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اسم المدة باللغة الإنكليزية: **Human Biology**

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عنوان المحاضرة باللغة العربية: جهاز الدوران

عنوان المحاضرة باللغة الإنكليزية: **CIRCULATORY SYSTEM**

محتوى المحاضرة:

CIRCULATORY SYSTEM

Introduction:

The **circulatory system** is an organ system that passes nutrients (such as amino acids, electrolytes and lymph), gases, hormones, blood cells, etc. to and from cells in the body to help fight diseases, stabilize body temperature and pH, and to maintain homeostasis.

This system may be seen strictly as a blood distribution network, but some consider the circulatory system as composed of the **cardiovascular system**, which distributes blood, and the **lymphatic system**, which distributes lymph. While humans, as well as other vertebrates, have a closed cardiovascular system (meaning that the blood never leaves the network of arteries, veins and capillaries), some invertebrate groups have an open

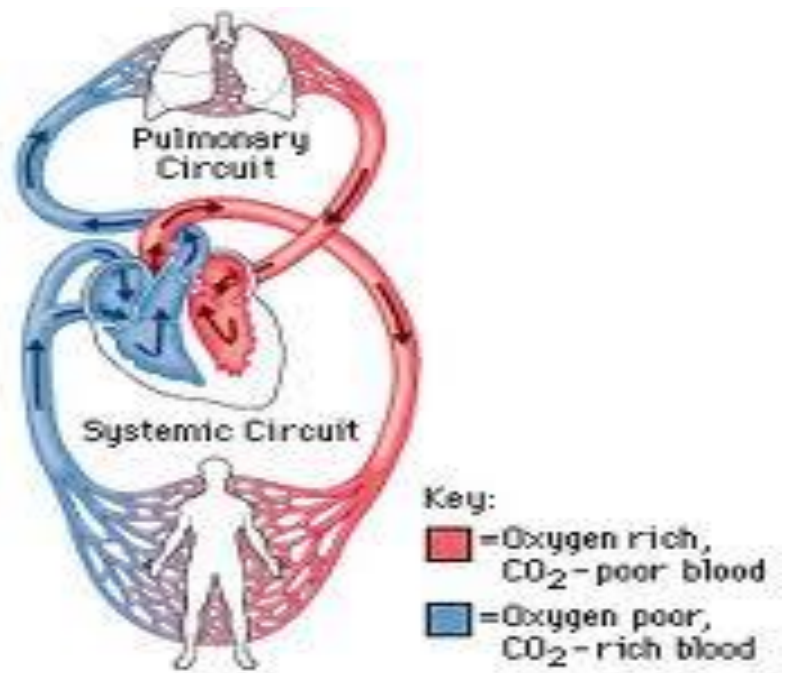
cardiovascular system. The most primitive animal phyla lack circulatory systems. The lymphatic system, on the other hand, is an open system.

Functions of the Circulatory System:

1. Contractions of the heart generate blood pressure, which moves blood through blood vessels.
2. Blood vessels transport the blood from the heart into arteries, capillaries, and veins; and blood then returns to the heart so the circuit can be completed.
3. Gas exchange (pickup of carbon dioxide waste and drop-off of oxygen for the cells) occurs at the smallest diameter vessels, the capillaries.
4. The heart and blood vessels regulate blood flow, according to the needs of the body.
5. Carry oxygen from lungs to tissues and carbon dioxide from tissues to lungs there by aiding in the exchange of gases. Supply of oxygen is needed for proper functioning of the cells. Removal of carbon dioxide is also equally essential as it becomes toxic to cells when present in high amount.
6. Help in fighting against infections by the defence cells- granulocytes.
7. Prevent over bleeding by forming blood clot by the platelets.
8. Helps to maintain pH of the blood by buffering system present
9. Heat exchange through the body surface

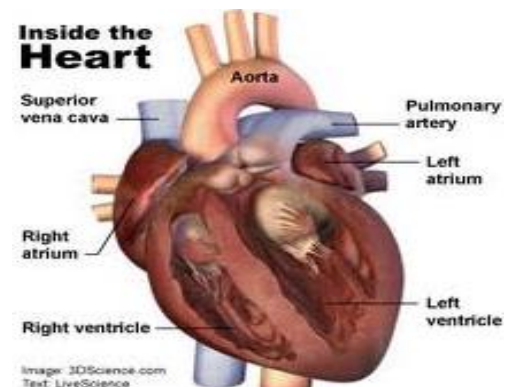
Components of the circulatory/cardiovascular system:

The circulatory system also known as the cardiovascular system, the ¹**heart**, ²**blood vessels** and ³**blood** all are three essential components the body needs to survive. The circulatory system consists of **two circuits** that blood travels through, **pulmonary** and **systemic**. Exercise affects these systems, causing the heart to pump blood faster around the body, which in turn allows you to exercise for longer. It is a double circulatory system. It comprises two separate circuits and blood passes through the heart twice. The **pulmonary** circuit carries blood to the lungs to be **oxygenated** and then back to the heart. In the lungs, carbon dioxide is removed from the blood and oxygen taken up by the haemoglobin in the red blood cells. The **systemic** circuit carries blood around the body to deliver the oxygen and returns **de-oxygenated** blood to the heart. Blood also carries nutrients and waste.



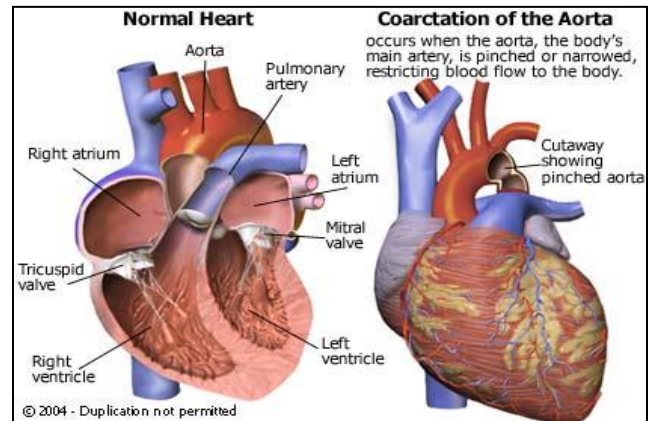
1- The Heart

The **Heart** is an amazing organ. The heart beats about 3 BILLION times during an average lifetime. It is a muscle about the size of our fist. The heart is located in the center of the chest slightly to the left, with cone-shaped, muscular organ exactly located between the lungs, directly behind the sternum (breastbone). The heart is tilted so that the **apex** (the pointed end) is oriented to the left. Its job is to pump the blood and keep the blood moving throughout the body. The major portion of the heart is the interior wall of tissue called the **myocardium**, consisting largely of cardiac muscle tissue. The muscle fibers of myocardium are branched. Each fiber is tightly joined to neighboring fibers by structures called *intercalated disks*. The heart is surrounded by the **pericardium**, a thick, membranous sac that supports and protects the heart. The inside of the pericardium secretes pericardial fluid (a lubrication fluid), and the pericardium slides smoothly over the heart's surface as it pumps the blood. Internally, a wall called the **septum** separates the heart into a right side and a left side. The heart has four chambers. The two **atria** collect the blood. The two **ventricles** pump the blood out of the heart. **Valves** prevent the blood from flowing backwards. The **septum** separates the two sides of the heart. The right side of the heart pumps **de-oxygenated** blood (blood not containing oxygen) to the lungs to pick up oxygen. The left side of the heart pumps the **oxygenated** blood from the lungs around the rest of the body.



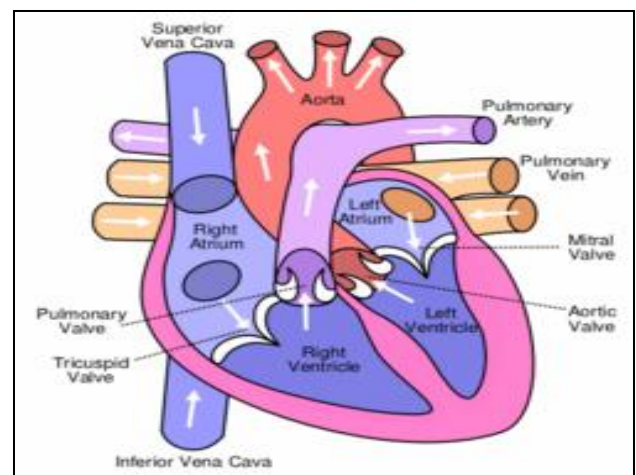
✓ **Two types of Arteries:**

- Arteries start with **A** takes blood away!!
- Aorta – Largest blood vessel in the heart
- Pulmonary Artery – Carries blood containing carbon dioxide from your heart to your lungs



✓ **Three Types of Veins:**

- Veins start with **V** brings blood back to me
 - 1. Inferior Vena Cava – Where the blood enters the heart from the body.
 - 2. Superior Vena Cava – Where the blood enters the heart from the body.
 - 3. Pulmonary Vein – Carries blood-containing oxygen from your lungs to your heart.



✓ **The Four Valves of the Heart:**

- Tricuspid Valve – Lets the blood fill in the right atrium before it enters the right ventricle.

- Bicuspid Valve – Lets the blood fill in the left atrium before it enters the left ventricle
- Right Semi lunar Valve- Lets the right ventricle fill before releasing the blood into the pulmonary artery.
- Left Semi lunar Valve – Lets the blood fill in the left ventricle before sending it to the aorta

2- THE BLOOD VESSELS:

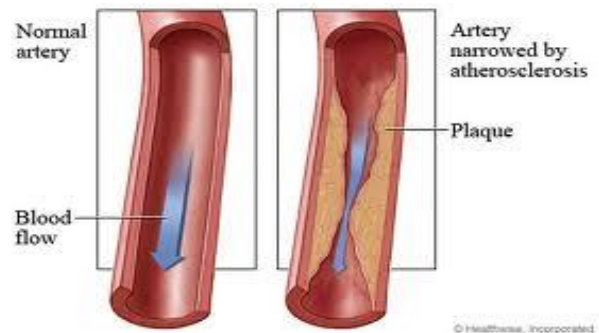
There are three types of **blood vessels**

1. Arteries
2. Veins
3. Capillaries

1- Arteries

Arteries are elastic blood vessels that carry oxygen rich blood **AWAY** from the heart (always oxygenated apart from the pulmonary artery which goes to the lungs). As the arteries move away from the heart, they divide into smaller vessels. The **largest arteries** are about as thick as a **thumb**. The **smallest arteries** are thinner than **hair**. These thinner arteries are called **arterioles**. Arteries carry bright red blood. The color comes from the oxygen that it carries. From the heart side the arteries structure composed of three layers. The innermost layer is a thin layer of cells called **endothelium**. Endothelium is surrounded by a relatively thick middle layer of smooth muscle and elastic tissue. The artery's outer layer is connective tissue. The strong walls of an artery give it support when blood enters under pressure; the elastic tissue allows an artery to expand to absorb the pressure. **Arterioles** are small arteries barely visible to the naked eye. Whereas the

middle layer of arterioles has some elastic tissue, it is composed mostly of smooth muscle. When the fibers contract, the vessel constricts; when these muscle fibers relax, the vessel dilates. The constriction or dilation of arterioles controls blood pressure. When arterioles constrict, blood pressure rises.



2-Veins

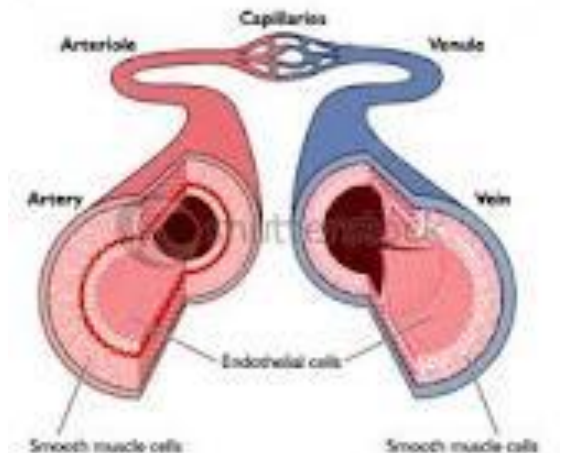
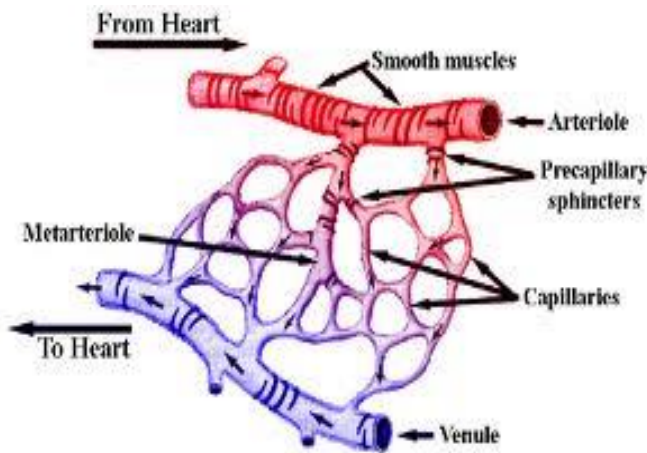
Veins carry blood back toward the heart. The smallest veins, also called **venules**, are very thin. They join larger veins that open into the heart. The veins carry dark red blood that doesn't have much oxygen. Veins have thin walls. They don't need to be as strong as the arteries because as blood is returned to the heart, it is under less pressure. There are term called **Venules** are small veins that drain blood from the capillaries and then join to form a vein. The walls of venules (and veins) have the same three layers as arteries. However, there is **less** smooth muscle in the middle layer of a vein and **less** connective tissue in the outer layer. Therefore, the wall of a vein is thinner than that of an artery. Veins often have **valves**, which allow blood to flow only toward the heart when open and prevent backward flow of blood when closed. Valves are extensions of the inner-wall layer and

are found in the veins that carry blood against the force of gravity, especially the veins of the lower extremities. The walls of veins are thinner, so they can expand to a greater extent. At any one time, about 70% of the blood is in the veins. In this way, the veins act as a blood reservoir. If blood is lost due to hemorrhaging, nervous stimulation causes the veins to constrict, providing more blood to the rest of the body. **Varicose veins:** Veins have leaflet valves to prevent blood from flowing backwards (retrograde). Leg muscles pump the veins to return blood to the heart, against the effects of gravity. When veins become varicose, the leaflets of the valves no longer meet properly, and the valves do not work. This allows blood to flow backwards and they enlarge even more (see figures below).

3- Capillaries

Capillaries are tiny blood vessels as thin as or thinner than the hairs on the head, found in the muscles and lung with very low blood pressure. Each capillary is an extremely narrow, microscopic tube with a wall composed only of **endothelium**. Capillaries connect arteries to veins. Food substances (nutrients), oxygen and wastes pass in and out of the blood through the capillary walls. Capillary endothelium is formed by a single layer of epithelial cells with a basement membrane. Capillary beds (networks of many capillaries) are present in all regions of the body, so no cell is far from a capillary and thus not far from gas exchange with blood. In the tissues, only certain capillaries are open at any given time. For example, after eating, the capillaries supplying the digestive system are open, whereas

most serving the muscles are closed. Rings of muscle called **precapillary sphincters** control the blood flow through a capillary bed.



Cardiovascular Disorders:

Cardiovascular disease (CVD) is the leading cause of death in Western countries. Modern research efforts have improved diagnosis, treatment, and prevention. Major cardiovascular disorders include **atherosclerosis**, **stroke**, **heart attack** and **hypertension**.

1- Atherosclerosis:

Atherosclerosis is due to a build-up of fatty material (*plaque*), mainly **cholesterol**, under the inner lining of arteries. The plaque can cause a *thrombus* (blood clot) to form. The thrombus can dislodge as an *embolus* and lead to *thromboembolism*.

2- Stroke and Heart Attack:

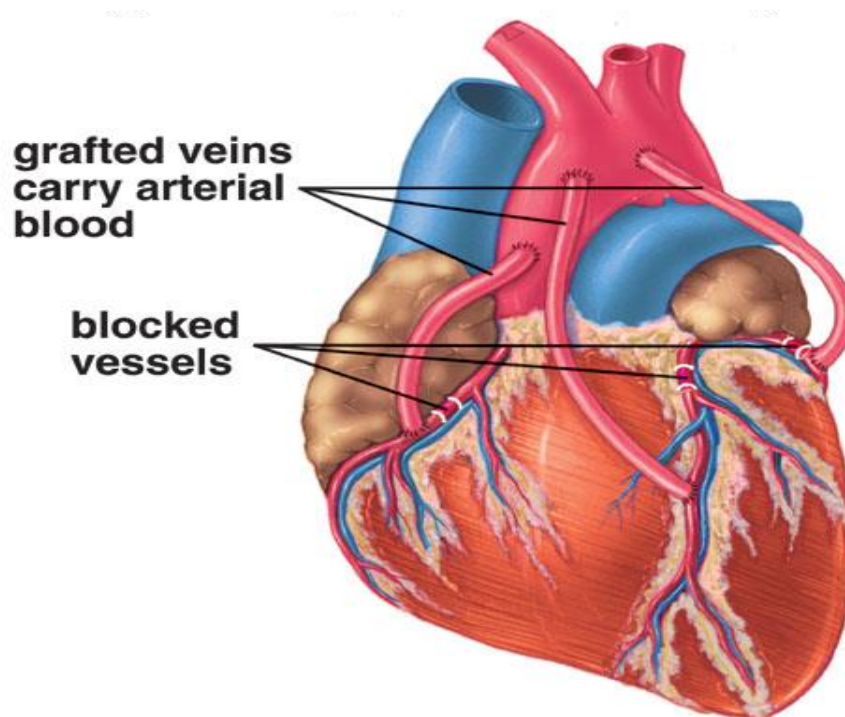
A ***cerebrovascular accident***, or *stroke*, results when an embolus lodges in a cerebral blood vessel or a cerebral blood vessel bursts; a portion of the brain dies due to lack of oxygen.

A ***myocardial infarction***, or *heart attack*, occurs when a portion of heart muscle dies due to lack of oxygen.

Partial blockage of a coronary artery causes *angina pectoris*, or chest pain.

3- Coronary Bypass Operations:

A *coronary bypass operation* involves removing a segment of another blood vessel and replacing a clogged coronary artery. It may be possible to replace this surgery with *gene therapy* that stimulates new blood vessels to grow where the heart needs more blood flow (see Figure below).

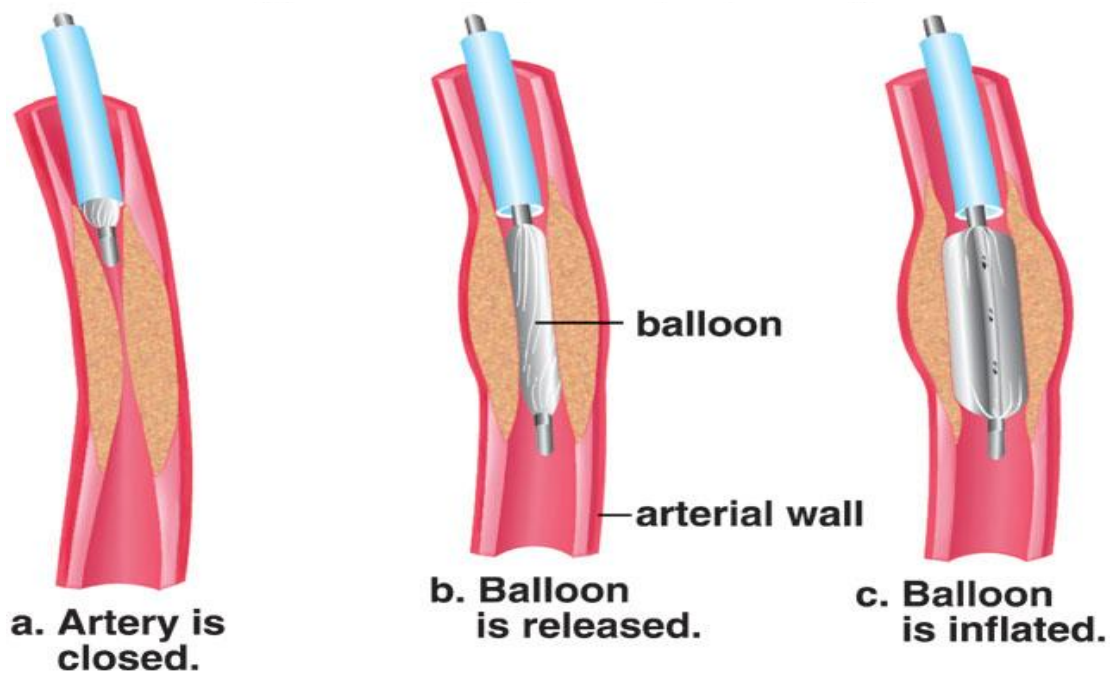


Clearing Clogged Arteries: 4-

Angioplasty uses a long tube threaded through an arm or leg vessel to the point where the coronary artery is blocked; inflating the tube forces the vessel open.

Small metal **stents** are expanded inside the artery to keep it open

Stents are coated with **heparin** to prevent blood clotting and with chemicals to prevent arterial closing.



Dissolving Blood Clots:

Medical treatments for dissolving blood clots include use of *t-PA (tissue plasminogen activator)* that converts plasminogen into plasmin, an enzyme that dissolves blood clots.

Aspirin reduces the stickiness of platelets and reduces clot formation and lowers the risk of heart attack.