Chapter 18 Body Fluids and Circulation

In the CBSE Class 11 Biology chapter on "Body Fluids and Circulation," students learn about how fluids move around the body. They study blood, which carries nutrients and oxygen to different parts of the body and removes waste.

Blood contains red blood cells, white blood cells, and platelets. This chapter also covers the circulatory system, which includes the heart and blood vessels. It explains how these parts work together to keep the body healthy. These notes are provided in this chapter help students understand these topics easily.

Blood

Blood is a vital fluid in our bodies that circulates through our blood vessels, carrying essential substances to different parts of the body. It consists of several components, including red blood cells (which carry oxygen), white blood cells (which fight infection), platelets (which help in blood clotting), and plasma (a liquid that carries nutrients, hormones, and waste products).

Blood plays a important role in transporting oxygen and nutrients to cells, removing waste products, maintaining body temperature, and defending against infections and diseases. It is pumped by the heart and flows through a network of arteries, veins, and capillaries, ensuring that all organs and tissues receive the necessary nourishment and oxygen for their proper functioning.

Plasma

Blood plasma is a crucial component of blood, making up about 55% of its total volume. It is a straw-colored, viscous fluid that serves as the matrix for blood cells. Plasma contains various proteins, including fibrinogen, globulins, and albumins. Fibrinogen plays a key role in blood clotting, helping to stop bleeding when injury occurs.

Albumins help maintain the body's osmotic balance, ensuring that the right amount of water is retained in tissues. Globulins are proteins that aid in immune function, fighting off infections and inflammation. Plasma contains important minerals like sodium, calcium, and magnesium ions, as well as bicarbonate ions, which help maintain the body's pH balance and support nutrient transport.

Amino acids and glucose are also present in plasma, providing essential nutrients for cells throughout the body. Overall, plasma plays a vital role in transporting nutrients, removing waste products, and maintaining the body's overall health and equilibrium.

Formed Elements

Formed elements are essential components of blood, consisting of erythrocytes (red blood cells), leukocytes (white blood cells), and platelets. Each type of cell plays a specific role in maintaining the body's health and functionality.

Erythrocytes, or red blood cells, are responsible for carrying oxygen to tissues and removing carbon dioxide. They are produced in the bone marrow and have a characteristic biconcave shape with no nucleus. Erythrocytes are the most abundant type of blood cell.

Leukocytes, or white blood cells, play a crucial role in the immune system, defending the body against infections and foreign invaders.

They are divided into two main categories: granulocytes and agranulocytes. Granulocytes include neutrophils, basophils, and eosinophils, while agranulocytes include lymphocytes and monocytes.

Neutrophils are the most numerous and function as phagocytic cells, engulfing and destroying pathogens. Basophils secrete inflammatory substances like histamine, while eosinophils are involved in allergic reactions.

Platelets, also known as thrombocytes, are fragments of larger cells called megakaryocytes and play a crucial role in blood clotting. They help seal off blood vessels and prevent excessive bleeding in case of injury or trauma.

Maintaining proper levels of formed elements is essential for overall health, as any imbalance can lead to various health issues, including anemia, infections, and bleeding disorders.

Groups of Blood

The ABO blood grouping system categorizes blood into four main types: A, B, AB, and O. These classifications are based on the presence or absence of specific antigens on the surface of red blood cells (RBCs). The two primary surface antigens are labeled as A and B. Blood type A has antigen A on its RBCs, blood type B has antigen B, blood type AB has both antigens A and B, and blood type O has neither antigen A nor B.

This system is crucial for determining blood compatibility for transfusions and plays a significant role in medical procedures and treatments.

Rhomboid Classification

The Rh factor, named after the Rhesus monkeys in which it was first discovered, is an antigen found on the surface of red blood cells (RBCs). Individuals with this antigen are considered Rh-positive, while those without it are Rh-negative. If an Rh-negative person receives Rh-positive blood, their body may produce antibodies against the Rh antigen, leading to potential complications in future transfusions.

During pregnancy, an Rh-negative mother carrying an Rh-positive fetus can develop antibodies against the Rh antigen if the blood mixes during childbirth. This can result in a condition known as erythroblastosis fetalis, where the mother's antibodies attack the fetus's RBCs, leading to anemia and jaundice in the newborn.

To prevent this, Rh-negative mothers are typically given injections of anti-Rh antibodies after the birth of their first child carrying an Rh-positive blood type. This helps prevent the development of Rh antibodies and reduces the risk of complications in subsequent pregnancies.

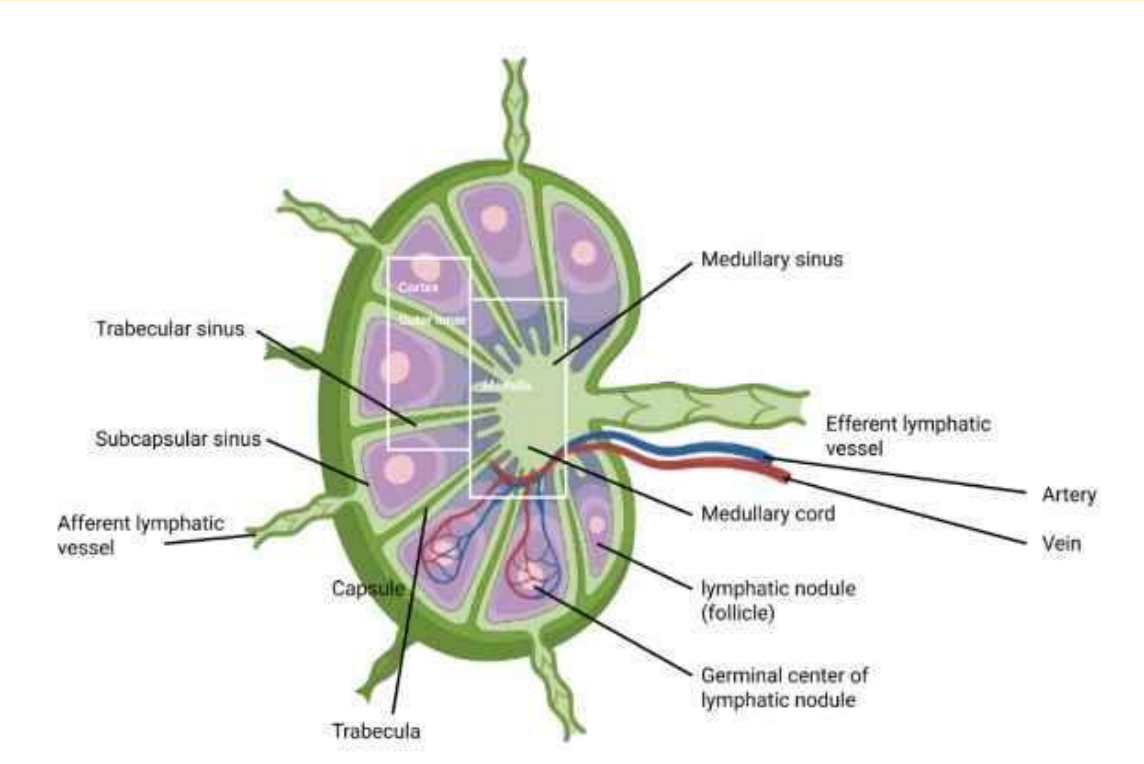
Coagulation of Blood

Blood clotting, also known as blood coagulation, is a natural process that occurs in response to injury or trauma to prevent excessive blood loss. When a person is injured, a clot forms at the site of the injury, which appears as a reddish-brown scab over time. This clot, medically known as a fibrin clot, is composed of a network of fibrils, which are threads formed from fibrinogen, a protein in the blood plasma.

When activated by the enzyme thrombin, fibrinogen is converted into fibrin, which forms the structural framework of the clot. Platelets

release certain substances that help initiate and promote the clotting process. Calcium ions play a crucial role in blood coagulation, aiding in the activation of various clotting factors. Overall, blood clotting is essential for wound healing and preventing excessive blood loss in the body.

Lymph



Lymph is another important fluid found in the body, alongside blood. As blood circulates through blood capillaries in tissues, some water and water-soluble compounds leak into the interstitial spaces. This fluid, known as tissue fluid or interstitial fluid, fills the spaces between cells and tissues.

The lymphatic system consists of a network of tubes that collect this interstitial fluid and transport it back to the main veins. This fluid collected by the lymphatic system is called lymph. Lymph contains

various components, including lymphocytes, which are a type of white blood cell crucial for the immune system's functioning.

Overall, the lymphatic system plays a vital role in maintaining fluid balance in the body and supporting the immune system's functions by transporting lymphocytes and other immune cells.

Pathways of Circulation

The circulatory systems in animals can be broadly categorized into two types: the open circulatory system and the closed circulatory system. In an open circulatory system, blood flows through lacunae and sinuses, bathing the organs directly. This type of circulation is commonly found in invertebrates like molluscs and arthropods.

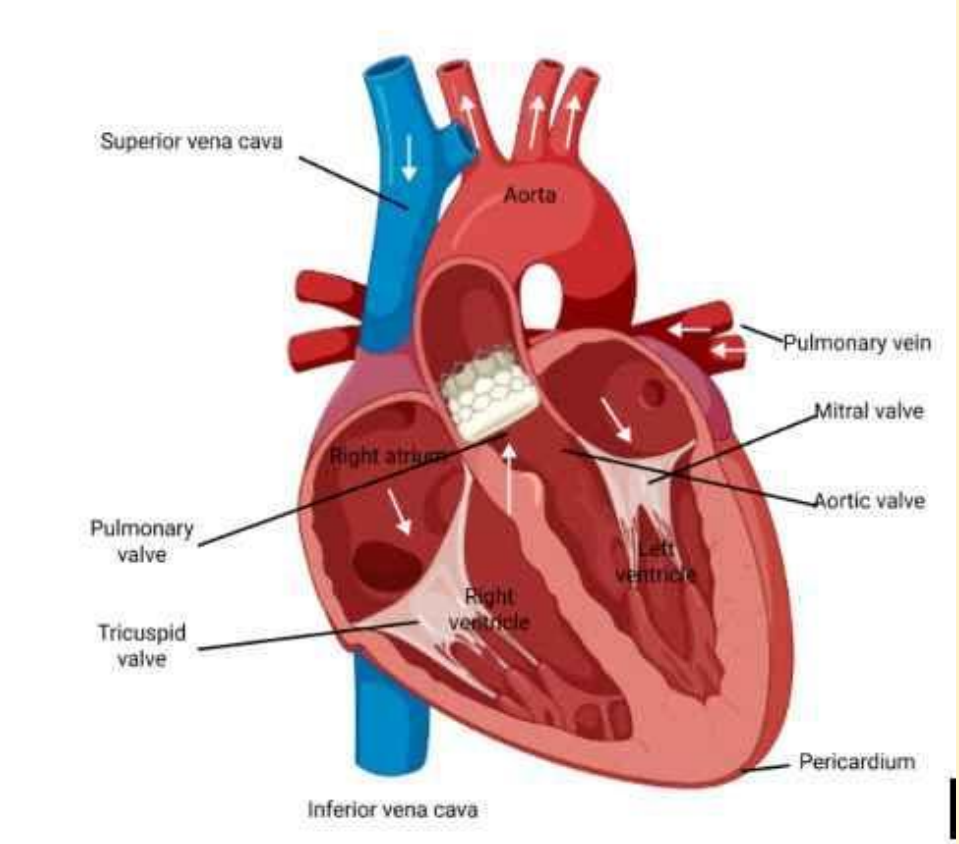
On the other hand, vertebrates, including humans, have a closed circulatory system where blood flows within vessels, such as arteries, veins, and capillaries. The heart, a muscular pumping organ, plays a central role in this system.

In fishes, the heart typically consists of two chambers: one atrium and one ventricle. Amphibians, except for crocodiles, have three-chambered hearts, while birds, reptiles, and mammals, including humans, have four-chambered hearts. These four chambers include two atria and two ventricles, allowing for efficient separation of oxygen-rich and oxygen-poor blood.

Circulatory System of the Human Body

The human circulatory system is comprised of the heart, blood vessels, and blood itself. The heart, a mesodermal organ, is situated in the thoracic cavity between the lungs. It is protected by a double

membrane called the pericardium, which surrounds the pericardial fluid. The heart consists of four chambers: two atria and two ventricles. These chambers are separated by walls called septa.



Valves within the heart ensure that blood flows in the correct direction. The tricuspid valve guards the opening between the right atrium and the right ventricle, while the mitral valve, or bicuspid valve, protects the opening between the left atrium and the left ventricle. Semilunar valves are located at the exits of the right and left ventricles into the pulmonary artery and aorta, respectively.

Composed of cardiac muscle, the heart contracts rhythmically to pump blood throughout the body. Specialized nodal tissue, including the sinoatrial (SA) node and atrioventricular (AV) node, coordinates this rhythmic contraction. The SA node, situated in the right atrium, acts as the heart's natural pacemaker, generating electrical impulses.

These impulses travel through the AV node and along the atrioventricular bundle and Purkinje fibers, causing the heart muscle to contract and pump blood effectively.

Cycle of the Heart

The cardiac cycle is the series of events that occur during each heartbeat, involving both electrical and mechanical processes. It consists of two main phases: diastole and systole.

During diastole, the heart's ventricles relax, allowing blood to flow into them. This is followed by atrial systole, where the atria contract, increasing blood pressure in the atria to push blood into the ventricles. At this stage, the AV valves are open while the semilunar valves are closed.

Next comes ventricular systole, where both the right and left ventricles contract, further increasing blood pressure to pump blood into the arteries. Here, the AV valves close and the semilunar valves open to allow blood to exit the heart.

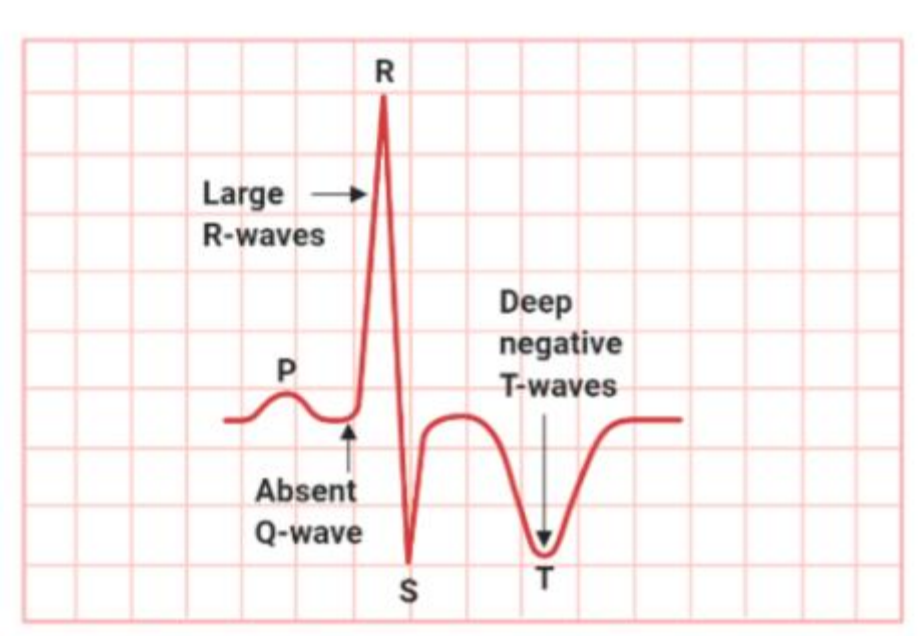
Finally, cardiac diastole occurs as the heart relaxes to fill with blood again. During this phase, both the atria and ventricles relax together. The mitral valve opens when the left ventricular pressure decreases below the left atrial pressure, allowing blood to fill the left ventricle. Similarly, the tricuspid valve opens when the right ventricular pressure falls below the right atrial pressure, allowing blood to fill the right ventricle.

Throughout the cardiac cycle, the heart maintains a rhythmic pattern of contraction and relaxation, ensuring continuous circulation of blood throughout the body.

The Sound of the Heart

The heartbeat produces a distinctive "lubb-dubb" sound. The first sound, "lubb," occurs when the mitral and tricuspid valves close at the beginning of ventricular systole. The second sound, "dubb," happens when the aortic and pulmonary valves close at the end of ventricular systole.

ECG



An electrocardiogram (ECG) is a graphical representation of the heart's electrical activity during the cardiac cycle. It consists of several peaks denoted by letters from P to T.

- P-Wave: Represents atrial electrical stimulation and atrial depolarization.
- QRS Complex: Represents ventricular depolarization and the onset of ventricular contraction.

- T-Wave: Represents ventricular repolarization, indicating the restoration of ventricles to their resting state after excitation.

Double circulation is a circulation system where blood passes through the heart twice in a single cycle. It includes pulmonary circulation, where blood circulates between the heart and lungs for oxygenation. This system ensures efficient oxygenation of blood before it is pumped to the rest of the body.

The Autonomic Nervous System (ANS) regulates heart activity through the neural center in the medulla oblongata. The sympathetic nervous system increases heart rate and ventricular contraction strength, thereby increasing cardiac output. Hormones from the adrenal medulla can also influence cardiac output.

Circulatory System Disorders

Disorders of the circulatory system can affect the heart, blood vessels, and blood itself. Some common circulatory system disorders include:

Coronary Artery Disease (CAD): This condition occurs when the blood vessels supplying the heart (coronary arteries) become narrowed or blocked due to the buildup of plaque (atherosclerosis). It can lead to chest pain (angina), heart attack, or heart failure.

Hypertension (High Blood Pressure): High blood pressure can damage blood vessels over time, increasing the risk of heart disease, stroke, and kidney problems.

Stroke: Stroke occurs when blood flow to part of the brain is blocked or reduced, depriving brain tissue of oxygen and nutrients. This can result in brain damage and neurological deficits.

Peripheral Artery Disease (PAD): PAD is a condition in which narrowed arteries reduce blood flow to the limbs, usually the legs. It can cause leg pain, cramping, and difficulty walking.

Aneurysm: An aneurysm is a bulge or ballooning in a blood vessel caused by weakness in the vessel wall. Aneurysms can rupture, leading to severe bleeding and life-threatening complications.

Deep Vein Thrombosis (DVT): DVT occurs when a blood clot forms in a deep vein, usually in the legs. If the clot breaks loose and travels to the lungs, it can cause a pulmonary embolism, a serious and potentially fatal condition.

Arrhythmias: Arrhythmias are abnormal heart rhythms that can cause the heart to beat too fast, too slow, or irregularly. They can lead to symptoms such as palpitations, dizziness, and fainting.

Heart Failure: Heart failure occurs when the heart cannot pump enough blood to meet the body's needs. It can result from conditions such as CAD, hypertension, or previous heart damage.

Atherosclerosis: Atherosclerosis is a condition in which fatty deposits (plaques) build up inside the arteries, narrowing them and restricting blood flow. It is a major risk factor for heart attack, stroke, and peripheral artery disease.

Thrombosis: Thrombosis is the formation of a blood clot (thrombus) inside a blood vessel. Depending on where the clot forms, it can cause

various complications, including heart attack, stroke, or pulmonary embolism.