CLASS 11 BIOLOGY NCERT SOLUTIONS

NCERT Solutions for Class 11 Biology Chapter 15: Body Fluids and Circulation – Free PDF Download

Class 11 Biology Chapter 15, Body Fluids and Circulation, explains how blood and lymph keep every cell of the body supplied with oxygen and nutrients while removing waste, and how the four-chambered human heart drives this transport through a cardiac cycle of systole and diastole. The chapter builds up from blood co...

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Class 11 Biology Chapter 15, **Body Fluids and Circulation**, explains how blood and lymph keep every cell of the body supplied with oxygen and nutrients while removing waste, and how the four-chambered human heart drives this transport through a cardiac cycle of systole and diastole. The chapter builds up from blood composition and blood groups to the structure of the heart, the SA node as pacemaker, the ECG, cardiac output, double circulation, and common circulatory disorders such as hypertension and coronary artery disease. These Class 11 Biology Chapter 15 solutions are also useful as quick revision notes before exams.

Exercises

Q1. Name the components of the formed elements in the blood and mention one major function of each of them.

The **formed elements** of blood make up about 45% of blood volume and consist of three types of cells/cell fragments:

Erythrocytes (RBCs): The most abundant blood cells, containing the red pigment **haemoglobin**, which binds oxygen and carbon dioxide. Their major function is the transport of respiratory gases, chiefly oxygen from the lungs to the tissues.

Leucocytes (WBCs): Colourless, nucleated cells that defend the body against infection. Neutrophils and monocytes engulf foreign organisms by phagocytosis, while lymphocytes are responsible for immune responses (antibody production and cell-mediated immunity).

Platelets (thrombocytes): Small cell fragments derived from megakaryocytes. Their major function is releasing factors that bring about coagulation (clotting) of blood, preventing excessive blood loss after an injury.

Q2. What is the importance of plasma proteins?

Plasma proteins make up about 6-8% of plasma and include fibrinogens, globulins and albumins. **Fibrinogens** are essential for the coagulation (clotting) of blood. **Globulins**, especially immunoglobulins, are involved in the body's defence mechanisms against pathogens. **Albumins** help maintain the osmotic balance of blood, which in turn regulates the movement of fluid between blood vessels and tissues. Without these proteins, the body would be unable to clot wounds, fight infections, or maintain normal blood volume and pressure.

Q3. Match Column I with Column II:

Column I	Column II
(a) Eosinophils	(i) Coagulation
(b) RBC	(ii) Universal recipient
(c) AB Group	(iii) Resist infections
(d) Platelets	(iv) Contraction of heart
(e) Systole	(v) Gas transport

Answer:

Column I	Column II
(a) Eosinophils	(iii) Resist infections
(b) RBC	(v) Gas transport

(c) AB Group	(ii) Universal recipient
(d) Platelets	(i) Coagulation
(e) Systole	(iv) Contraction of heart

Q4. Why do we consider blood as a connective tissue?

Blood is classified as a **connective tissue** because, like other connective tissues, it is mesodermal in origin and consists of living cells (formed elements) suspended in an extracellular fluid matrix (plasma), just as connective tissue proper consists of cells embedded in a matrix. Connective tissues bind, connect and support different organs of the body; blood performs a similar connecting role by circulating throughout the body and linking all organs together, transporting nutrients, gases, hormones and waste products between them. For this reason blood is described as a **fluid (vascular) connective tissue**.

Q5. What is the difference between lymph and blood?

Blood	Lymph
A red-coloured fluid connective tissue.	A colourless fluid, also called tissue fluid.
Flows through blood vessels – arteries, veins and capillaries.	Flows through a separate network of lymphatic vessels.
Contains RBCs, WBCs, platelets and plasma proteins such as haemoglobin, fibrinogen and albumin.	Contains only lymphocytes among the formed elements; lacks RBCs and platelets.
Transports O_2, CO_2, nutrients, hormones and wastes to and from all tissues.	Drains excess tissue fluid back into the blood and transports fats (via lacteals) and lymphocytes.
Contains a higher concentration of proteins, calcium and phosphorus.	Contains a lower concentration of proteins, calcium and phosphorus than blood.

Q6. What is meant by double circulation? What is its significance?

Double circulation is the pattern of blood flow in which blood passes through the heart twice in one complete circuit of the body, through two separate pathways:

Pulmonary circulation: Deoxygenated blood is pumped by the right ventricle into the pulmonary artery, carried to the lungs for oxygenation, and returned via the pulmonary veins to the left atrium.

Systemic circulation: Oxygenated blood is pumped by the left ventricle into the aorta, distributed to all body tissues through arteries, arterioles and capillaries, and the deoxygenated blood is collected by venules, veins and the venae cavae back into the right atrium.

Significance: Because the heart is completely divided into right and left halves in birds and mammals, oxygenated and deoxygenated blood never mix. This ensures that tissues receive blood with the maximum possible oxygen content, allowing a higher and more efficient metabolic rate, and lets the two circuits be maintained at different pressures suited to the lungs and the rest of the body.

Q7. Write the differences between:

(a) Blood and Lymph

Blood	Lymph
Red fluid connective tissue flowing in blood vessels.	Colourless tissue fluid flowing in lymphatic vessels.
Contains RBCs, WBCs and platelets.	Contains only lymphocytes as formed elements.
Higher protein content.	Lower protein content.

(b) Open and Closed system of circulation

Open circulatory system	Closed circulatory system
Blood pumped by the heart passes into open body cavities called sinuses and directly bathes the tissues.	Blood is always confined within a closed network of blood vessels.
Blood flow cannot be precisely regulated; flows at low pressure.	Flow can be precisely regulated by the heart and vessel diameter; flows at higher pressure.
Found in arthropods and molluscs.	Found in annelids and all chordates (including humans).

(c) Systole and Diastole

Systole	Diastole
Contraction of a heart chamber.	Relaxation of a heart chamber.
Forces blood out of the chamber (e.g., into the aorta/pulmonary artery from the ventricles).	Allows the chamber to fill with incoming blood.
Raises pressure within the chamber.	Lowers pressure within the chamber.

(d) P-wave and T-wave

P-wave	T-wave
First wave of a standard ECG.	Last wave of a standard ECG.
Represents depolarisation (electrical excitation) of the atria, initiated by the SA node, leading to atrial contraction.	Represents repolarisation of the ventricles as they return from an excited to a relaxed state; its end marks the end of systole.

Q8. Describe the evolutionary change in the pattern of the heart among the vertebrates.

The vertebrate heart shows a clear evolutionary progression from a simple two-chambered structure to a fully divided four-chambered one:

Fishes have a **two-chambered heart** (one atrium, one ventricle). It pumps only deoxygenated blood, which is sent to the gills for oxygenation and then distributed to the body – this is called **single circulation**, and the heart is often termed a “venous heart” since it handles only deoxygenated blood.

Amphibians and most reptiles have a **three-chambered heart** (two atria, one ventricle). The left atrium receives oxygenated blood (from lungs/skin/gills) and the right atrium receives deoxygenated blood from the body, but both mix in the single ventricle, which pumps out mixed blood – this is called **incomplete double circulation**.

Reptiles (except crocodiles) show a partially divided ventricle (an incomplete septum), reducing but not eliminating mixing.

Crocodiles, birds and mammals possess a fully **four-chambered heart** (two atria, two ventricles) with a complete septum, so oxygenated and deoxygenated blood are kept entirely separate – this is **complete double circulation**, which is far more efficient at supplying oxygen-rich blood to tissues and supports the higher metabolic demands of endothermic (warm-blooded) animals.

Q9. Why do we call our heart myogenic?

The term “myogenic” comes from *myo* (muscle) and *genic* (originating from). Our heartbeat is called

myogenic because the impulse that initiates each heartbeat originates within specialised heart muscle itself – the **sino-atrial node (SAN)**, located in the wall of the right atrium near the opening of the superior vena cava – rather than from an external nerve source. This is in contrast to a "neurogenic" heart (as in some invertebrates like crustaceans), where the beat originates from an external nerve ganglion. Since the SAN can generate impulses on its own (auto-excitability), even a heart removed from the body and kept under suitable conditions continues to beat rhythmically for some time.

Q10. Sino-atrial node is called the pacemaker of our heart. Why?

The **sino-atrial node (SAN)** is a mass of specialised, auto-excitable neuromuscular (nodal) tissue in the wall of the right atrium. All parts of the nodal tissue can generate action potentials on their own, but the SAN generates the highest number – about 70-75 action potentials per minute – which is faster than any other part of the conduction system (AV node, bundle of His, Purkinje fibres). Because it sets this rhythm, the impulse from the SAN spreads and controls the timing of contraction of the entire heart, and it is therefore called the **pacemaker** of the heart.

Q11. What is the significance of the atrioventricular node and atrioventricular bundle in the functioning of the heart?

The **atrioventricular node (AVN)** is a mass of nodal tissue located in the right atrial wall, near the base of the interatrial septum. It receives the impulse generated by the SA node (after it has spread through both atria, causing atrial systole) and briefly delays it, giving the atria time to empty completely into the ventricles before ventricular contraction begins. The **atrioventricular bundle (bundle of His)** arises from the AVN, passes through the atrioventricular septum, and divides into right and left branches that give off fine **Purkinje fibres** throughout the ventricular walls. This conducting system rapidly transmits the impulse to the entire ventricular musculature, ensuring that both ventricles contract almost simultaneously and in a coordinated way, producing an efficient, synchronised heartbeat.

Q12. Define the cardiac cycle and the cardiac output.

Cardiac cycle: The sequence of events occurring in the heart during one complete heartbeat, consisting of alternating **systole** (contraction) and **diastole** (relaxation) of the atria and ventricles, is called the cardiac cycle. It includes joint diastole, atrial systole, ventricular systole, and ventricular diastole, and it repeats itself in a fixed sequence. One cardiac cycle lasts about **0.8 seconds** in a healthy adult at rest (72 beats per minute).

Cardiac output: This is the volume of blood pumped out by each ventricle per minute. It is calculated as:

Cardiac output = Stroke volume x Heart rate

Since the average stroke volume (blood pumped per beat) is about 70 mL and the average heart rate is 72 beats/min, the average cardiac output is approximately **5000 mL (5 litres) per minute**.

Q13. Explain heart sounds.

During each cardiac cycle, the closing of heart valves produces two audible sounds that can be heard with a stethoscope. The first sound, **"lub,"** is low-pitched and of relatively longer duration; it is produced by the closure of the **tricuspid and bicuspid (mitral) valves** at the start of ventricular systole. The second

sound, **"dub,"** is higher-pitched, sharper and shorter; it is produced by the closure of the **semilunar valves** (guarding the aorta and pulmonary artery) at the end of ventricular systole. These heart sounds are of significant clinical diagnostic value, as abnormal or additional sounds (murmurs) can indicate valve defects or other heart disorders.

Q14. Draw a standard ECG and explain the different segments in it.

An **electrocardiogram (ECG)** is a graphical record of the electrical activity of the heart during a cardiac cycle, obtained using an electrocardiograph. A standard ECG shows a characteristic sequence of waves labelled P through T:

P-wave: A small upward wave representing depolarisation (electrical excitation) of the atria, triggered by the SA node, which causes both atria to contract (atrial systole).

QRS complex: A sharp set of waves representing depolarisation of the ventricles, which initiates ventricular contraction (ventricular systole); this activity begins shortly after the Q point.

T-wave: A rounded wave representing repolarisation of the ventricles – their return from an excited to a normal (relaxed) state; the end of the T-wave marks the end of systole.

By counting the number of QRS complexes occurring in a given time period, one can determine an individual's heart rate. Because the ECG pattern is broadly similar for a given lead arrangement across healthy individuals, any deviation from the standard shape indicates a possible cardiac abnormality, which is why the ECG has major clinical diagnostic significance.

Class 11 Biology Chapter 15 – Notes and Extra Questions

This chapter's exercise contains **14 questions** in the current NCERT textbook, and this count and wording have remained unchanged through the 2023 rationalisation – the chapter was renumbered from the older Chapter 18 to the current Chapter 15, but no exercise questions were added or dropped, including the ECG-diagram question (Q14), which is retained exactly as before. Note that there is no separate stand-alone question on blood groups/Rh factor in the exercise; that content is tested indirectly through Q3 (the AB group/universal recipient matching item), so students should still study the ABO and Rh systems carefully from the in-text material since they are frequently asked in school tests and in NEET. For revision, focus on getting the sequence SA node to AV node to bundle of His to Purkinje fibres firmly memorised, be able to redraw the standard ECG with all five waves (P, Q, R, S, T) labelled, and practise the cardiac output formula along with the values for stroke volume, heart rate and cardiac cycle duration, since numerical and diagram-based questions from this chapter are common in board exams.

How many exercise questions are there in Class 11 Biology Chapter 15?

There are 14 exercise questions in Chapter 15, Body Fluids and Circulation, covering blood composition, plasma proteins, connective tissue nature of blood, lymph, double circulation, heart evolution, the myogenic heart, the SA and AV nodes, cardiac cycle and output, heart sounds, and the ECG.

Why is O blood group called the universal donor and AB the universal recipient?

O group RBCs carry neither A nor B antigens, so their blood can be transfused into people of any ABO

group without triggering an antigen-antibody clumping reaction – hence “universal donor.” AB group plasma contains neither anti-A nor anti-B antibodies, so a person with AB blood can receive blood from any ABO group without an immune reaction – hence “universal recipient.”

What is the difference between plasma and serum?

Plasma is the fluid, straw-coloured matrix of blood that still contains the clotting factors (including fibrinogen) in an inactive form. Serum is plasma from which the clotting factors and fibrinogen have been removed after coagulation has taken place – in other words, serum is plasma minus the clotting proteins.

Why does the SA node, and not the AV node, set the heart’s rhythm?

All the nodal tissue in the heart is auto-excitable and can generate its own action potentials, but different regions do so at different intrinsic rates. The SA node generates the highest number of impulses (about 70-75 per minute), faster than the AV node or the Purkinje fibres. Since the fastest-firing tissue drives the timing of the whole heart, the SA node dictates the rhythm and is therefore called the pacemaker.