



Circulatory and Gas exchange

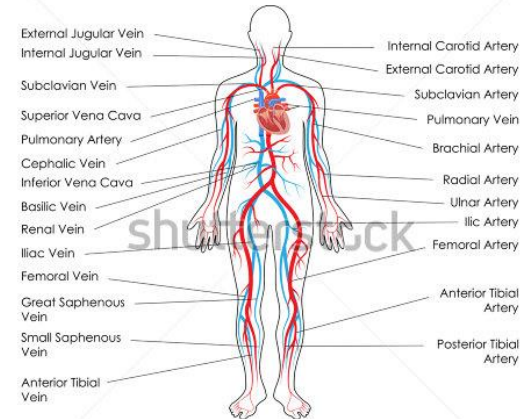
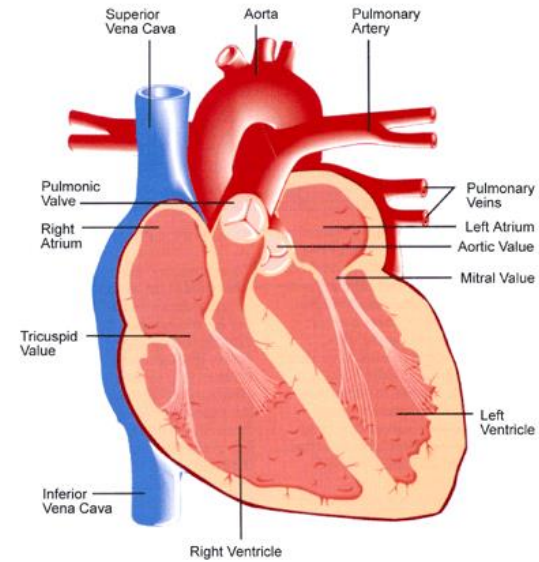
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[https://www.youtube.com
/watch?v=5tTkxYeNF9Q](https://www.youtube.com/watch?v=5tTkxYeNF9Q)

Circulatory System Song!!!!

Major structures

- Heart-made of muscle tissue and protected by rib cage,consists of 4 hollow chambers, pumps blood throughout the body
- Blood vessels
 - arteries-carry oxygen rich blood away from the heart
 - veins-carry oxygen deprived blood, full of carbon dioxide, back to the heart
 - capillaries-exchange food, oxygen and wastes between blood and body cells through gas exchange and diffusion
- Blood- carries the nutrients and oxygen through the blood vessels and to the areas of the body that need them

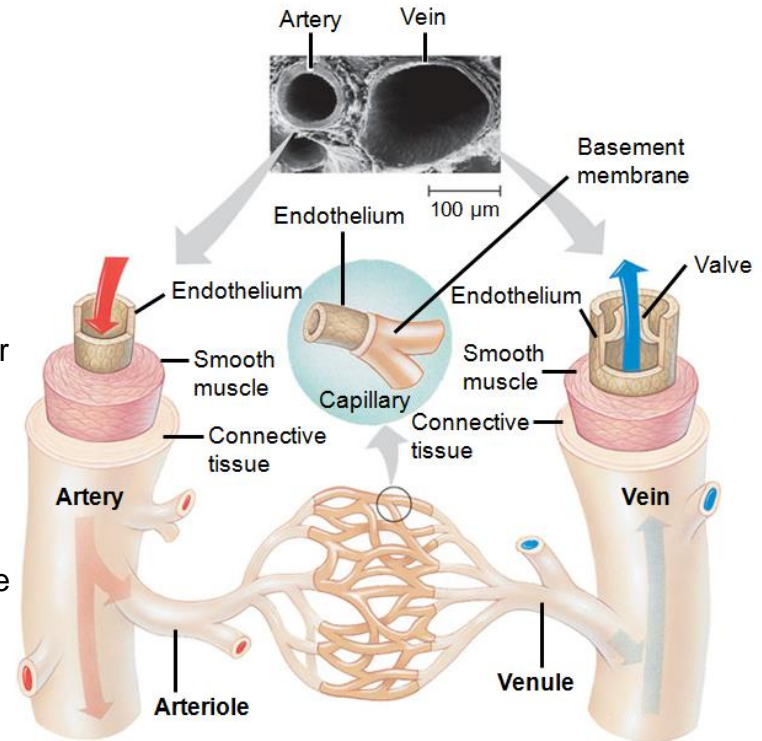


Structure and function of blood

- ❖ Blood carries oxygen to and carbon dioxide from tissues of the body and consists of plasma, erythrocytes (red blood cells), leukocytes (white blood cells), and platelets.
 - plasma makes up 55% of blood's volume
 - made of 90% water and 10% inorganic salts/other solutes
 - buffer the blood against pH changes
 - help combat viruses and other foreign agents
 - erythrocytes are the most numerous blood cells
 - 25 trillion red blood cells
 - transport O₂
 - leukocytes
 - fight infections
 - 5,000-10,000 white blood cells

Blood Pressure's effects

- Blood flows from areas of high pressure to low pressure
- Contraction of a heart ventricle generates blood blood pressure
 - exerts force in all directions
- The force directed lengthwise in an artery causes the blood to flow away from the heart
 - the site of highest pressure
- Force exerted against the wall stretches and the recoil plays a critical role in maintaining blood pressure
- When blood enters the arterioles and capillaries, narrow diameter generates resistance to the flow
 - this dissipates much of the pressure from the heart by the time blood reaches the veins
- The structure of the wall of the arteries is what allows for blood pressure to be regulated
- The arrangement of the vessels relates the the structure because
 - blood moves from high pressure to low
 - the size of the vessels varies so that pressure can be maintained



Interdependence with Other Systems

Nervous System: The nervous system is made up of the brain, spinal cord and nerves. The brain sends messages to the heart telling it to beat. The heart beat pumps blood throughout the body so that nutrients and oxygen can be brought to cells and waste can be removed.

Digestive System: The digestive system breaks down foods and takes out needed nutrients. These nutrients are put into the blood stream for the cells to use as energy. Minerals and vitamins are also put into the blood stream to strengthen bones and the immune system.

Muscular System: The heart is a muscle. The expanding and contracting of this muscle is what pumps blood throughout the body.

Respiratory System: The respiratory system is how oxygen is brought into the body. It enters through the lungs into the alveoli. From there it is sent through blood vessels into the blood stream for the body to use. At the same time, carbon dioxide is brought to the lungs through the blood to be exhaled.

Skeletal System: Marrow inside of bones produces red and white blood cells. These blood cells are parts of the blood stream and are responsible for carrying oxygen and fighting off disease.

Endocrine System: The endocrine system is where hormones are produced. Hormones and other chemicals produced by these glands use the circulatory system to travel to needed parts of the body. Example: Adrenaline, created by the Adrenal gland, travels through the blood stream to the heart causing an increased heart rate.

Immune System: The immune system is made up of white blood cells and antibodies. These things travel inside the blood so that they can be transported to the site of infection/invasion to remove and/or hopefully destroy it. This is how you fight off sickness

Circulatory System's Effect with Homeostasis

- Blood is composed of two parts: formed elements and plasma. All of the formed elements contribute to homeostasis.
 - Oxygen is utilized during cellular respiration, a process that provides energy for metabolic activities.
 - Fighting infection keeps the body intact and prevents it from succumbing to disease caused by viruses and bacteria.
 - Clotting of blood when a vessel has been cut prevents the loss of this vital fluid.
- Plasma, too, contributes to homeostasis. The nutrients needed and wastes given off by cells are carried in plasma.
 - Nutrients leave plasma at the capillaries and wastes enter plasma at the capillaries.
 - Blood pressure created by the pumping of the heart forces water out of a capillary at the arteriole end and osmotic pressure maintained largely by proteins draws water back in at the venous end of a capillary

Open vs Closed

Open Circulation Systems

- Do not have veins because fluids move freely throughout the body on the organs
- There is no distinction between blood and other fluids
 - In these animals there is hemolymph which is a circulatory fluid that contracts as the heart pumps this fluid through vessels into interconnected tissue and spaces surrounding the organs
- common in invertebrates like shellfish, spiders and mainly only small animals
- Advantages of an open system:
 - more energy efficient and less costly
- Disadvantages:
 - fluid can not be sent to a specific region of the body

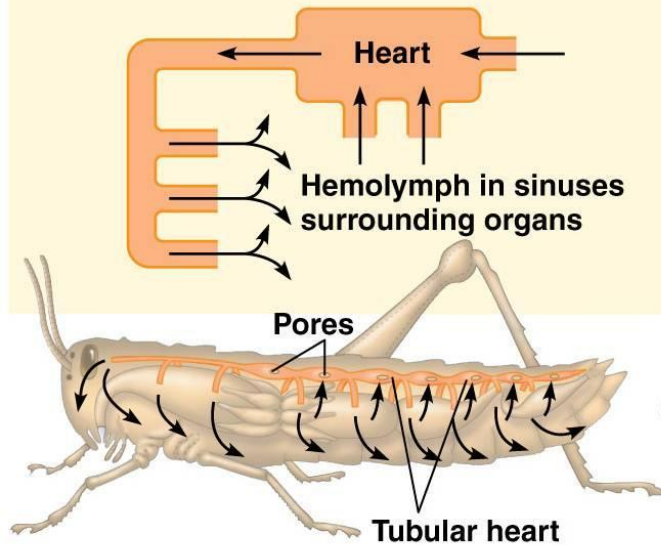
Both of these systems involve blood, blood vessels, and the heart

Closed Circulation Systems

- Blood is contained in veins which branch of the heart/s which course throughout the organs
- Common in vertebrates such as humans and any animal with a vertebrae
- Advantages of a closed system:
 - much more effective with transporting blood and other fluids
 - has the ability to support high metabolic demands
 - Can have high blood pressures which enables the effective delivery of oxygen and nutrients to the cells

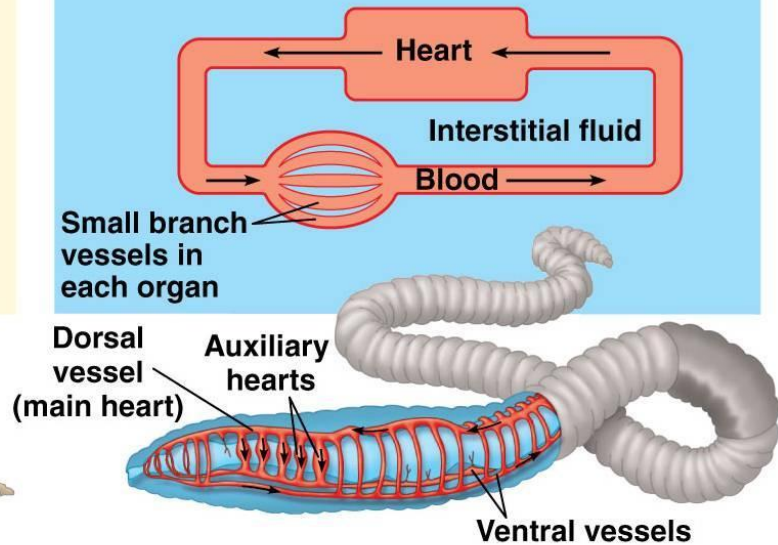
Open vs Closed Circulatory System

(a) An open circulatory system

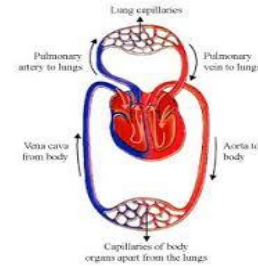


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(b) A closed circulatory system



Double Circulation



- Mammals have two distinct circuits which is also known as double circulation. Having a double circulation means you have two loops throughout the body that blood circulates. One route is oxygenated while the other is deoxygenated
- This type of circulation is important because it ensures that all of the tissues and muscles are getting blood full of oxygen instead of oxygenated and deoxygenated blood.
- This may take more time and energy than a single circulatory system but this is a more efficient way.
- Having both pumps simplifies the coordination of the pumping cycle
- How it all works: One of the pumps on the right side of the heart delivers oxygen poor blood to the capillary beds of the gas exchange where there is a net movement of oxygen into the blood and carbon dioxide out of the blood. Once the blood leaves the gas exchange tissues it enters the other pump to the left side of the heart. Each contraction of the heart propels blood into organs and tissues of the body. Following the exchange of oxygen and carbon dioxide as well as nutrients and waste products, the now oxygen-poor blood returns to the heart which completes the systemic circuit

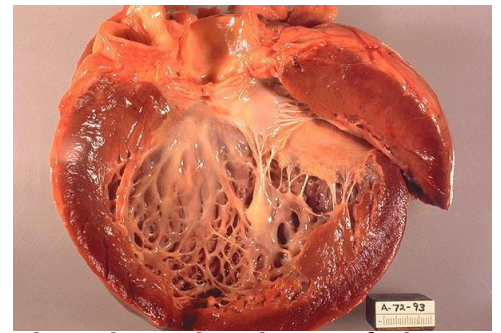
Lymphatic System

- The lymphatic system is a subset to the circulatory system and has a number of functions. One function of the lymphatic system is to collect and transport tissue fluids from the intercellular spaces in all of the body back to the veins in the blood system.
- Another function of this system is digested fats are absorbed then transported from the villi in the small intestine to the bloodstream
- The lymphatic and the circulatory system are the two most important systems in the body. Both systems compromise the bodies waste removal and blood circulating capabilities.

The systems are intertwined and work together to transport substances through the body as well as provide the body with lymph. Lymph is a clear white fluid made of white blood cells and attack bacteria in the blood. There are 600 to 700 lymph nodes in the human body that filter lymph before it returns back to the circulatory system

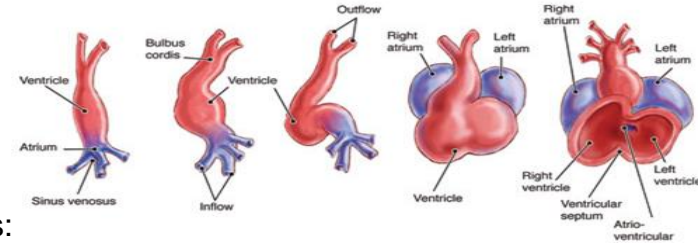
- The lymphatic system is primarily made up of lymph, lymph vessels, and lymph nodes. While the spleen, tonsils, thymus are all part of the lymphatic system.

Diseases



- **Atherosclerosis**
 - caused by high fat diets
 - leads to fatty plaques lining blood vessels
 - fatty areas can become calcified and further lead to hardening of the arteries
 - less flexible arteries can cause high blood pressure and heart attacks
- **Ischemia**
 - heart muscle doesn't get enough blood flow with a decrease of oxygen in that blood
 - causes patient to experience chest pain-angina pain
- **Angina pectoris**
 - pain in the chest
 - shortness of breath, fatigue and nausea
 - caused by too little blood flowing to the heart

Development of the Heart



- The first sign of cardiac development is the cardiogenic plate
- The development of the heart then goes rapidly through 3 main phases:
 - plexiform phase
 - tubular phase
 - loop phase
- The flexion of the embryo causes the tissue of the original cardiogenic plate, which is enveloped by the pericardial cavity, to move into a ventral position. It consists of epicardium, myocardium and endocardium.
 - A gelatinous mass, the cardiac jelly, temporarily forms between the myo- and endocardium
- On the inside, the heart forms into chambers
- The vessels near the heart are influenced in their development by the right-left determination of the heart. Certain portions of the venous and arterial systems atrophy and others develop further for this reason.
- Then the low pressure area of the placenta falls away while, on the other hand, the pressure in the pulmonary circulation system decreases due to the distention of the lungs following the beginning of breathing.
 - These two events cause the pressure in the left part of the heart to increase

Gas Exchange and adaptation

Gas exchange, or respiration, is the intake of oxygen and the discharge of carbon dioxide to the environment.

- ❖ gas always diffuses from higher pressure to lower pressure
- ❖ gas exchanges varies depending on whether the respiratory medium is air or water
- ❖ specialization is apparent, for gas exchange, in the structure of the respiratory surface
- ❖ gas exchange is fast when the air for diffusion is large and the path for diffusion is short, because of this respiratory surfaces tend to be large and thin
- ❖ some animals are able to adapt to a different environment and gas exchange due to their ability to store large amounts of O_2
- ❖ these “diving animals” also have adaptations that conserve O_2
- ❖ blood supply to the muscles decreases during long dives

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