatory systems and the main functions of each~~
  - ~~Heart- the pump that keeps the blood circulating~~
  - ~~Blood- a liquid that serves as a medium of transport~~
  - ~~Blood vessels- a system of tubes that conduct the blood throughout the body~~
- ~~Understand the functions of the human circulatory system~~
  - ~~Transport O2 from the lungs or gills to the tissues, and transport CO2 from the tissues to the lungs or gills~~
  - ~~Distribute nutrients from the digestive system to all body cells~~
  - ~~Transport of waste products and toxics substances to the liver, where many of them are detoxified, and to the kidneys for excretion~~
  - ~~Distribution of hormones from the glands and organs that produce them to the tissues on which they act~~
  - ~~Regulation of body temperature by adjustments in blood flow~~
  - ~~Wound healing and blood clotting to prevent blood loss~~
  - ~~Protection against disease by circulating white blood cells and antibodies~~
- ~~Understand how the human heart differs from fish, amphibian and reptile hearts~~
  - ~~The human heart has 3 chambers which consist of two atria and one ventricle~~
  - ~~Fish only had 2 chambers with a single atrium that empties into a single ventricle~~
- ~~Understand the circulation terminology~~
  - ~~Artery- vessel that carries blood AWAY from the heart~~
  - ~~Vein- vessel that carries blood TO the heart~~
  - ~~Pulmonary- having to do with the lungs~~
  - ~~Systemic- having to do with everywhere else in the body~~
  - ~~Vena cava- largest vein in the human body~~
  - ~~Aorta- largest artery in the human body~~
- Be able to trace the flow of blood through the mammalian heart, including all valves (swinging doors) involved
  - When valves contract, blood must be prevented from flowing back into the atria
    - Blood entering the pulmonary artery and aorta must also be prevented from flowing back into the ventricles as the heart relaxes
  - ~~The directionality of blood flow is maintained by one-way valves~~
  - ~~Pressure in one direction opens them, but reverse pressure forces them closed~~
  - ~~Artioventricular valves (AV)- allow blood to flow from the atria into the ventricles, but not the reverse~~
  - ~~Semilunar valves- allow blood to enter the pulmonary artery and the aorta when the ventricles contract, but prevent blood from returning as the ventricles relax~~
- ~~Understand the difference between systolic and diastolic pressure, and what causes each~~
  - ~~Systolic pressure- the higher of the 2, measured during ventricular contraction~~
  - ~~Diastolic pressure- minimum pressure in the arteries as the heart rests between contractions~~

- ~~Hypertension is caused by the constriction of small arteries, which causes resistance to blood flow and strain on the heart~~

- Be able to trace the flow of the electrical signal throughout the heart, and all of the structures involved
  - The contraction of the heart is initiated and coordinated by a **pacemaker**, a cluster of specialized heart muscle cells that produce spontaneous electrical signals at a regular rate
  - The heart's pacemaker is the **sinoatrial (SA) node**, located in the upper wall of the right atrium
  - Electrical signals from the SA node pass freely into the connecting cardiac muscle cells and then throughout the atria
  - The electrical signal then passes from the right atrium to a specialized group of muscle cells between the right atrium and right ventricle called the **atrioventricular (AV) node**
  - From the AV node, the signal to contract spreads along specialized tracts of rapidly conducting muscle fibers called the **atrioventricular bundle** (AV bundle), which sends branches to the lower portion of both ventricles
    - Here, the bundles branch further, forming **Purkinje fibers** that transmit the electrical signal throughout the ventricle
- Understand the purpose of the AV nodal delay
- Understand the major components of both the plasma portion and cellular portion of blood, and their functions
  - Blood has two major components
    - Plasma- 55% of total blood volume
      - Primarily water in which proteins, salts, nutrients, and wastes are dissolved
      - Proteins are the most abundant dissolved molecules by weight and include
        - Albumin- maintains the blood's osmotic strength
        - Globulins- antibodies that play an important part in immune response
        - Fibrinogen- blood clotting
    - Cell-based portion which is 40-45% of total blood volume and consists of
      - Red blood cells
        - Mature red blood cells are not actual cells because they lack a nucleus
        - Carry oxygen from the lungs to the tissues
          - Most are oxygen carrying red blood cells called erythrocytes
          - Red color caused by hemoglobin which transports oxygen to the blood
        - Lifespan of about 4 months
        - Iron from the erythrocytes is returned to the bone marrow where it is recycled into new red blood cells
      - White blood cells
        - Only complete, functional cells
        - Break down the old red blood cells
        - Defend the body against disease

- 5 types- also called leukocytes
  - Neutrophils
  - Eosinophils
  - Basophils
  - Lymphocytes
  - Monocytes- enter tissues and transform into macrophages that engulf bacteria and cellular debris

- Platelets
  - Small fragments of cells
  - Aid in blood clotting
  - Platelets are pieces of megakaryocytes that reside in bone marrow
  - Blood clotting is a complex process that plugs damaged blood vessels and protects animals from excessive blood loss
    - All three originate from stem cells
      - Unspecialized cells that can divide to produce offspring capable of maturing into one or more types of specialized cells

- Understand the structure of hemoglobin, and its role regarding O2 and CO2 in the blood
  - Each one has a 4 iron-containing heme groups that can bind four oxygen molecules
    - Oxygenated hemoglobin takes on a bright red color
    - Hemoglobin becomes bluish as it releases 02 and picks up CO2 at tissues
- Understand the structural and functional differences between veins, arteries, venules, arterioles, and capillaries
  - Arteries and arterioles carry blood away from the heart
    - The walls of arteries are thicker and more elastic than those of veins
    - With each heartbeat, the arteries expand slightly, like thick-walled balloons
    - Arteries branch into smaller diameter vessels called **arterioles**
  - Capillaries
    - Capillary walls are a single cell thick and allow exchange of nutrients and wastes
    - Arterioles conduct blood into elaborate networks of tiny **capillaries**, microscopically thin vessels
    - Capillaries allow individual body cells to exchange nutrients and wastes with the blood by diffusion
    - They are so numerous that most of the body's cells are no more than 100 micrometers from a capillary, which is close enough for diffusion to work effectively
    - Capillaries are so narrow that red blood cells pass through them single file
  - Veins
    - Veins and venules carry blood back to the heart
      - After picking up carbon dioxide and other wastes from cells, capillary blood drains into larger vessels, called **venules**, which empty into still larger veins
    - Arterioles control the distribution of blood flow
      - Arterioles carry blood to capillaries; their muscular walls are influenced by nerves, hormones, and chemicals produced by nearby tissues
      - Arterioles contract and relax in response to the needs of the tissues and organs they supply