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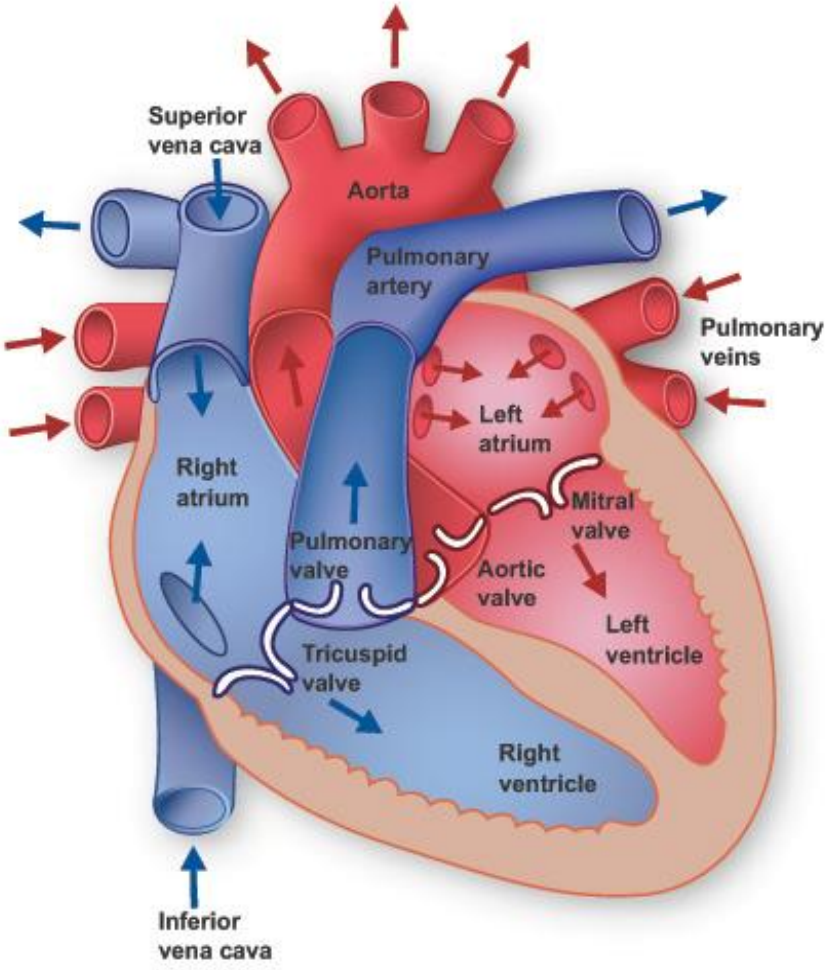
Cardiovascular system

The main components of the human cardiovascular system are the heart and the blood vessels. It includes: the pulmonary circulation, a "loop" through the lungs where blood is oxygenated; and the systemic circulation, a "loop" through the rest of the body to provide oxygenated blood. An average adult contains five to six quarts (roughly 4.7 to 5.7 liters) of blood, which consists of plasma, red blood cells, white blood cells, and platelets. Also, the digestive system works with the circulatory system to provide the nutrients the system needs to keep the heart pumping

2-6 The heart

The heart weighs between 7 and 15 ounces (200 to 425 grams) and is a little larger than the size of your fist. By the end of a long life, a person's heart may have beat (expanded and contracted) more than 3.5 billion times. In fact, each day, the average heart beats 100,000 times, pumping about 2,000 gallons (7,571 liters) of blood.



Your heart is located between your lungs in the middle of your chest, behind

and slightly to the left of your breastbone (sternum). A double-layered and slightly to the left of your breastbone (sternum). A double-layered membrane called the pericardium surrounds your heart like a sac. The outer layer of the pericardium surrounds the roots of your heart's major blood vessels and is attached by ligaments to your spinal column, diaphragm, and other parts of your body. The inner layer of the pericardium is attached to the heart muscle. A coating of fluid separates the two layers of membrane, letting the heart move as it beats, yet still be attached to your body.

Your heart has 4 chambers. The upper chambers are called the left and right atria, and the lower chambers are called the left and right ventricles. A wall of muscle called the septum separates the left and right atria and the left and right ventricles. The left ventricle is the largest and strongest chamber in your heart. The left ventricle's chamber walls are only about a half-inch thick, but they have enough force to push blood through the aortic valve and into your body.

3-6 The Heart Valves :-

Four types of valves regulate blood flow through your heart:

- **The tricuspid valve regulates blood flow between the right atrium and right ventricle.**
- **The pulmonary valve controls blood flow from the right ventricle into the pulmonary arteries, which carry blood to your lungs to pick up oxygen.**
- **The mitral valve lets oxygen-rich blood from your lungs pass from the left atrium into the left ventricle.**
- **The aortic valve opens the way for oxygen-rich blood to pass from the left ventricle into the aorta, your body's largest artery, where it is delivered to the rest of your body.**

4-6 The Conduction System

Electrical impulses from your heart muscle (the myocardium) cause your heart to contract. This electrical signal begins in the sinoatrial (SA) node, located at the top of the right atrium. The SA node is sometimes called the heart's "natural pacemaker." An electrical impulse from this natural pacemaker travels through the muscle fibers of the atria and ventricles, causing them to contract. Although the SA node sends electrical impulses at a certain rate, your heart rate may still change depending on physical demands, stress, or hormonal factors

Blood vessels

A VEINS (proprieties of veins)

1- Veins function to return poorly oxygenated blood to the heart.

1- veins tubes collapse when their lumen are not filled with blood.

2- The thick, outer-most layer of a vein is made of collagen, wrapped in bands of smooth muscle while the interior is lined with epithelial cells called intima.

3- Most veins have one-way flaps called venous valves that prevent blood from flowing back and pooling in the lower extremities due to the effects of gravity.

4- The precise location of veins is much more variable from person to person than that of arteries.

B- ARTERIES (proprieties of arteries)

1- Arteries are blood vessels that carry blood away from the heart (as opposed to veins, blood vessels carrying blood toward the heart). All arteries, with the exception of the pulmonary and umbilical arteries, carry oxygenated blood.

2- The artery is has three layers: A muscular middle which is very elastic and strong, an outer layer of tissue, and an inner layer of smooth epithelial cells that allow the blood to flow easily.

3- The muscular wall of the artery actually helps the heart to pump blood. When your heart beats the artery expands with blood. Because the artery keeps pace with the heart you can actually measure how many heart beats per minute you have by counting the contractions of the artery (pulse rate)

4- Arteries also deliver oxygen rich blood to the capillaries where the actual exchange of carbon dioxide and oxygen happen.

C- Capillaries (proprieties of capillaries)

1- Capillaries are very thin, fragile blood vessels that receive oxygen-rich blood from arteries, exchange oxygen and carbon dioxide and then deliver the waste-rich blood to the veins.

2- Capillaries are only one epithelial cell thick and blood can only flow through them in a single file. The red blood cells inside the capillary release their oxygen, which passes through the wall and into the surrounding tissue. The tissue releases its waste products, e.g. carbon dioxide, which pass through the wall and into the red blood cells. The exchange occurs and the waste blood is carried back to the heart and lungs through the veins.

2-7 THE BLOOD CIRCULATORY SYSTEM

There are three types of blood circulatory system, two of which (systemic circulation and pulmonary circulation) depend on a pump, the heart, to push the blood around. The third type of circulation is known as a portal system. These are specialised channels that connect one capillary bed site to another but do not depend directly on a central pump. The largest of these in the human is the hepatic portal system which connects the intestines to the liver.

3-7 The systemic circulation

transfers oxygenated blood from a central pump (the heart) to all of the body tissues (systemic arterial system) and returns deoxygenated blood with a high carbon dioxide content from the tissues to the central pump (systemic venous system).

As briefly mentioned above the systemic circulation supplies all the body tissues, and is where exchange of nutrients and products of metabolism occurs. All the blood for the systemic circulation leaves the left side of the heart via the aorta.

This large artery then divides into smaller arteries and blood is delivered to all tissues and organs. These arteries divide into smaller and smaller vessels each with its own characteristic structure and function. The smallest branches are called arterioles.

The arterioles themselves branch into a number of very small thin vessels, the capillaries, and it is here that the exchange of gases, nutrients and waste products occurs.

Exchange occurs by diffusion of substances down concentration and pressure gradients.

The capillaries then unite to form larger vessels, venules, which in turn unite to form fewer and larger vessels, known as veins.

The veins from different organs and tissues unite to form two large veins. The inferior vena cava (from the lower portion of the body) and the superior vena cava (from the head and arms), which return blood to the right side of the heart. Thus there are a number of parallel circuits within the systemic circulation.

The pulmonary circulation

is where oxygen and carbon dioxide exchange between the blood and alveolar air occurs. The blood leaves the right side of the heart through a single artery, the pulmonary artery, which divides into two - one branch supplying each lung. Within the lung, the arteries divide, ultimately forming arterioles and capillaries; venules and veins return blood to the left side of the heart.

Portal circulation:-

Normally there is only one capillary bed for each branch of a circuit; however, there are a few instances where there are two capillary beds, one after each other, in series. These are known as portal systems or portal circulations. One example of this is in the liver. Part of the blood supply to the liver is venous blood coming directly from the gastrointestinal tract and spleen via the hepatic portal vein. This

arrangement enables the digested and absorbed substances from the gut to be transported directly to the liver, where many **of the body's metabolic requirements are synthesised. Thus there are two micro-circulations in series, one in the gut and the other in the liver.**

The force required to move the blood through the blood vessels in the two circulations is provided by the heart, which functions as two pumps, the left side of the heart supplying the systemic circulation and the right side the pulmonary circulation.

The systemic circulation is much larger than the pulmonary circulation and thus the force generated by the left side of the heart is much greater than that of the right side of the heart. However, as the circulatory system is a closed system, the volume of blood pumped through the pulmonary circulation in a given period of time must equal the volume pumped through the systemic circulation - that is, the right and left sides of the heart must pump the same amount of blood. In a normal resting adult, the average volume of blood pumped simultaneously is approximately 5 liters per min. As there are approximately 5 liters of blood in an adult, this means that the blood circulates around the body approximately once every minute. During heavy work or exercise, the volume of blood pumped by the heart can increase up to 25 liters per min .