

BI103 Spring 2024

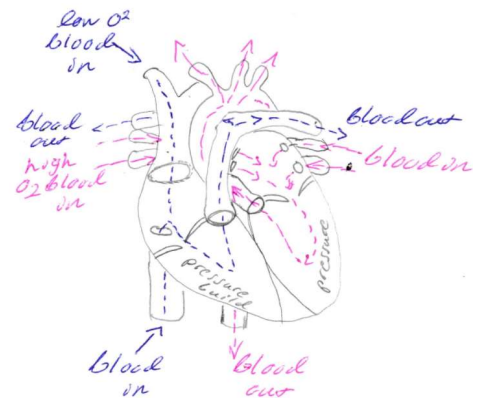
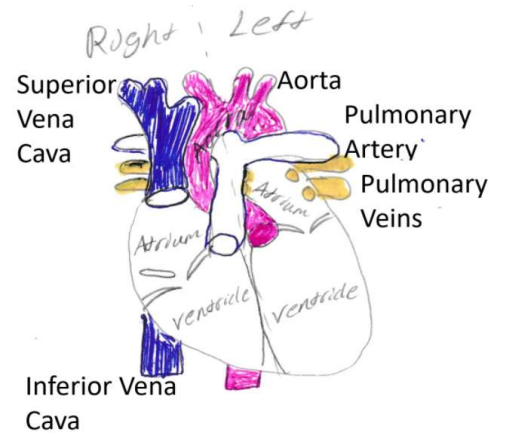
Cardiovascular Summary

The heart is complex, but its structure can be broken down easily. Before observing a heart, note you are observing the heart of someone else so left and right directions are inverted.

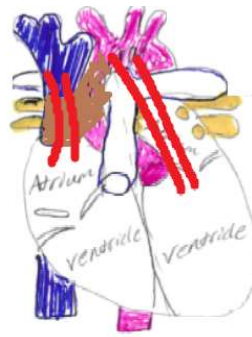
- *Atria*ms are upper chambers where blood fills up initially
- Once full, blood is flows down to *ventricle*
- Muscles in ventricle contract, pushing blood out of the heart

Oxygen first comes to the heart on the right side via the *superior vena cava*, the blood coming in is low oxygenated. It fills its respective atrium before going down, where it then gets pushed out once pressure builds in the ventricle. It exits the heart and heads to the lungs via the *pulmonary arteries*, on its way to collect oxygen. Once the blood is oxygenated it returns to the heart on the left side via the *pulmonary veins*, and the process of filling the respective atrium into the ventricle repeats itself. On the final exertion of blood out of the heart, the blood leaves through the *aorta*, going up for upper body needs and down for lower body.

Many things can go wrong with the heart. As mentioned before, there are essentially 4 important heart chambers, an atrium and ventricle on each side of the heart. If one of these chambers has a defect, such as tissue death or abnormal size of the chamber, the heart can not efficiently do its job of pumping blood. This is heart failure. Another issue that can occur is blockage of blood vessels. If blood vessels come under pressure and are unable to bring/take blood, then blood can't circulate. This is coronary artery disease, and it is common for surgeons to do a bypass where blood is rerouted via blood vessels acquired from elsewhere in the body. In doing so, you create another pathway for the blood to circulate, and so the heart is still able to function normally



Obstruction of blood

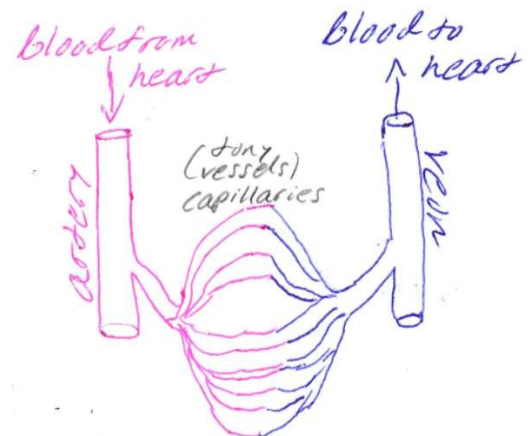


Blood can "bypass" via new vessel pathways

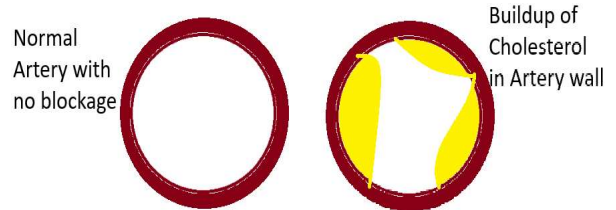
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When blood vessels are mentioned, there are 3 main types that can be referred to. Arteries, veins and capillaries. Each of these 3 have a major role in blood transport, but the routes taken are different.

- Arteries in the body distribute oxygenated blood, blood which has gone through the heart's two step process
- Capillaries, the smallest blood vessel, network blood coming from the arteries so that its nutrients can be distributed. In the process waste is collected and oxygen is dropped off
- Veins send the blood back to sender, taking now deoxygenated blood back to the heart so it can once again go through the two step process

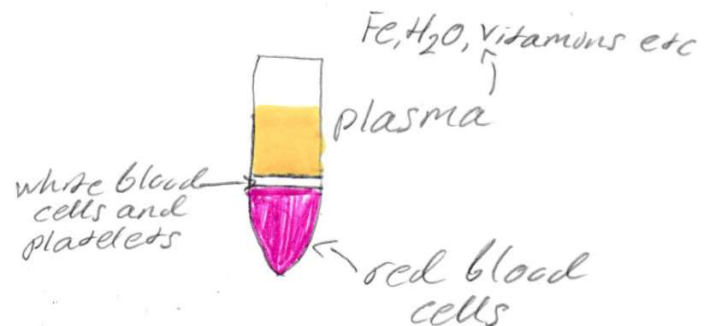


In this system it is very important for oxygenated blood to come from the arteries, but the arteries can become clogged by buildup of fats or cholesterol. This is called atherosclerosis, buildup of substances in the artery walls limit blood flow.



Restriction of blood flow can have other major consequences. If blood can not flow but more and more blood arrives then the vessel can swell, and given time could even rupture. This is called an aneurysm, the vessel swells or gets to a point it can rupture causing internal bleeding. If the location of the aneurysm is towards the brain, then it could even cause a stroke and could prove fatal.

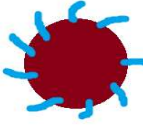

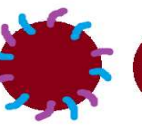
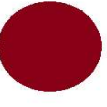



Blood is composed of 3 main parts, plasma, white blood cells and platelets and the iconic red blood cells. Plasma (shown in yellow on the right) is primarily water plus major nutrients and substances, including cellular waste.



White blood cells and platelets (shown as a thin white line) are important cells responsible for fighting off infections. There are many types of white blood cells, each with their own function. Platelets are smaller pieces of what were once larger bone marrow cells, and their function is producing fibrin, an important protein capable of clotting a vessel rupture which may occur. Lastly red blood cells are well, red blood cells. They are also known as erythrocytes. They carry oxygen so that it can be used throughout the body.

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Blood type is determined by genes at birth, but more specifically it is determined by combinations of proteins on red blood cells and antibodies present in plasma. There are many types of blood types, but there are 4 key types with further variation existing for each. The table on the right showcases which protein and antibody combinations result in which main type.

	Type A	Type B	Type AB	Type O
Red blood cells and protein combinations				
Antibodies in plasma			N/A	

There are several blood disorders that exist, and their existence can be traced to genetics once more. A blood disorder that impacts erythrocytes or red blood cells is sickle cell anemia. As the name suggests, the red blood cells take a sickle-like appearance, and the cells are impacted because their lifespan shortens. The new structure of the cell also impacts their movement, restricting blood flow and leading to potential complications later.



Another blood disorder is blood cancer, more commonly referred to as leukemia. Most leukemia types are a result of white blood cell mutation. Recall that there are many types of white blood cells, and the mutation of one or another can result in different types of leukemia. Abnormal growth of white blood cells, regardless of which one, can have complications with the overall function of the immune system, since the white blood cells are a vital part of it.

The cardiovascular system is very complex, and there are a few actions which can pose severe risks to it. Eating a lot of processed food, or foods high in sugars and fats, can cause excess of lipids or fatty compounds in the body which can produce blockage of vessels as seen before. Smoking is quite common these days too, but it also has its risks. Aside from lung cancer or other dangers, smoking causes platelets, those small broken cells capable of clotting blood, to clot even more. This is a danger because inadvertent blood clotting is not something that is desired, and causes a similar blockage of blood flow as fatty foods can do.

