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Unit 5 THE CIRCULATORY AND EXCRETORY SYSTEM

The internal medium

The internal medium is the name given to liquids (the interstitial plasma, lymph and blood) which establish contact between the cells and the exterior of the organism using the nutrition-related systems.

1.Interstitial plasma

It is a liquid with defensive and nutritional function which remains among the cells. It is made from the blood which has been filtered through the tiny walls of the blood capillaries.

2.Blood

It is the fluid through which the substances are transported along the blood vessels.

3.Lymph

It is a liquid which is made from the interstitial plasma and which runs through the lymphatic vessels. They are ducts which, after going across a big part of the organism, flow into the blood vessels.

Homeostasis

The good running of the cells depends on whether the internal medium maintains constant itself; that is, that its properties do not vary (composition, temperature, etc). The maintenance of these properties is called homeostasis. The definition of homeostasis is the ability or tendency to maintain internal stability in an organism to compensate for environmental changes. An example of homeostasis is the human body keeping an average temperature of 37 C degrees.

The circulatory system

The circulatory system transports nutrients, oxygen and residues around the body. It is made up of blood, blood vessels and the heart.

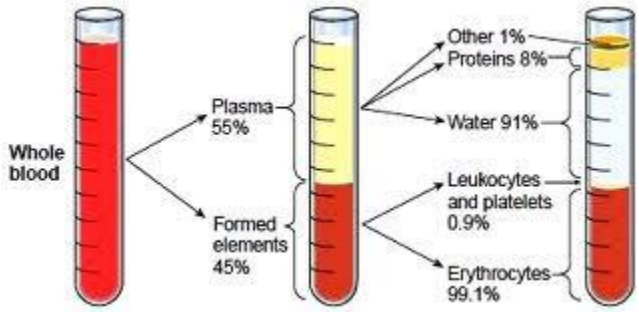
A)Blood: It is a thick, salty, red liquid which runs through the inner of the blood vessels. A healthy adult person usually has about five litres of blood, which represent about 8% of his body weight, even the blood volume varies with the age, the sex, the height, and the weight.

The functions of blood

Blood takes part in different body functions: Nutrition, · Respiration, · Excretion. · Defence. and · Temperature regulation.

Blood composition

The blood is composed of: Plasma and blood cells.



Plasma

It is a pale yellow liquid composed by 90% of water. It contains different substances dissolved; proteins, carbohydrates, lipids, urea, mineral salts and gases (oxygen, carbon dioxide and nitrogen).

Most of its properties are due to its proteins. The plasma without certain proteins is called blood serum. The process by which the plasma solidifies is called coagulation or clotting.

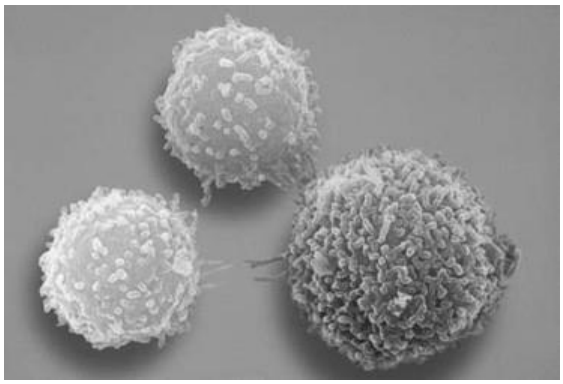
BLOOD CELLS

There are there types of blood cells: red blood cells, white blood cells, and platelets. All of them come from cells which are inside the red bone marrow, which is inside the bones of the skeleton.

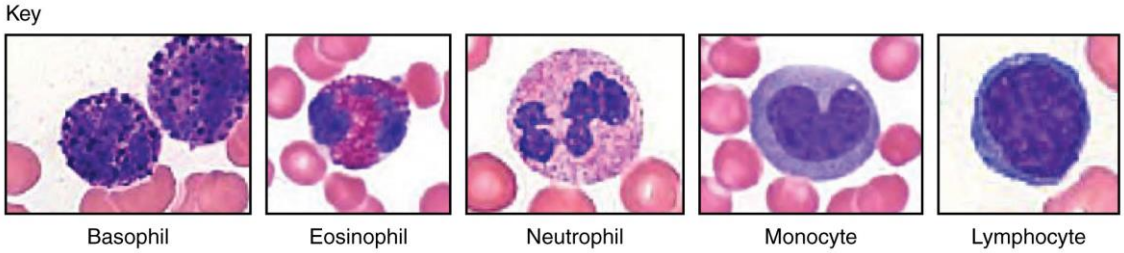
Red blood cells or Erythrocytes

Erythrocytes give the blood its colour and transport oxygen to the body cells and collect carbon dioxide. Erythrocytes have got a biconcave disk shape to give maximum surface area for absorbing oxygen. They are elastic and adaptable so that they can pass through the narrowest capillaries. Erythrocytes contain haemoglobin, a protein that combined with oxygen is very red, and which contains a lot of iron. Red blood cells have not got a nucleus, making more room for haemoglobin. In a healthy person there are from 4.5 to 5 millions erythrocytes per mm3 (one drop of blood), it supposes 45% of blood volume. The average life cycle of an erythrocyte is 120 days. The bones are continually producing new red blood cells, replenishing your supply.

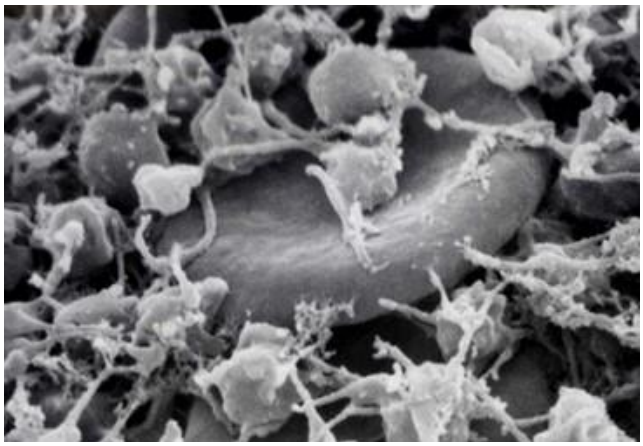
White blood cells or Leukocytes



Leukocytes protect us and defend us from infections and diseases. White blood cells have got a big nucleus and are bigger than erythrocytes. Leukocytes gobble up unwelcome micro-organisms. White blood cells produce antibodies to fight bacteria, and antitoxins to neutralise the toxins produced by bacteria. There are five types of leukocytes: Basophils, Eosinophils, Neutrophils, Monocytes, and Lymphocytes. In a healthy person there are from 5000 to 10000 leukocytes per mm3 (one drop of blood).



Platelets

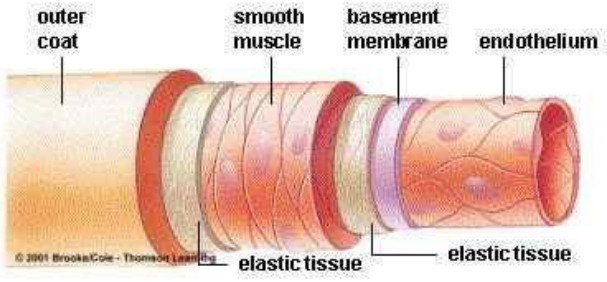


Platelets are small fragments of cells. Platelets have not got a nucleus. They block our wounds so this stops all your blood from pouring out and stops micro-organisms from getting in. In a healthy person there are from 150000 to 300000 platelets per mm3 (one drop of blood).

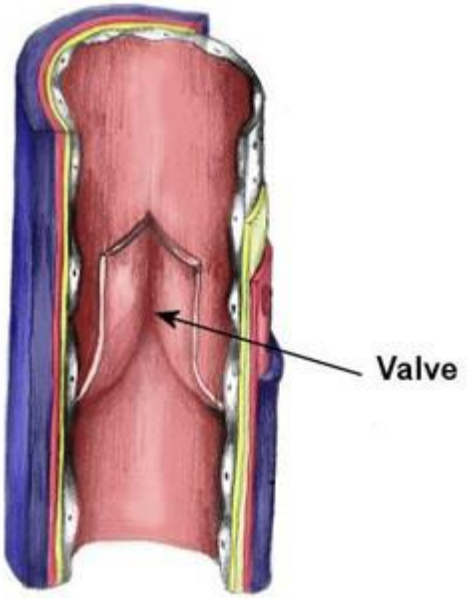
THE BLOOD VESSELS

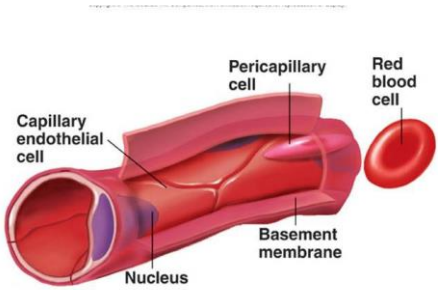
Blood vessels are the ducts through which the blood circulates, pushed by the heart. There are three types:

Arteries



Arteries carry the blood from the heart to the organs. The blood comes out of the heart at high pressure, so the artery walls have to be strong, muscular, and elastic. The size of the lumen (the hole down the middle) of the artery is small in comparison with the thick of its wall. Arteries branch out in smaller vessels called arterioles. In arteries the movement is not smooth, the blood flows in pulses.





Veins

Veins carry the blood from the organs to the heart. The blood travels at a very low pressure in the veins so the walls do not need to be so thick and muscular. Veins have got a bigger lumen than arteries to help the blood flow. Veins have got valves to help keep the blood flowing in the right direction to the heart, and to prevent its back flow.

Capillaries

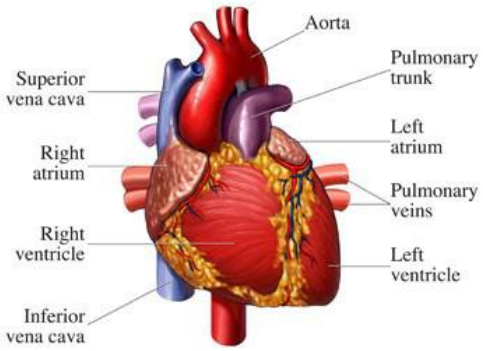
Capillaries are very small vessels that connect the veins and arteries and reach the cells in our body. Capillaries use diffusion to deliver nutrients and oxygen direct to the body tissues and take carbon dioxide and urea away. Their walls are only one cell thick to make it easy for gases and substances to pass in and out of them. A network of collection of capillaries is known as a capillary bed.

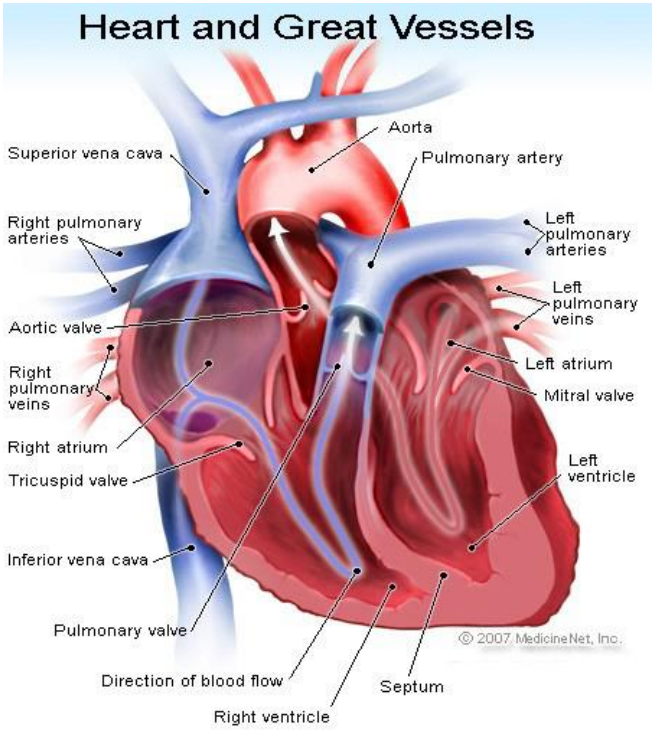
THE HEART

The heart is a hollow muscular organ about the size of your fist which pumps blood around the blood vessels. It is located slightly left to the centre of your chest, between the two lungs. The heart is made up of a special kind of muscle called myocardium

The heart is surrounded by an outer double-walled membrane called the pericardium. Between them there is some pericardial fluid which functions to permit the inner and outer walls to slide easily over one another with the heart movements The heart is lined by a thin tissue layer called the endocardium that is in contact with the blood.

The heart pumps about 4.7-5.7 litres of blood per minute, and it beats about 100 000 times in one day. That is about 35 million times a year.





Parts of the heart

The heart is divided into two unconnected parts, the right and the left side. The division protects oxygen-rich blood from mixing with oxygen-poor blood.· The left side of the heart receives oxygen-rich blood from the lungs and pumps it out round the whole body, so it has got thicker, more

muscular walls. The right side of the heart receives oxygen-poor blood from the body and pumps it only to the lungs, so it has got thinner walls than the left side.

Each part is also divided into two parts: The upper part and the lower part.

· The upper part is the auricle or atrium.

· The lower part is the ventricle. The ventricles are much bigger than the atria because they push blood round the body

The atrium and ventricle are connected by a valve called atrioventricular valve (AV) that prevent backflow of the blood.

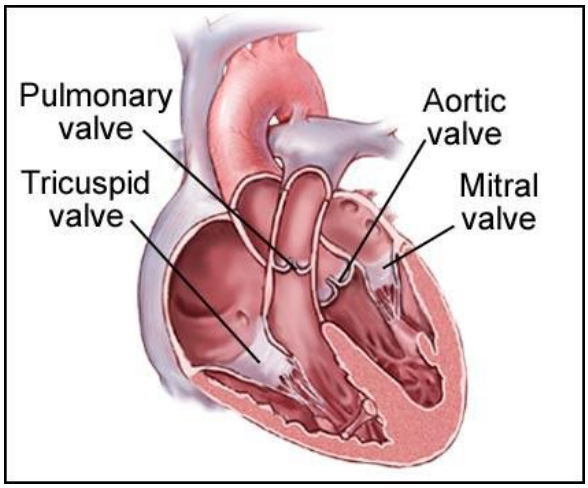
The valves

The heart has got four valves. The valves are made up of two or three small but strong leaflets of tissue called flaps. The valves work like the gates of a fence; they open only one way, and only when are pushed on, keeping the blood in the heart always flowing in the same direction. The opening and closing of the valves is controlled by blood pressure changes within each heart chambers.

Each valve opens and closes once per heartbeat, or about once every second. There are two valves which separate atria from ventricles:

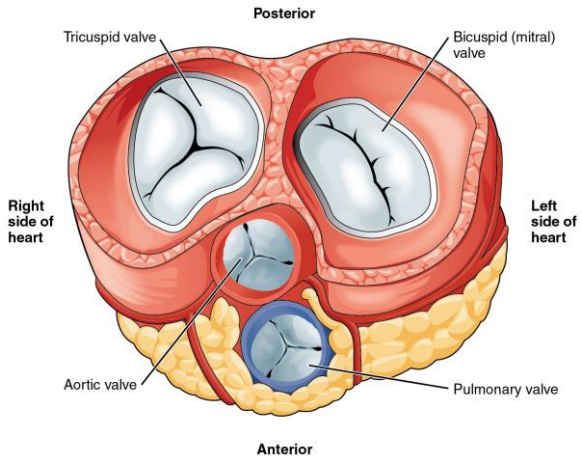
-Mitral valve or left AV valve.

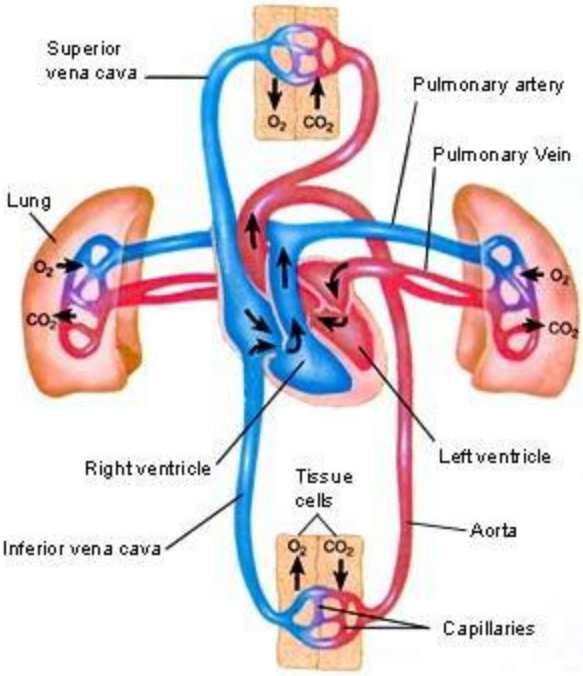
-Tricuspid valve or right AV valve.



The cardiac muscle contracts and relaxes, on average, 70 times per minute. Each contraction is called a heartbeat. The release of blood from the ventricles is regulated by the:

-Pulmonary and Aortic Valve.





BLOOD CIRCULATION

In human beings, blood travels round via pulmonary circulation and systemic circulation, for this reason our circulation is double and complete.

Pulmonary circulation

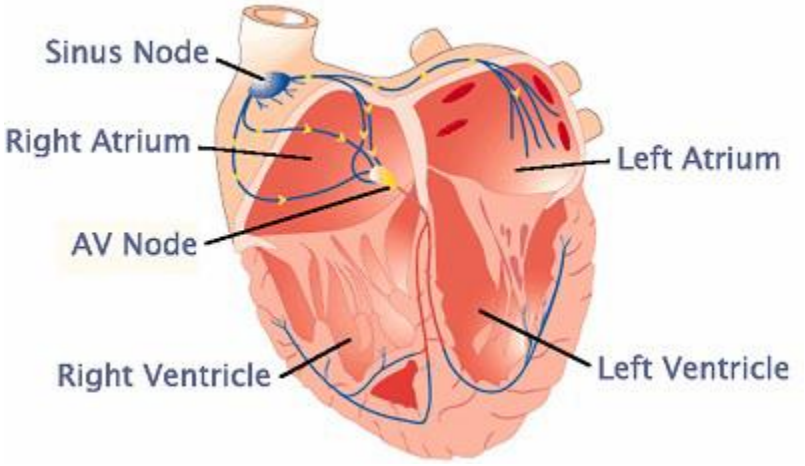
Blood with oxygen-poor blood; carbon dioxide, nutrients and waste substances from the body, enters through the superior and inferior vena cava into the right atrium. The blood is pumped through the pulmonary trunk to the lungs where it is oxygenated. From the lungs, four pulmonary veins, two for each lung, return the oxygen-rich blood to the heart, where it enters the left atrium.

Systemic circulation

Oxygen-rich blood from the left ventricle is pumped out through the aorta into the rest of the body to supply tissues and cells with oxygen. The arteries branch out into capillaries that transport the oxygen and the nutrients to the tissues and cells of the body.

The oxygen-poor blood flows back to the heart through the two venae cavae. The pulmonary circulation starts again.

THE CARDIAC CYCLE



The cardiac cycle is the series of events which makes up one complete pumping action of the heart, and which can be heard as the heartbeat (about 70 times a minute). The heart has got electrical wiring which keeps it beating. Electrical impulses begin high in the right atrium, in an área called the sinoatrial node. Then they travel through a special pathway, the atrioventricular node, where the signal is checked. Finally, the electrical impulses reach the ventricles, delivering the signal to pump, and they contract.

Sometimes the sinoatrial node is referred to as the heart's natural pacemaker, since it keeps the heart rate constant and consistent. The heart rate can change depending on external conditions such as diet, physical exercise, stress, or even hormonal factors.

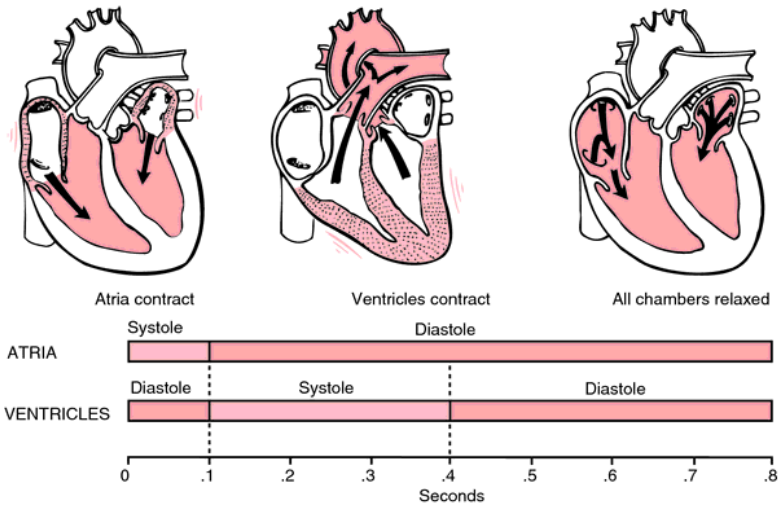
The cardiac cycle is made up of three phases:

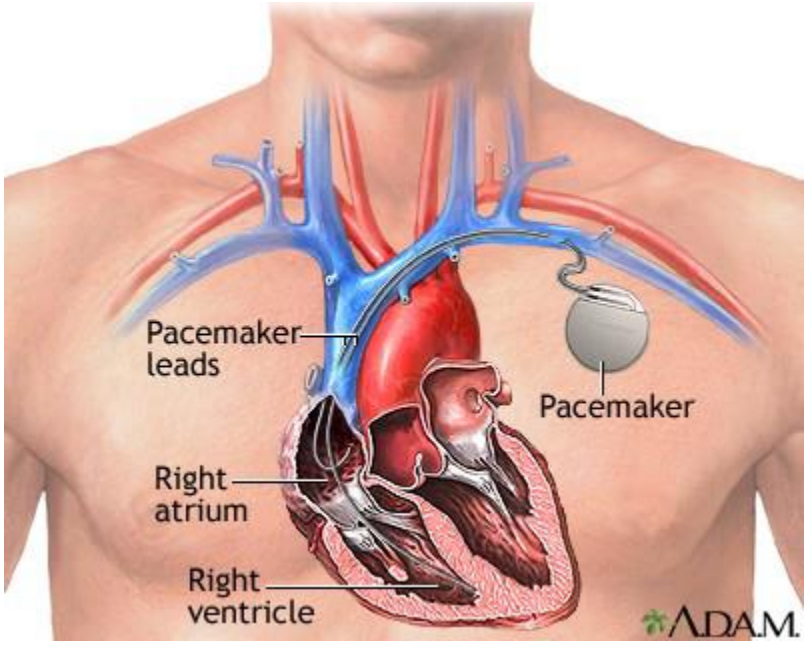
1. Both atria contract and pump blood into their respective ventricles, which relax to receive it.

2. The atria relax and take in blood.

3. The ventricles contract to pump the blood into the aorta and the pulmonary trunk. The right ventricle contracts a Little bit before the left ventricle does.

The ventricles are much more powerful than the atria, so when they beat, the heart valves shut automatically to prevent backflow.





As soon as the ventricles relax, the valves at the start of the arteries shut to prevent backflow of blood into the ventricles. The relaxing phase of a chamber is its diastole phase; the contracting phase is its systole phase. There is a short pause after the systole phase of the ventricles, during which all chambers are in diastole phase (relaxing).

THE LYMPHATIC SYSTEM AND THE INTERNAL MEDIUM

The exchange of substances between the circulatory system and the cells is not carried out directly, because the capillaries and the cells are not in direct contact; between them there is a liquid called interstitial plasma.

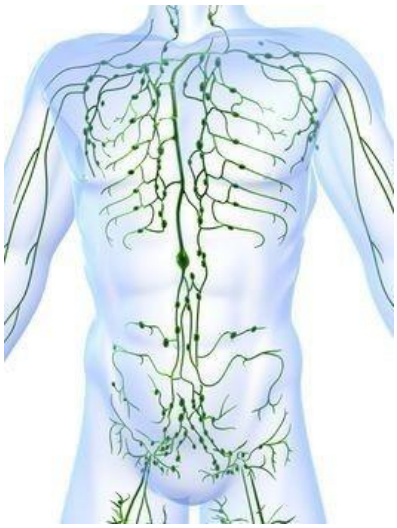
So that our organism can function correctly, the composition of the interstitial plasma must remain constant. The lymphatic system intervenes in this function.

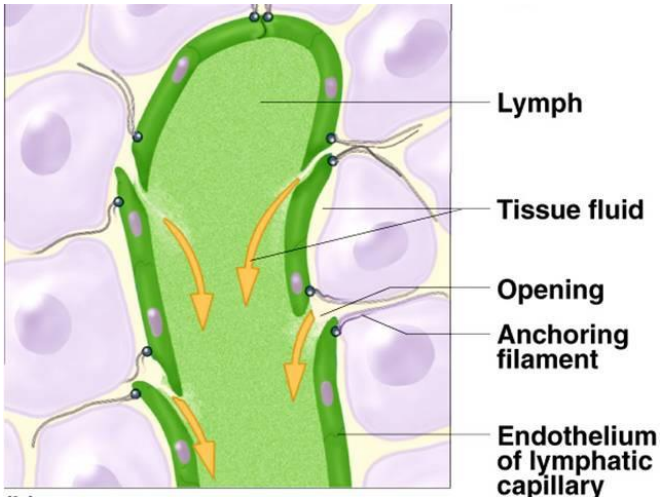
The lymphatic system

The lymphatic system is a circulatory system that transports lymph, important in the recycling of body fluids and in the fight against diseases. Lymph is a clear liquid that is formed from the interstitial plasma.

The lymphatic system is composed of the lymph capillaries, the lymph vessels and the lymph nodes (which are the swelling of the lymph vessels where white blood cells are made) The lymphatic system has not got a pumping organ like the circulatory system.

The lymph moves around propelled by the movement of the body, i.e. when the contractions of the muscles that surround the lymph vessels push it. The lymphatic system collects the surplus interstitial plasma between the cells and returns it to the blood. The lymphatic system transports fats as well, which are absorbed in the intestine and participates in the defence of the organism, as it produces white blood cells.





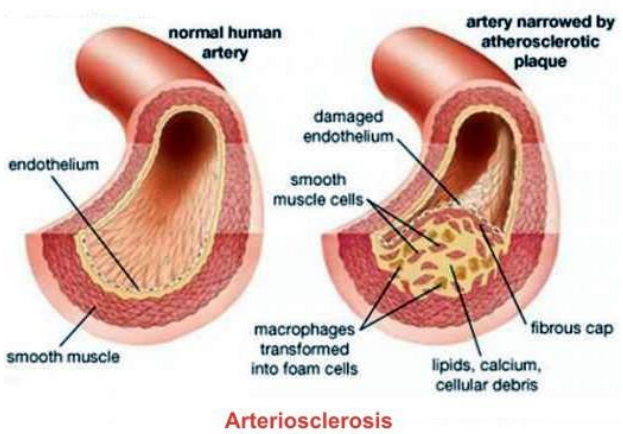
CIRCULATORY SYSTEM DISEASES

The diseases which affect the heart and the blood vessels are called cardiovascular diseases.

Arteriosclerosis

The arteriosclerosis is also called hardening of the arteries. It is a chronic disease characterized by abnormal thickening and hardening of the walls of arteries, with a resulting loss of elasticity.

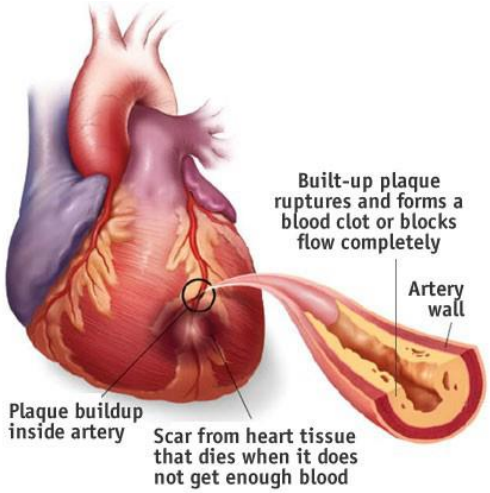
The major form of arteriosclerosis is atherosclerosis, in which plaques of fatty deposits, or atheromas, form on the inner walls of the arteries. When this atheromas or thrombus detaches from the wall of arteries, they can reach vital organs such as the heart, the brain or the lungs, blocking the blood flow and making a thrombosis.



Heart attack or myocardial infarction

The arteriosclerosis can affect any artery of the organism, but it is especially serious when it hurts. The coronary arteries are responsible for the supplying of nutrients and rich-oxygen blood to the cardiac muscle. The cardiac muscle tissue, which is fed by the coronary artery beyond the point of

the blockage, is deprived of oxygen and nutrients when these two things happen: When cholesterol plaque accumulates to the point of blocking the flow of blood through a coronary artery. When there is a thrombus in any coronary artery.



This area of cardiac muscle tissue ceases to function properly. The condition when a coronary artery becomes blocked causing damage to the cardiac muscle tissue it serves is called a myocardial infarction or heart attack.

The heart attack shows up with strong and prolonged pain and pressure in the chest, which can spread to arms and shoulders, back, and even teeth and maxillas. This can cause the death of the person.

Angina

If the obstruction of some coronary artery is partial, the heart is forced to make a biggest effort and the organism is unable to increase the blood flow, and this triggers an angina.

Cardiovascular health

The cardiovascular diseases are the main cause of death in the western world. To avoid them, it is important to have healthy habits such as:

-Physical exercise

Playing sports keep fit the body, making easier the blood transport through the vessels and the working of the heart. The sport must be suitable to the age and characteristics of each person.

-Good feeding

An inadequate diet can produce the building up of fats and cholesterol. A part of these substances builds up in the arteries and provoke arteriosclerosis. Besides, the overweight increases the heart attack risk.

-No smoking

The nicotine hardens the artery walls, which complicates the blood transport and forces the heart to work harder. This decreases the blood flow of all organs and increases the risk of undergoing a heart attack.

The Excretory System.

As blood flows through the body, the cells empty their waste. This waste must be eliminated before it builds up and causes damage.

The removal of waste from the body is called excretion.

Excretion is the process by which the waste products, which come from the cellular metabolisms, are eliminated from the blood.

We expel waste through the excretory system which consists of:

· The urinary system which expels the waste in form of urine.

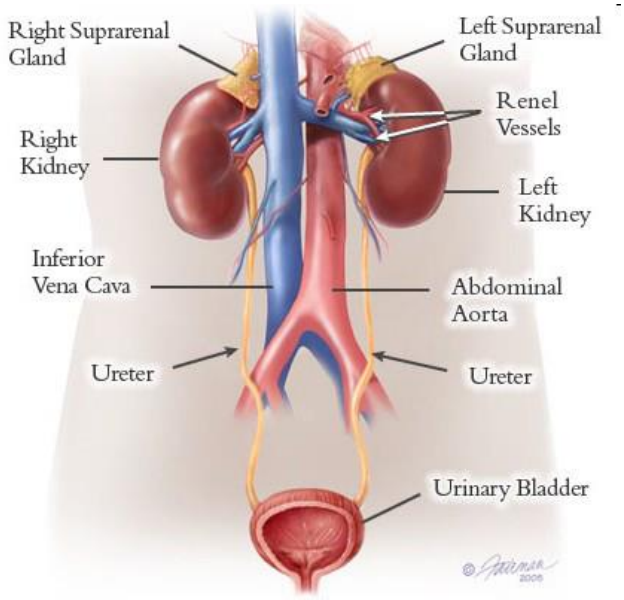
· The sweat glands which expel the waste in form of sweat.

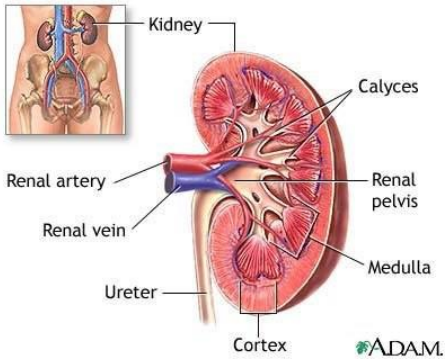
· The lungs which expel the waste in form of carbon dioxide.

· The liver which expels the waste in form of cellular rest.

The urinary system

The urinary system is concerned with the formation and elimination of urine. The urinary system includes the kidneys and the urinary tract.





Kidneys

The kidneys are two bean-shaped organs at the back of the body below the ribs which filter the blood. They extract toxic substances from the blood and form urine. In 24 hours, your kidneys filternaround 150 litres of blood and produce roughly 1.5 litres of urine.

A cross section of a kidney shows three parts:

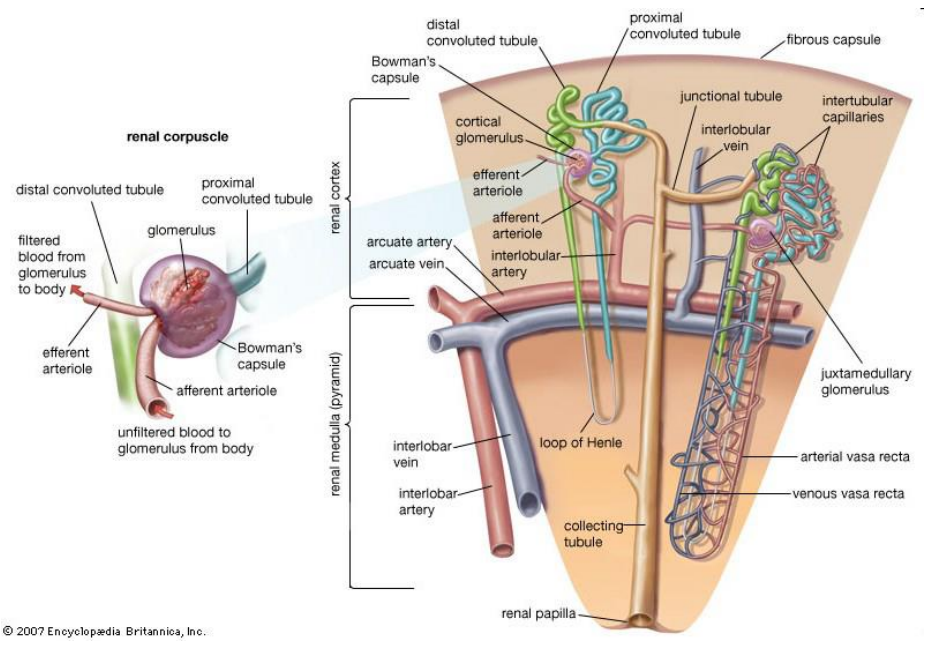
-The cortex. It is the outer region of the kidney.

-The medulla. It is the inner region of the kidney, where the urine is produced.

-The renal pelvis. It lies at the core of the kidney, a funnel-shaped chamber which collects the urine and leads it into the urinary tract.

The blood enters a kidney via a renal artery and leaves it via a renal vein.

A kidney consists mostly of more than one million tiny filtering units called nephrons.



Nephron

· The nephron is a highly specialized coiled tubule measuring up to one inch (2.54 cm) in length. Each nephron consists of a renal corpuscle, and a renal tubule.

Renal corpuscle

They are the bodies which filter fluids out of the blood. It is housed in the cortex of the kidney. Each renal corpuscle consists of abGlomerulus and a Bowman's capsule.

Renal tubules

They are long tubes, each one leading out from a Bowman's capsule. It is housed in the medulla of the kidney.

Each renal tubule has got three main parts: The proximal convoluted tubule, The loop of Henle, and The distal convoluted tubule

Nephrons are the filtration units in the kidneys

1. Ultrafiltration:

A high pressure is built up which squeezes water, urea, amino acids, vitamins, ions and glucose out of the blood and into the Bowman's capsule. However, big molecules like proteins are not squeezed out and stay in the blood.

2. Reabsortion:

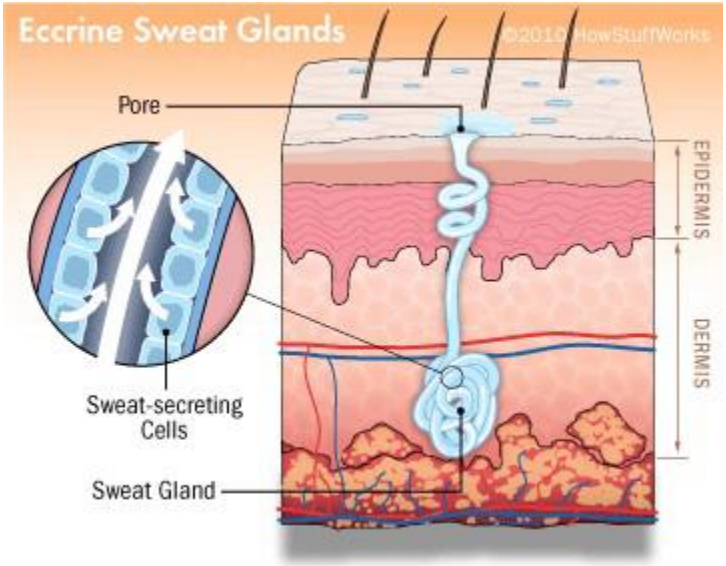
As the liquids flow along the next nephron section, the renal tubule, useful substances from the filtrate are reabsorbed into the blood vessels which surround this section called peritubular capillaries. It is a plexus derived from the efferent arteriole leaving the Renal corpuscle: All the sugar, amino acids, and vitamins are reabsorbed. This involves the process of active absorption against the concentration gradient.

3. Secretion:

Secretion occurs in the distal convoluted tubule. Some waste: Ammonia, uric acid, hydrogen ion, and penicillin are secreted from blood vessels into the renal tubule.

Sweat glands

Our skin has got millions of sweat glands which produce sweat, a liquid similar to the urine.



EXCRETORY SYSTEM DISEASES

When the excretion organs are malfunctioning, toxic substances are stored inside the body.

The most frequent causes of the diseases in the excretory tracts are due to functional disorders of them or to the presence of some microorganisms. Tha main diseases are:

Renal colic

The renal colicIt is produced by the accumulation of calculi or stones of mineral salts. The calculus can stay inside the kidney or move through the urinary tract.

Cystitis

Cystitis is the swelling of the bladder's wall or the urinary tract. It is produced by the infection of some microorganisms.

Prevention

To avoid the show up of the excretory system diseases, it is necessary to keep some healthy habits, such as:

-Hygiene

An adequate hygiene of the urinary tract is very important. We must clean our hands after the urination in order to avoid microorganisms. At the same time we must maintain our skin in good conditions due to the fact that it protects us of injuries and it is a barrier in front of many pathogenic microorganisms. To clean diary your skin with water and soap daily avoids the obstruction of the pores which are the exit of the sweat.

-Adequate feeding

The moderate consumption of uric acid rich foods, such as sea food or red meat, avoids the showing up of renal colics. At the same time, the consumption of acid fruits (strawberry, oranges, lemons) helps to make the urine acid, making an inadequate environment for the growing of microorganism.

-To drink abundant water.

The doctors recommend having, at least, one and a half litre of water per day. It is a way to ease the good functioning of the kidneys, which makes waste in the urine to be eliminated easily. When the ingestion of water is low, a person can dehydrate, so his tissues stop their good functioning. The kidneys try to keep the water and excrete a high concentrated urine .

ACTIVITIES

1. What is the function of the internal medium? What liquid is it made of?

2. How is the interstitial plasma formed?

3. What does homeostasis mean?

4. Define capillaries, artery, and vein.

5. Give two differences in structure between an artery and vein. What differences are there between them?

6. The capillaries have got a very thin epithelium. What process occurs through this epithelium?

7. When you have got an injury, how do you know if a vein or an artery has been damaged?

8. What are the functions of the pulmonary and the aortic valves? Where are they situated?

9. What is the function of the coronary arteries?

10. Why do they say that the blood circulation is double and complete?

11. What is a heartbeat?

12. What is the basic function of the kidneys? What three particular things do they deal with?

13. What is a neprhon? What are its functions?

14. What is the difference between the blood which enters the kidney and the one which exits?

15. Describe how a sweat gland works.