Body Fluids and Circulation Class 11 Study Notes

Blood

Before we find out about body fluids and circulation, let us talk about the most important fluid in our body, blood! Blood is a connective tissue comprising:

- Fluid matrix
- Plasma
- Formed elements

We will now talk about these important components of blood.

Fluid matrix

The fluid matrix mainly comprises highly specialized cells suspended in the liquid matrix. These cells serve a particular function. The fluid matrix of the cell is also called Plasma.

Plasma

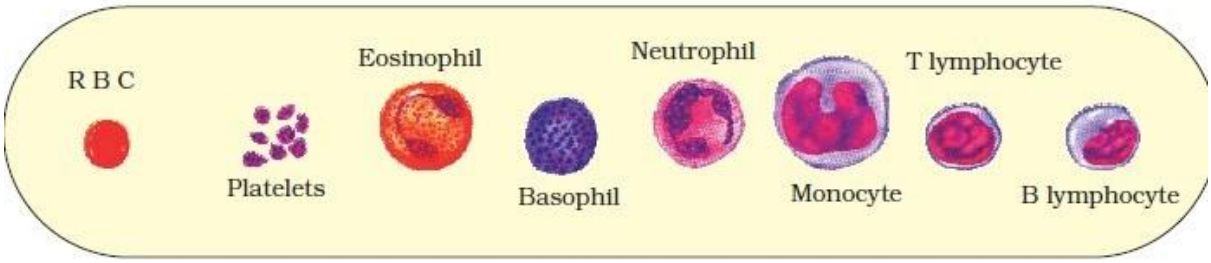
Plasma is a viscous fluid that constitutes nearly 50-55% of the blood volume. Plasma consists of

- 90-92% of water
- 5-8% of proteins (fibrinogens, globulins and albumins)
- Small amounts of minerals like Na+, Ca++, Mg++, HCO3 –, Cl–.
- Glucose, amino acids, lipids etc

Formed Materials

Formed elements nearly constitute 45% of the blood. Formed elements are comprised of

- **Enterocytes**- Also called RBCs. Biconcave, devoid of any nucleus, they are formed in the red bone marrow. A healthy individual has on an average, 5 million to 5.5 million RBCs mm–3 of blood. They contain complex proteins like haemoglobin. They have a lifespan of 120 days.
- **Leukocytes** - are also called WBC's. They are nucleated and much lesser in number (6000-8000 mm–3 of blood). The two main categories of WBC's are granulocytes and agranulocytes. There are 2 major forms of Leucocytes- B and T forms and are responsible for the body's immune responses.
- **Thrombocytes** - Thrombocytes are also called platelets. A healthy human being has about 1500,00-3,500,00 platelets mm–3. Platelets release substances that help in coagulation and clotting of blood.



Blood Groups

Body fluids and circulation also talks about blood groups. There are two main types of blood groupings done all over the world are ABO and RH. **ABO** grouping is done on the basis of the presence or absence of antigens in the RBC's namely A and B. Therefore considering the presence or absence of antigens and antibodies, there are 4 types of blood groups **A, B, AB and O.** Tabulated below are details about blood groups.

Blood Group	Antigens on RBCs	Antibodies in Plasma	Donor's Group
A	A	Anti – B	A,O
AB	B	Anti - A	B,O
B	A,B	Nil	AB,B,A,O
O	Nil	Anti – A,B	O

People with the O blood group are called **Universal Donors** because they can give blood to anyone and people with the AB blood group are called **Universal Recipients** as they can receive blood from any other group.

RH Group

RH Groups form an important part of body fluids and circulation. Rh antigen is present in nearly 80% of human beings. Those with the antigen are Rh-positive and those without them are Rh-negative. Here are a few details about RH Groups.

- When the mother's blood is Rh-negative, and the foetus is Rh-positive, there is a possibility of the blood mixing at the delivery time.
- The mother's blood might form antibodies against the Rh antigen in her blood.
- This could destroy the RBCs of the foetus and might prove to be fatal.
- This condition is called erythroblastosis fibrosis and can be avoided by administering anti-Rh antibodies to the mother after the delivery.

Coagulation of Blood

Coagulation of blood is another important aspect of body fluids and circulation. As a mechanism to prevent excessive loss of blood, the blood exhibits **coagulation or clotting**. Let us find out more about it.

- This is in response to an injury or trauma.
- At the injury site, a clot or coagulum is formed from a network of threads called fibrils.
- Enzyme thrombin converts inactive fibrinogens to fibres.
- Prothrombins, present in the plasma form Thrombins.
- Thrombokinase, which is an enzyme complex, is required for the above reaction.
- This complex is a result of a series of enzymatic reactions.

Lymph (tissue fluid)

Lymph is also a **fluid connective tissue** that is released as blood passes through capillaries in tissues. It is essential to find out about lymph in the study of body fluids and circulation. The mineral distribution of this liquid is the same as plasma. It facilitates the exchange of gases and nutrients between the blood and the cells. Lymph contains lymphocytes and is a part of the immune response system. It also carries nutrients, hormones etc.

Circulatory Pathway

Next in body fluids and circulation, we have the circulatory pathway. Circulatory pathways are mainly of 2 types - **open or closed**.

Open circulatory pathway - Blood vessels are absent, and blood is found in the open cavities/sinuses. The internal organs float in the sinuses.

Closed circulatory pathway - There are networks of blood vessels that circulate the blood.

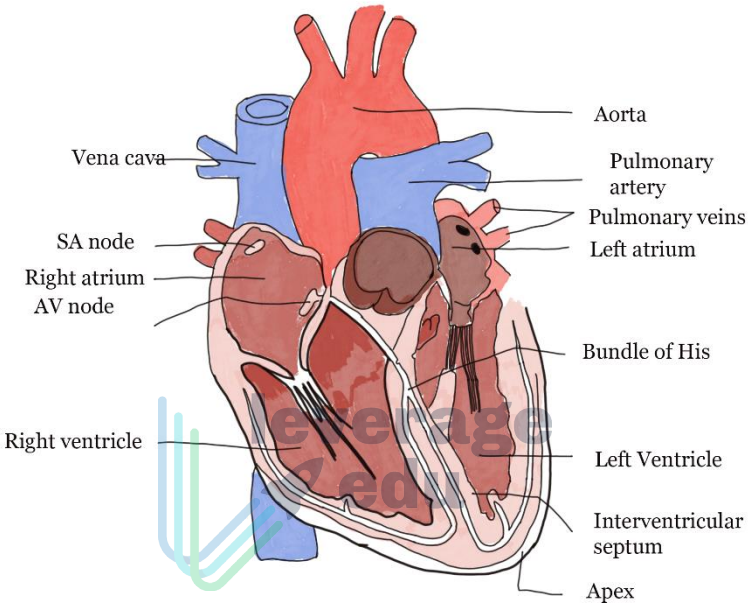
Name	Type of Heart	Circulation
Fish	2 chambered, 1-atrium and 1-ventricle	Single circulation
Amphibian and Reptiles	3 chambered, 2-atrium and 1-ventricle	Incomplete double circulation
Crocodiles, Birds and Mammals	4 chambered, 2-atrium and 2-ventricle	Double circulation

Human Circulatory System

The heart is an organ that is derived from the mesoderm. It is situated between the thoracic cavity, between the two lungs. Tilted slightly to the left, a human heart is roughly the size of a fist. Some of the important terms to know of, with respect to the heart are

- **Bicuspid valve** - Present between the left atrium and ventricle.
- **Tricuspid valve** - Present between the right atrium and ventricle.
- The left ventricle opens to the aorta, and the right ventricle opens to the pulmonary artery.
- There are nodal tissues present in the heart such as sinoatrial node (SAN) which is present on the upper right corner of the right atrium and the atrioventricular node (AVN) lower-left corner of the right atrium.

- Purkinje Fibres are present throughout the ventricle and minute fibres are present throughout the ventricle.
- Purkinje Fibres and AV bundles together form the Bundle of His. It performs the function of regulating heartbeat and conducting impulses.
- The SAN is called the pacemaker as it initiates and maintains the heart's rhythmic activity. It generates 70 to 75 action potentials per minute.
- The 3 layers that makeup arteries and veins are:
  Inner tunica intima
  Middle tunica media
  Outer tunica externa



Cardiac Cycle

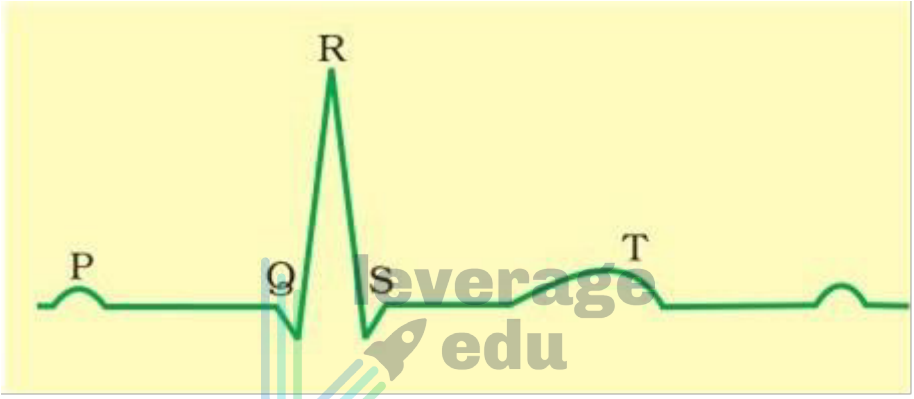
Moving further in body fluids and circulation, we find out about the cardiac cycle. At the start of the cycle, all 4 chambers are in a relaxed state called the **joint diastole**. Here is how it functions:

- As the bicuspid and tricuspid valves open, the blood flows to the left and right ventricles.
- Semilunar valves are closed at this point.
- The SA node generates action potential that contracts both the atria.
- The action potential then passes to the AV node.
- The bundle of His then transmits it to the ventricular musculature.
- This causes ventricular systole.
- Along the same time the atria undergoes relaxation which closes the bicuspid and tricuspid valve.semilunar valves open to the circulatory system.
- The valves are closed in order to prevent backflow of blood.
- With the decrease in the pressure inside the ventricles, the cycle is repeated again.
- During 1 cycle, **2 sounds are produced**, lub - because of the closing of bicuspid and tricuspid valve and dub- because of the closing of Semilunar valves.

ECG

ECH is a graphical representation of the electrical activity of the heart during a circadian cycle. It is important to have an understanding of ECG to study body fluids and circulation. The ECG machine provides an electrocardiogram.

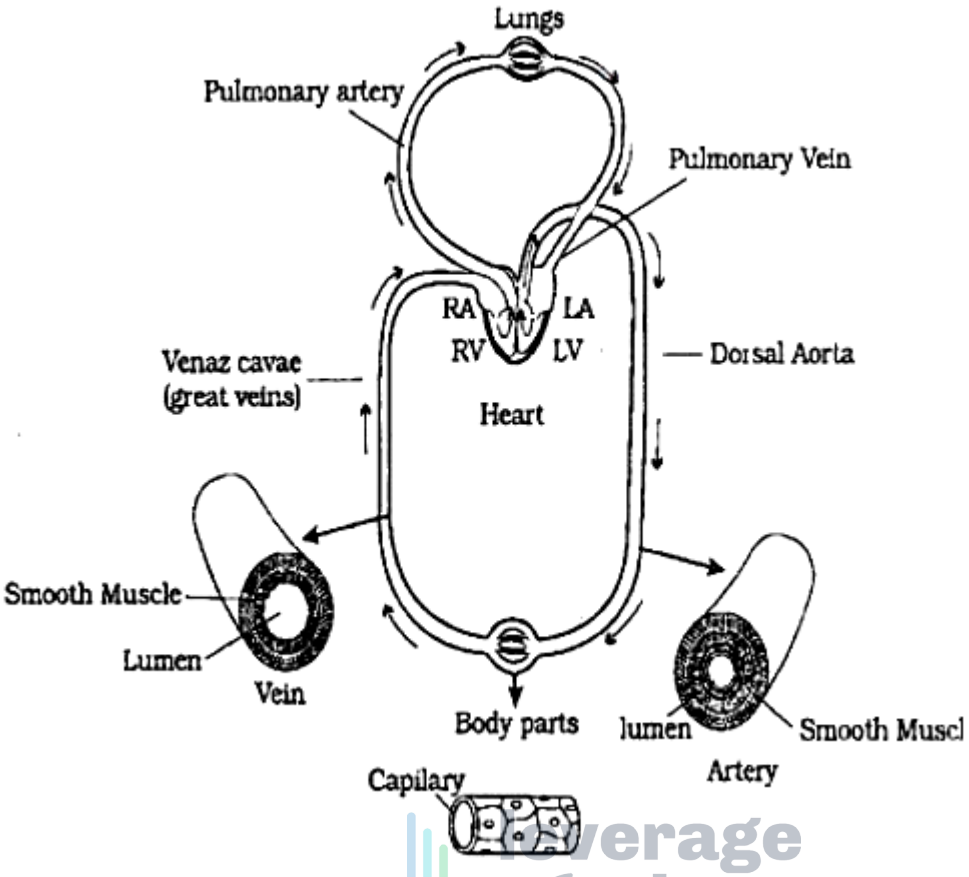
- The P wave causes the atria's excitation (depolarization), which causes the atria to contract.
- The QRS wave is the depolarization of the ventricle. It initiates ventricular contraction.
- The T wave represents repolarization, the return of the ventricle from excited to a normal state. The end of t wave is the end of the systole. The number of QRS complexes determines the heart rate in a given period of time.



Double Circulation

Moving ahead in body fluids and circulation, let us now find out about double circulation. The blood flows twice through the heart, once in an oxygenated state and the other in a deoxygenated state. This is called **Double circulation** and includes systematic and pulmonary circulation.

- **Systemic circulation**- Flow of oxygenated blood from the left ventricle to all parts of the body and deoxygenated blood from other parts of the body to the atrium.
- **Pulmonary circulation** - It is the flow of deoxygenated blood from the right ventricle to the lungs and oxygenated blood from the lungs to the left atria.



Regulation of Cardiac Activity

Next in body fluids and circulation, we talk about cardiac activity, as cardiac activity helps in pumping blood throughout the body.

- The heart's function is regulated by the ANS (autonomic nervous system) with a neural centre in the medulla oblongata.
- Sympathetic neural signals and adrenal medullary hormones help increase heart rate and cardiac output.
- Parasympathetic neural signals help decrease heart rate.

Disorder of the Circulatory System

A disorder in the circulatory system can cause trouble in pumping body fluids and circulation activity in the body. Let us find out about these disorders.

- **High Blood Pressure (Hypertension)**: blood pressure higher than 140/90 mm Hg for a longer duration may lead to various heart diseases. It may also adversely affect the brain and kidneys.
- Coronary Artery Disease (CAD): It is also referred to as atherosclerosis. It impacts the blood supply to the heart, and the lumen of the arteries becomes narrower due to deposition of cholesterol, fat, calcium or fibrous tissues.
- Angina (Angina Pectoris): The severe chest pain resulting from the scarcity of oxygen reaching the heart muscles. This happens when there is an interrupted blood flow.

- Heart Failure: This is different from a heart attack. Heart Failure occurs when the heart fails to pump enough blood to meet the body's requirement whereas in a heart attack there is sudden damage of heart muscle due to a lack of blood supply or cardiac arrest when the heart stops beating.
- Coronary Thrombosis: there is a clot formation in the coronary artery in this condition. It frequently occurs in the left anterior descending coronary artery.