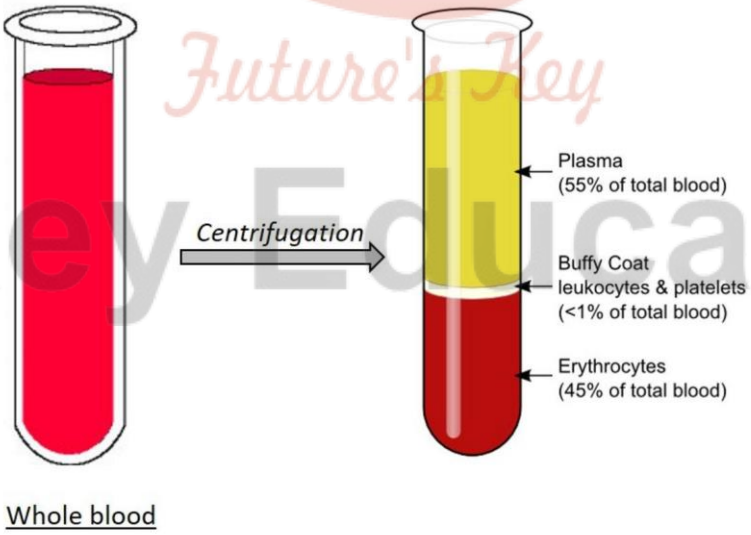
BIOLOGY

Chapter 15: Body Fluids and Circulation

BODY FLUIDS AND CIRCULATION

Blood

Blood, also known as connective tissue, is responsible for transporting oxygen, nutrients, hormones, respiratory gases, to the body, and waste materials away from it. The total volume of the blood in the human body is approximately seven per cent of the total body's weight which will be about 5 to 5.5 liters (1.5 gallons) of blood.



Human blood comprises of 4 components that serve specific tasks, namely:

- Plasma.
- Red Blood Cells.
- White Blood Cells.

1. Eosinophil.
2. Basophil.
3. Neutrophil.
4. Lymphocytes.
    - T-Lymphocyte.
    - B-Lymphocytes.
1. Monocytes.
2. Platelets.

Plasma: Plasma is straw colored viscous fluid that constitutes 55% of blood volume. It consists of 90-92% water, 6-8% protein (fibrinogens, albumins and globulins), glucose, amino acids and small amount of minerals like Na^+, Ca^{++}, Cl^- etc.

Formed elements: Erythrocytes, leucocytes and platelets are collectively called formed elements.

Erythrocytes: Erythrocytes are most abundant cells in human body. Total blood count of RBCs is 5-5.5 million, which is slightly less in females due to menstruation. It is formed in bone marrow. Nucleus is absent in mammalian RBCs having biconcave shape.

Every 100 ml of blood contain 12-16 gm. of haemoglobin. They have life span of 120 days. They are destroyed in spleen (graveyard of RBCs)

Leucocytes: Leucocytes or WBCs are colourless due to absence of haemoglobin. 6000-8000 of WBCs are present in each ml. of blood.

Neutrophils: Neutrophils are most abundant and basophils are least abundant WBCs. Monocytes and neutrophils are phagocytic cells which destroy foreign organisms.

- Basophils secrete histamine, serotonin and heparin that are involved in inflammatory reactions.
- Eosinophils resist infection and allergic reactions. B and T lymphocytes are responsible for immune response of the body.

Thrombocytes: Thrombocytes or platelets are cell fragments produced from megakaryocytes in bone marrow. 150000-350000 platelets are present in each ml of blood. Platelets are involved in clotting or coagulation of blood in case of injuries.

Serum: Blood plasma from which fibrinogen and other clotting factors have been removed. (Plasma– (fibrinogen & other clotting factor) = blood serum.

Lymph: Lymph is a colorless fluid present in the interstitial tissues. It circulates

throughout the lymphatic system. It can be defined as blood without the RBCs. The exchange of nutrients, hormones, and gases occurs through this fluid. It consists of lymphocytes that play a major function in the immune responses of the body.

Blood Groups: blood of human beings differ in certain aspects although it appear same in all individuals. Two main types of grouping are ABO and Rh.

ABO grouping is based on presence or absence of two surface antigens RBC, antigen A and antigen B. The plasma of an individual also contains two antibodies produced in response of antigens.

Blood Groups and Donor Compatibility

Blood Group	Antigens on RBCs	Antibodies in Plasma	Donor's Group
A	A	anti-B	A, O
B	B	anti-A	B, O
AB	A, B	nil	AB, A, B, O
O	nil	anti-A, B	O

- During blood transfusion, blood of donor has to be matched with blood of recipients to avoid clumping of RBCs.
- Group 'O' blood can be donated to any individual with any blood group, so it is called universal donor.
- Person with 'AB' blood group can receive blood from any person of any group, so it is called universal recipient.

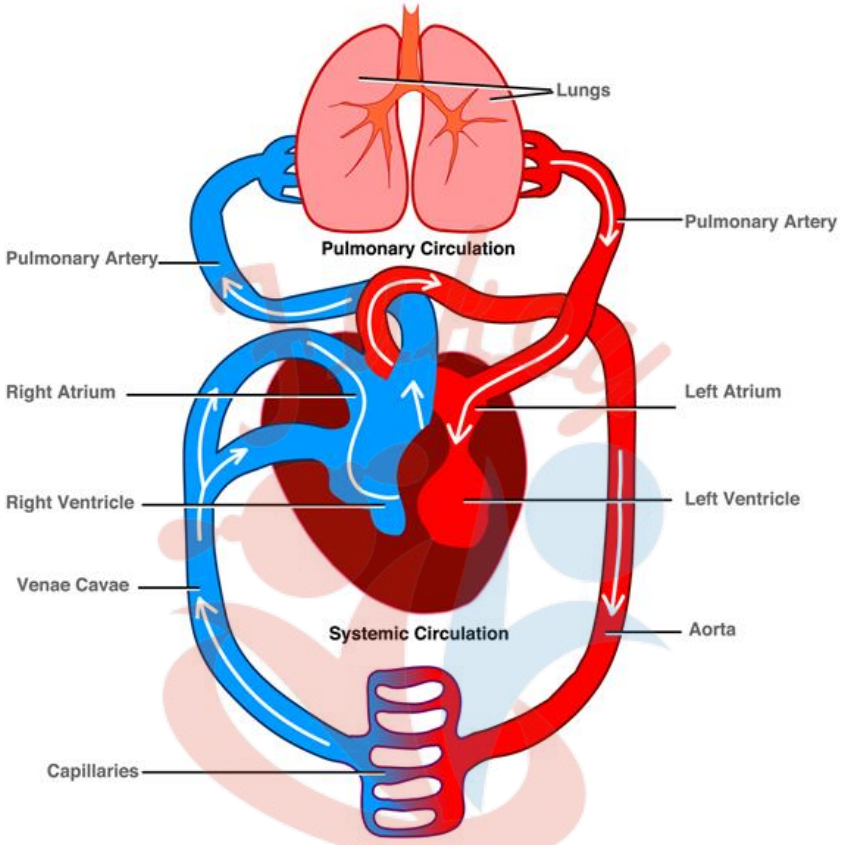
Rh grouping: Rh antigen (similar to Rhesus monkey) are observed on surface of RBCs of majority of individuals (about 80%). Such people are called Rh positive (Rh+) and those in whom this antigen is absent are called Rh negative (Rh-).

Erythroblastosis foetalis: If father blood is Rh+ and mother blood is Rh-, the foetus blood is Rh+. During the delivery of first child there is a possibility of exposure of mother blood with foetus blood to develop antibodies in mother blood. In subsequent pregnancy the mother's blood can leak into foetus blood and destroy the foetus RBC. This case is called erythroblastosis foetalis.

Coagulation of blood (Blood Clotting): When an injury is caused to a blood vessel bleeding starts which is stopped by a process called blood clotting. An injury or trauma

stimulates the platelets in the blood to release certain factors that activate the mechanism of coagulation. Calcium play important role in blood clotting.

Human Circulatory System

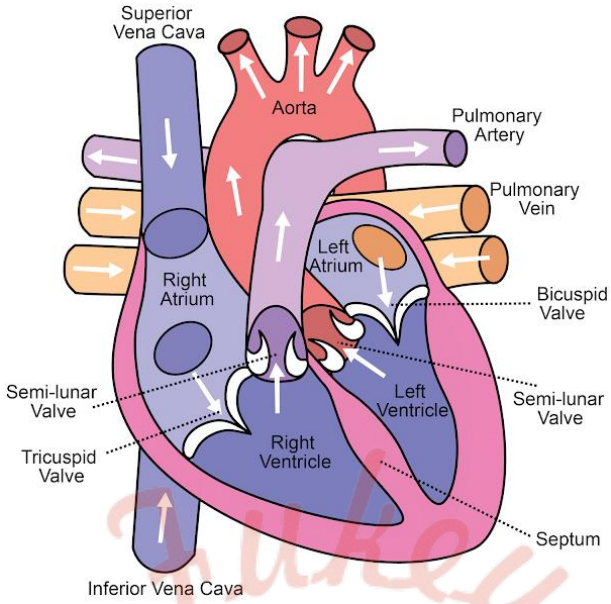


The human circulatory system consists of four main organs, which function together and each of them has specific roles and functions that helps in smooth circulation of blood to different parts of the body.

The vital circulatory system organs include:

- Heart.
- Blood.
- Blood Vessels.
- Lymphatic system.

Heart: Heart is the mesodermally derived muscular organ, present in thoracic cavity between the two lungs protected by double membrane of pericardium.



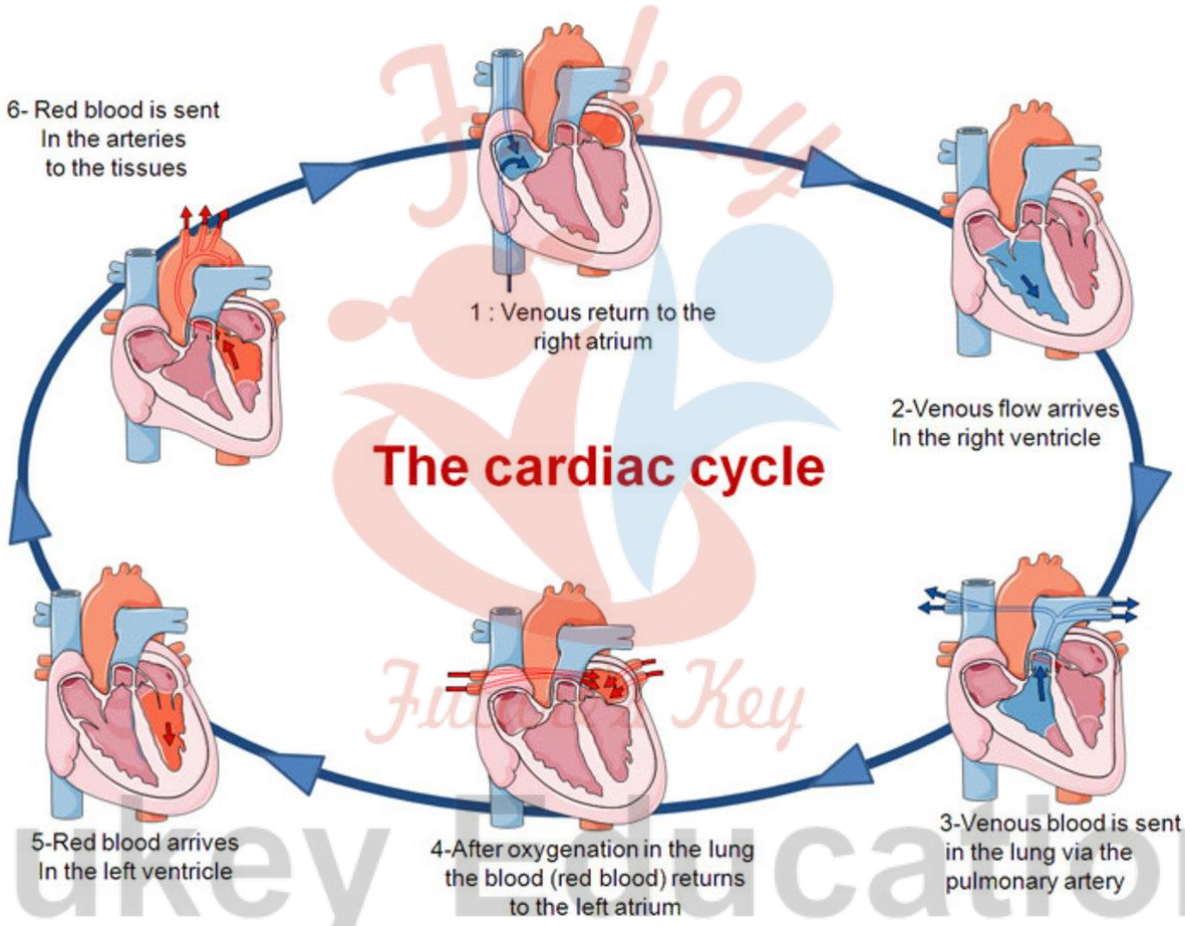
- The upper two chamber is called atria and lower two chambers are called ventricles. Interatrial septum separate the right and left atrium and thick walled inter ventricle septum separate the ventricles.
- The opening between right atrium and right ventricle is guarded by a three muscular flaps called tricuspid valve. Bicuspid or mitral valve guards the left atrium and ventricle.
- The opening of right and left ventricle to pulmonary artery and aorta respectively is controlled by semilunar valve.
- The nodal tissue present on upper right corner of right atrium is called SAN (sino-atrial node) and those on lower left corner of right atrium is called AVN (atrio-ventricular node).
- The purkinje fibers along with right and left bundles form the bundle of HIS. The nodal musculature has ability to generate action potential.
- SAN generate maximum number of action potential and is responsible for rhythmic contraction of heart. Therefore, it is called pace maker.

Cardiac Cycle

- To begin with, all four chambers are in relaxed state called joint diastole. As the bicuspid and tricuspid valves are open, blood from pulmonary vein and vena cava flows to left and right ventricle respectively. Semilunar valves are closed at this stage.
- SA node generates action potential that contracts both atria (atrial systole). The action potential passes to AV node and bundle of HIS transmit it to ventricular musculature to cause ventricular systole. At the same time atria undergoes

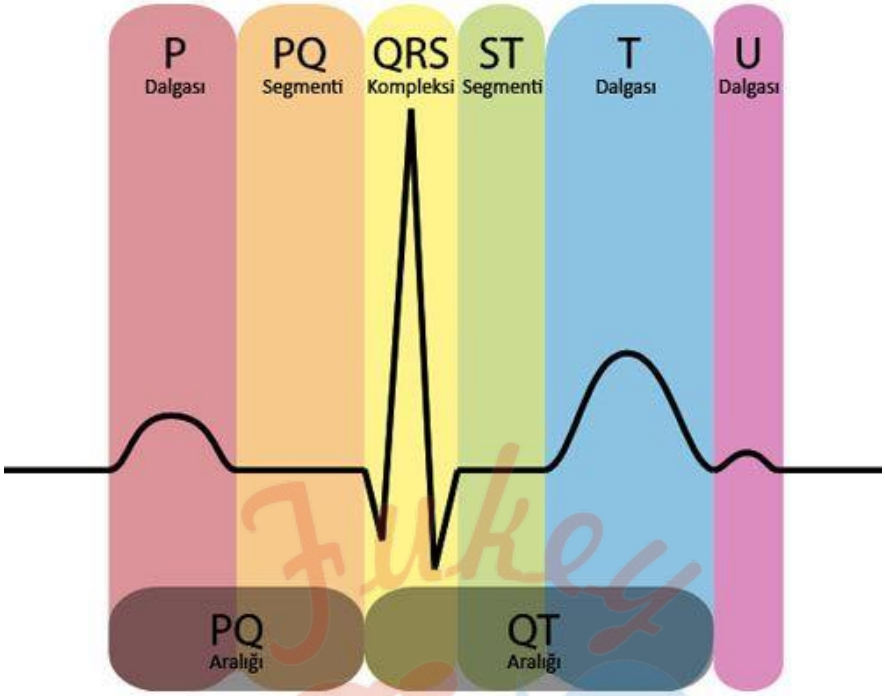
relaxation diastole to close the bicuspid and tricuspid valve.

- Semilunar valves open into circulatory system that relax the ventricle and close the valves to prevent back flow of blood.
- As the pressure inside ventricle decreases the bicuspid and tricuspid valve open to repeat the process or cardiac cycle.
- During each cardiac cycle two sounds are produced. The first sound (lub) is due to closure of bicuspid and tricuspid valve and 2nd heart sound (dub) is due to closure of semilunar valve.



ECG (Electrocardiograph)

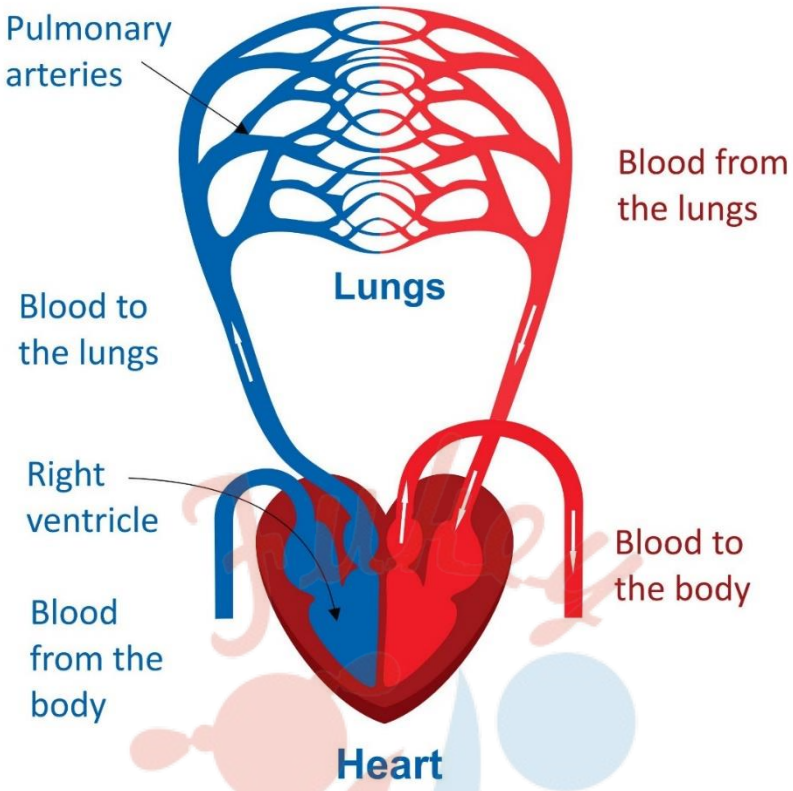
ECG (Electrocardiograph) is a graphical representation of electrical activity of heart during cardiac cycle. The electrocardiograph machine is used to obtain electrocardiogram. The patient is connected to three electrical leads to wrists and left ankle.



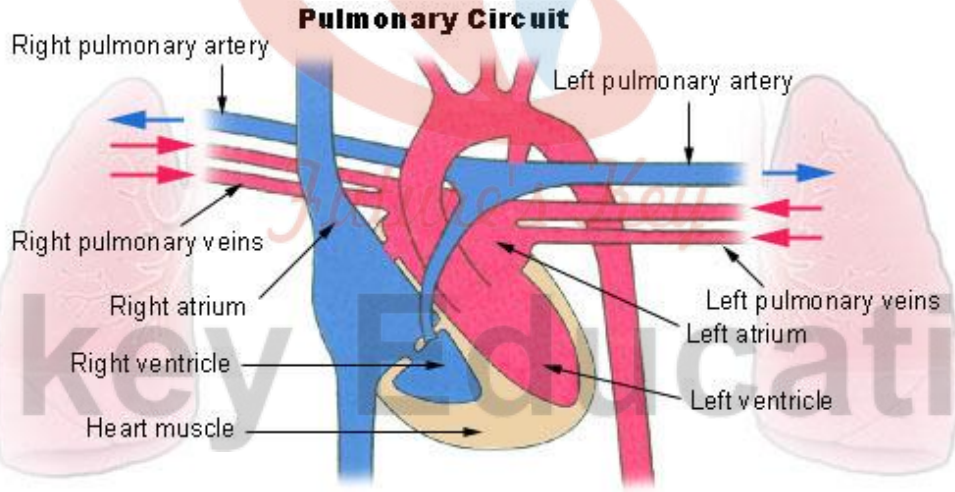
- The P-wave represents the electrical excitation of atria (depolarization) which leads to contraction of atria.
- The QRS-wave represents the depolarization of ventricles, which initiates the ventricular contraction.
- The T-wave represents the return of ventricle from exited to normal state (repolarization). The end of T-wave marks the end of systole. Counting the number of QRS complex in given period of time determine the heartbeat rate.

Double Circulation: Flow of same blood twice through the heart once in oxygenated form and other in deoxygenated form is called double circulation. It includes systematic and pulmonary circulation.

Systematic circulation: Systematic circulation includes flow of oxygenated blood from the left ventricle to all parts of body and deoxygenated blood from various body parts to the right atrium. All systematic circulation starts form aorta and ends at superior vena cava, inferior vena cava or coronary sinus to right atrium. The systematic circulation provides oxygen, nutrients and other substances to the tissues and take CO2 and other harmful substances away for removal.



Pulmonary Circulation:



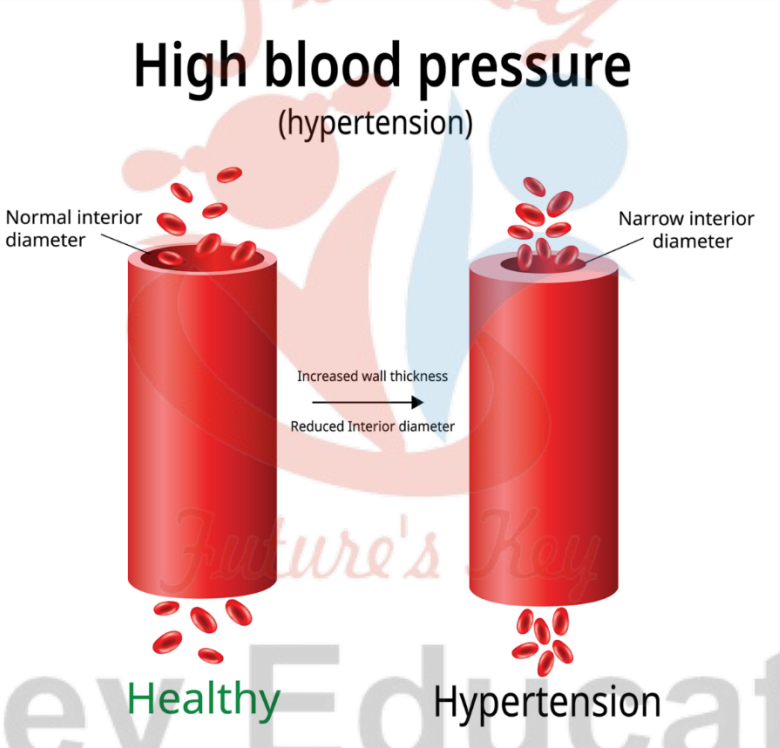
- The flow of deoxygenated blood from the right ventricle to the lungs and the return of oxygenated blood from the lung to the left atrium is called pulmonary circulation.
- Two pulmonary veins from each lung transport the oxygenated blood to the left atrium.
- Double circulation prevents the mixing of oxygenated and deoxygenated blood.

Regulation of Cardiac Activity:

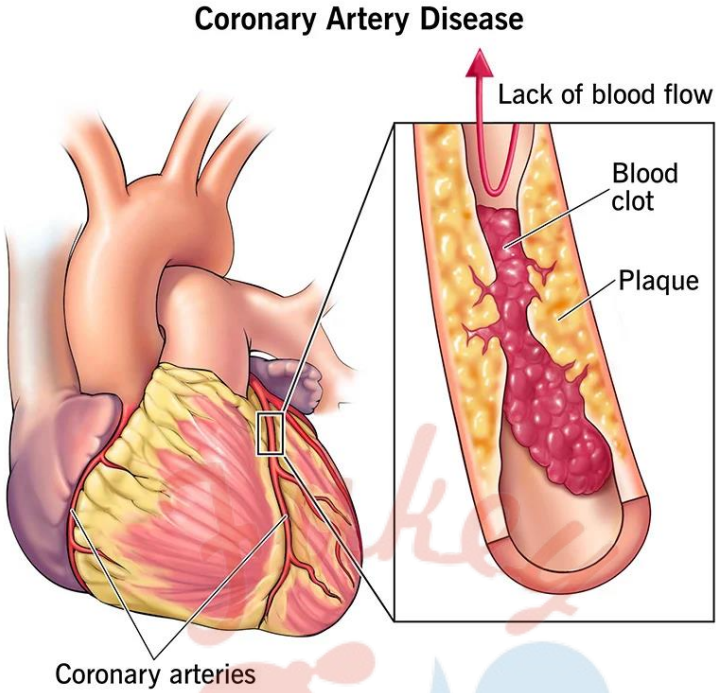
- Normal activities of heart are regulated by nodal tissue (SA and AV node), so the heart is myogenic.
- A special neural center in medulla oblongata moderates the cardiac function by ANS. Sympathetic nerve can increase the rate of heart beat and parasympathetic nerve of ANS decrease the rate of heart beat.
- Adrenal medullary hormone also increases the cardiac output.

Disorder of Circulatory System:

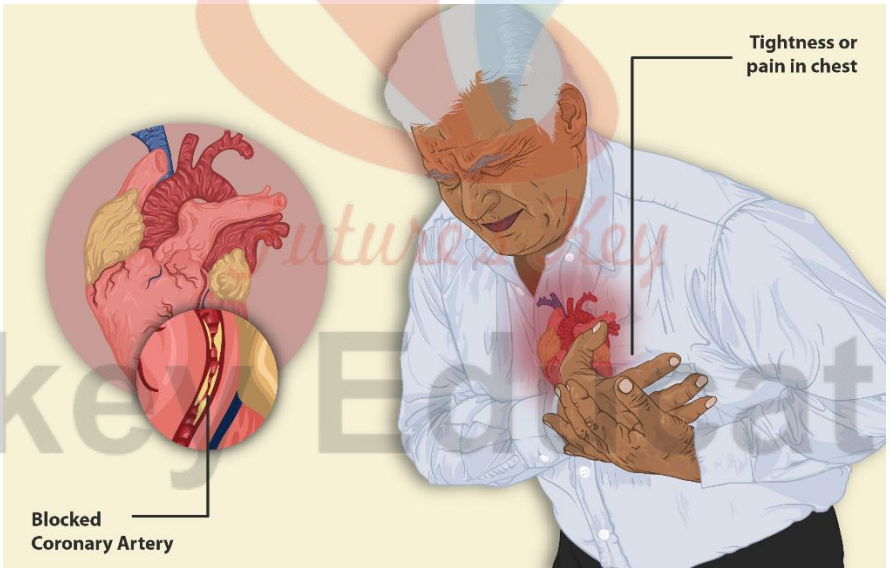
Hypertension (high blood pressure): Blood pressure higher than (120/80) . 120 mm Hg is the systolic that is pumping pressure and 80 mm Hg is the diastole, resting pressure. It leads to heart disease and affect vital organs like brain and kidney.



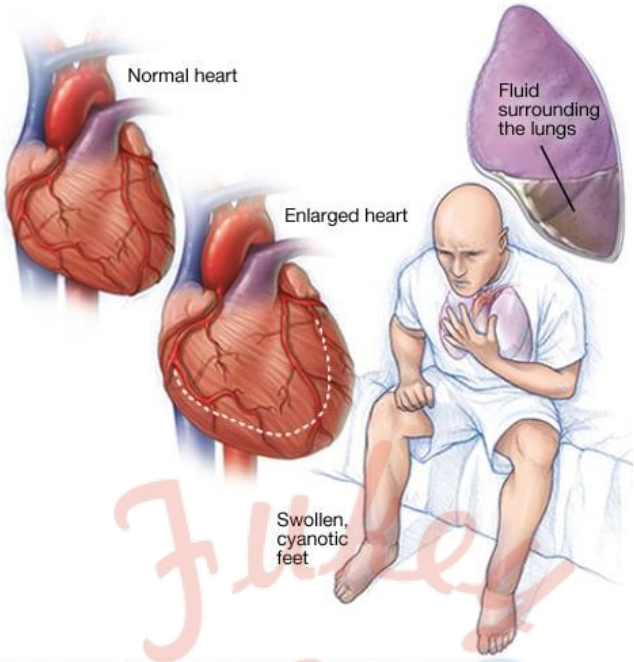
Coronary Artery Disease (CAD): Commonly called atherosclerosis that affects the blood vessels that supply blood to heart muscles due to deposition of fat, calcium, cholesterol that makes the arteries lumen narrower.



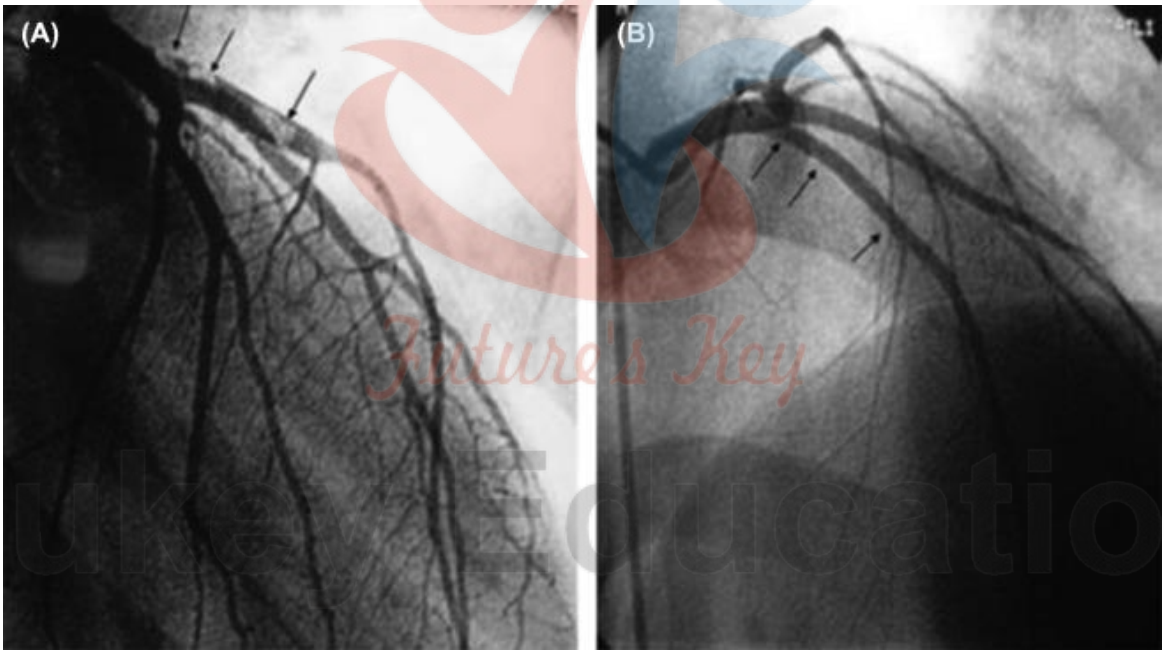
Angina: Also called angina pectoris, acute chest pain due to less supply of oxygen to heart muscles. It may occur in elderly male and female. It occurs due to restricted blood flow.



Heart failure: Heart does not pump enough blood to meet the requirement of body. It is also known as congestive heart failure because congestion of lung is one of its causes. Heart failure is different from heart attack (heart muscle is damaged by inadequate blood supply) and cardiac arrest (when heart stops beating).



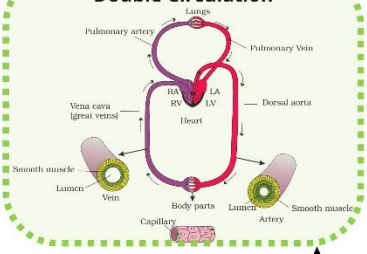
Coronary Thrombosis: Formation of clot in the coronary artery is coronary thrombosis. It occurs most frequently in the left anterior descending coronary artery.



Class : 11th Biology
Chapter- 18 : Body Fluids and Circulation

Body Fluids and Circulation

Double Circulation



Blood

- Plasma
  - Fibrinogen
  - Globulin
  - Albumin
- Formated Elements
  - Platelets
  - RBC
  - WBC
    - Granulocytes
      - Neutrophils
      - Eosinophils
    - Agranulocytes
      - Lymphocytes
      - Monoctyes

Disorders
- High B.P
- Coronary artery disease
- Angina
- Heart failure

ABO grouping

Blood Group	Antigens on RBCs	Antibodies in Plasma	Donor's Group
A	A	anti-B	A, O
B	B	anti-A	B, O
AB	A, B	nil	AB, A, B, O
O	nil	anti-A, B	O

Blood Groups

Erythroblastosis foetalis
- Rh + ve
- Rh - ve

Regulation of cardiac Activity

- ANS
  - Sympathetic nerve
  - Parasympathetic nerve
- Adrenal medullar hormone

Blood vessels

- **Histology**
  - Tunica interna
  - Tunica media
  - Tunica externa
- Types
  - Arteries
  - Vein
  - Capillaries

Human Heart

- **Heart Sounds**
  - Lubb
  - Dub
- **Heart valves**
  - Tricuspid valve
  - Bicuspid valve
  - Semilunar valve
- **Types**
  - Myogenic heart
  - Neurogenic
- **Histology**
  - Endocardium
  - Myocardium
  - Pericardium
- **Cardiac Cycle**
  - Atrial systole
  - Ventricular systole
  - Cardiac diastole

Circulatory pathways

- Closed: E.g. Annelids, Echinoderms, Vertebrates
- Open: E.g. Arthropods,

Coagulation of blood
When an injury is caused to a blood vessel, bleeding starts which is stopped by a process called blood clotting.

Evolution of heart
- Fishes- 2 chambered heart
- Amphibians- 3 chambered heart
- Reptiles (except crocodiles)- 3 chambered heart
- Crocodiles, Birds and Mammals4 chambered heart.

Lymph (Tissue Fluid)
It is a colourless fluid containing specialized lymphocytes that provide immune response to body.

Important Questions

➢ Multiple Choice Questions:

Question 1. Heart is incompletely 4 chambered in

(a) Amphibian

(b) Birds

(c) Fishes

(d) Reptiles

Question 2. Blood will lose maximum O_2 while passing through

(a) Left atrium

(b) Arteries

(c) Tissue capillaries

(d) Alvelor capillaries

Question 3. Ventricular systole is stimulated by

(a) S-A node

(b) A-V aperture

(c) A-V node

(d) A-V valve

Question 4. Lymph lacks

(a) Erythrocytes

(b) Plasma proteins

(c) Platelets

(d) All of these

Question 5. The sound dupp in heart is produced by

(a) Closure of semilunar valves

(b) Closure of A-V valves

(c) Opening of A-V Valves

(d) Opening of semilunar valves

Question 6. Heart beat initiates from

(a) Bundle of his

(b) Purkinje fibres

(c) Sinuauricular node

(d) Auriculoventricular node

Question 7. Pulmonary vein carries

(a) Pure blood from heart

(b) Impure blood from lungs

(c) Pure blood from lungs

(d) Impure blood from heart

Question 8. Blood and lymph differ in

(a) Blood has cells while lymph is without cells

(b) Blood has RBCs which are absent in lymph

(c) Blood has several inorganic substances which are absent in lymph

(d) Blood has WBCs which are absent in lymph

Question 9. Blood platelets are source of

(a) Calcium

(b) Fibrinogen

(c) Haemoglobin

(d) Thrombolastin

Question 10. Pacemaker of the heart is

(a) A-V node

(b) I-A septum

(c) S-A node

(d) A-V septum

Question 11. Valves are found in veins to check the back flow of the blood, flowing under

(a) Low pressure

(b) High pressure

(c) Very high pressure

(d) No pressure

Question 12. The vessel carrying blood to Bowman's capsule is

(a) Efferent arteriole

(b) Afferent arteriole

(c) Pulmonary vein

(d) Renal vein

Question 13. Thrombin occurs in vertebrates in

(a) Blood and important for clotting

(b) Liver and initiates secretion

(c) Stomach and digests proteins

(d) Blood and imparts red colour

Question 14. The blood pressure is measured by the instrument

(a) Stethoscope

(b) Echocariograph

(c) Sphymomanometer

(d) Electrocardiograph

Question 15. Which of the following carries oxygenated blood from the lungs to the heart

(a) Pulmonary veins

(b) Renal vein

(c) Hepatic vein

(d) Jugular vein

➢ Fill In the Blanks:

1. ……. is the most commonly used body fluid by most of the higher organisms including ……. for this purpose.
2. Another body fluid, ……. also helps in the transport of certain substances.
3. Blood is a special connective tissue consisting of a fluid matrix, ……. and formed elements.
4. ……., ……. and ……. are the major proteins.
5. Plasma is a ……. coloured, viscous fluid constituting nearly ……. percent of the blood.
6. Plasma also contains small amount of minerals like …….. etc.

➢ True or False:

1. The SAN can generate maximum number of action potentials i.e., 70-75 per minute and is responsible for initiating and maintaining the rhythmic contractile activity of the heart. Therefore, it is called the pacemaker.

2. Ventricular systole increases the ventricular pressure causing the closure of tricuspid and bicuspid valves due to attempted backflow of blood into the atria.
3. Our heart normally beats 50-60 times in a minute.
4. During a cardiac cycle, each ventricle pumps out approximately 70 ml of blood which is called the stroke volume
5. The cardiac output of an athlete will be much higher than that of an ordinary man
6. During each cardiac cycle two prominent sounds are produced which can be easily heard through a stethoscope

➢ Very Short Question:

1. What is systole?
2. What is diastole?
3. Where is SA-node located?
4. In which animals we can find the sinus Venosus?
5. What is the 'lubb' sound?
6. What is AV-node?
7. What is hemolymph?
8. What is a sphygmomanometer?
9. What is the "dup" sound?
10. What is the role of AV-node?

➢ Short Questions:

1. Why does the ventricle contract as a closed chamber in the early phase of its systole?
2. The blood vascular system is considered efficient than the water circulatory system in animals, why?
3. Mention, in brief, the important events that happen during the cardiac cycle.
4. Describe in brief the types of valves present in the heart.
5. What is hypertension? What are causative factors?
6. What is heart rhythm? Discuss.
7. Fill in the blanks:
8. What is an artificial pacemaker? Explain.

➢ Long Questions:

1. (a) Why is the AV bundle essential for the conduction of cardiac muscles? Explain.

(b) Make a graphic representation of double circulation in the mammalian heart.

2. Define portal system. How is the hepatic portal system useful to our body?
3. What is the lymphatic system? Discuss its importance.
4. Describe the structure of the human heart.
5. Describe the circulatory system of cockroach.

Assertion Reason Question-

1. In these questions, a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices.

   (a) If both Assertion and Reason are true and Reason is the correct explanation of Assertion.

   (b) If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

   (c) If Assertion is true but Reason is false.

   (d) If both Assertion and Reason are false.

   Assertion: WBCs accumulate at the site of wounds by diapedesis.

   Reason: It is the squeezing of leucocytes from the endothelium. [AIIMS 2002]

2. In these questions, a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices.

   (a) If both Assertion and Reason are true and Reason is the correct explanation of Assertion.

   (b) If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

   (c) If Assertion is true but Reason is false.

   (d) If both Assertion and Reason are false.

   Assertion: In most of the mammal RBCs are devoid of nucleus.

   Reason: Red colour is filled in the entire cytoplasm of RBCs, iron containing complex protein called haemoglobin.

✓ Answer Key-

➢ Multiple Choice Answers:

1. (d) Reptiles
2. (c) Tissue capillaries

3. (c) A-V node
4. (d) All of these
5. (a) Closure of semilunar valves
6. (c) Sinuauricular node
7. (c) Pure blood from lungs
8. (b) Blood has RBCs which are absent in lymph
9. (d) Thromboplastin
10. (c) S-A node
11. (a) Low pressure
12. (b) Afferent arteriole
13. (a) Blood and important for clotting
14. (c) Sphymonanometer
15. (a) Pulmonary veins

➢ Fill In the Blanks:

1. Blood, humans
2. lumph
3. plasma
4. Fibrinogen, globulins, albumins
5. straw, 55
6. Ca^{++}, Mg^{++}, HCO_3^- Cl^-

➢ True or False:

1. True
2. True
3. False
4. True
5. True
6. True

➢ Very Short Answers:

1. Answer: The contraction phase of the cardiac chamber (s) is called systole.
2. Answer: The relaxation phase of the cardiac chamber is called diastole.

3. Answer: It is located at the place of merge of sinus venous at the right wall of the right atrium.
4. Answer: Sinus venosus can be found in fishes, amphibians and reptiles.
5. Answer: It is the first sound produced by the heart due to the sharp closure of AV valves at the start of ventricular systole.
6. Answer: It is a node of specialised fibres, located at the junction of the right atrium and right ventricle.
7. Answer: The blood of insects that lack haemoglobin is called haemolymph.
8. Answer: The instrument which measures blood pressure is called a sphygmomanometer.
9. Answer: It is the second sound produced by the heart due to the sharp closure of semilunar valves at the start of ventricular systole.
10. Answer: It collects the wave contraction generated by SA-node and passes down to a bundle of His and Purkinje fibres.

➢ Short Answer:

1. Answer: In the early phases of systole the ventricle contracts as a closed chamber, so to increase the pressure in the atrium. Backflow of blood into atria is prevented by closure of AV-valves. In a closed chamber, the ventricles contract and increased pressure cause the opening of semi-lunar valves. The blood is passed into arteries with great force.
2. Answer: The dissolved oxygen and nutrient present in water are in fewer amounts. Oxygen is supplied through oxygen carrier molecule (haemoglobin) present in plasma or cells, in higher animals. Oxygen and nutrients are supplied quickly and in fairly large amounts in animals with a blood vascular system, so considered comparatively efficient.
3. Answer: The cardiac cycle comprises the following three phases.

   (a) Atrial systole

   (b) Ventricular systole

   (c) Joint diastole.

   (a) Atrial systole: The atria contract from anterior to posterior and the blood is sent to respective ventricles. Time taken is 0.1 sec.

   (b) Ventricular systole: The ventricles contract, deoxygenated blood is sent to lungs for oxygenation, while oxygenated blood received from lungs is sent to different parts of the body through the aortic arch. Time taken is 0.3 sec.

   (c) Joint diastole: All the chambers are in systole, called joint diastole. Time taken is 0.4 sec.
4. Answer: Different valves present in the heart are described as under:

(a) Tricuspid valve: The valve present at the right atrioventricular aperture formed of three flaps.

(b) Bicuspid valves: The valve present at the left atrioventricular aperture, formed of two flaps, also called the mitral valve.

(c) Semi-lunar valve: Two sets of half-moon shaped (3) valves, present at openings of pulmonary aorta and aorta, present here to check backflow of blood.

5. Answer: It is a manifestation of an increase in blood pressure. A continuous or sustained rise in arterial blood pressure is known as hypertension.

   The normal systolic and diastolic pressure of a healthy human is 120m and 80mm Hg respectively. Under various physiological conditions, a moderate level of fluctuation may occur and blood pressure increase. It is referred to as high blood pressure.

6. Answer: Heart muscles continuously generate impulses in a manner that causes rhythmic contraction and relaxation of the heart chambers. For the purpose of maintenance of the heart rhythm, a highly excitatory' and conductive system is present, which includes sino-atrial node (SA) inter- nodal pathways, the atria-ventricular node (Avnode) AV bundle and the bundle of Purkinje fibres.

   In normal conduction of impulse, the atrial contraction precedes that of the ventricle.

   The automatic rhythmicity of the heart is its ability to contract spon¬taneously at a regular rate.

7. Answer:

   (a) Eosinophil is a bilobed nucleus

   (b) Pulmonary artery carries deoxygenated blood.

   (c) Heart of cockroach is present in the pericardial sinus.

   (d) Platelets helps in coagulation

   (e) Haemoglobin is present in RBCs due to which its colour is red.

8. Answer: A pacemaker is a rhythmic centre that establishes a pace of activity. Sometimes the component of the impulse conduction system is disrupted, causing irregularity in the heart rhythm like heart failure. Such types of patients are provided with an artificial electronic device, which regularly sends a small amount of electrical charge for maintaining the rhythmicity of the heart.

   The device is known as an artificial pacemaker. It is implanted subcu¬taneously in the upper thoracic region having a connection with the heart.

   If patients having symptoms of ventricular escape, in which atrial impulse suddenly fails, the artificial pacemaker is connected to the right ventricle for controlling its rhythm. The artificial pacemaker consists of a pulse generator containing a cell to produce electric

impulse.

➢ Long Answer:

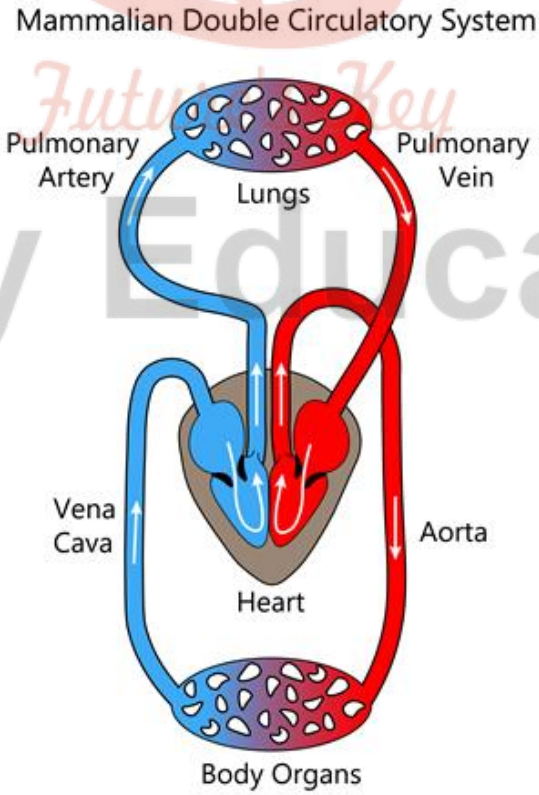
1. (a) Answer: The sinoatrial node (pacemaker) of the heart spreads the cardiac impulse over the two atria to bring about their systole. It, however, cannot spread along the common cardiac muscle fibres from the atria to the ventricles. It is because, in the mammalian heart, there is no continuity between the cardiac muscle fibres of the atria and those of the ventricles.

   Although the fibres of each individual chamber exist in a functional syncytium (not separatable). It is because a bond of specialized cardiac muscle fibres exists on the interatrial septum called the ATRIOVENTICULAR BUNDLE (AV bundle).

   AV bundle forms the only muscular continuity between atrial and ventricular muscles. The AV bundle descends from the AV node along the interatrial septum and the interventricular septum. It branches into right and left bundle branches as it enters the ventricle.

   From each AV bundle branch Purkinje which fibres spread out and connect with the common ventricular muscle fibre. Thus, the cardiac impulse spreads over the atria to reach the AV node; the AV bundle is necessary for the conductions of impulse through its two branches and the Purkinje fibres to reach the ventricular muscle fibres causing contraction of ventricles.

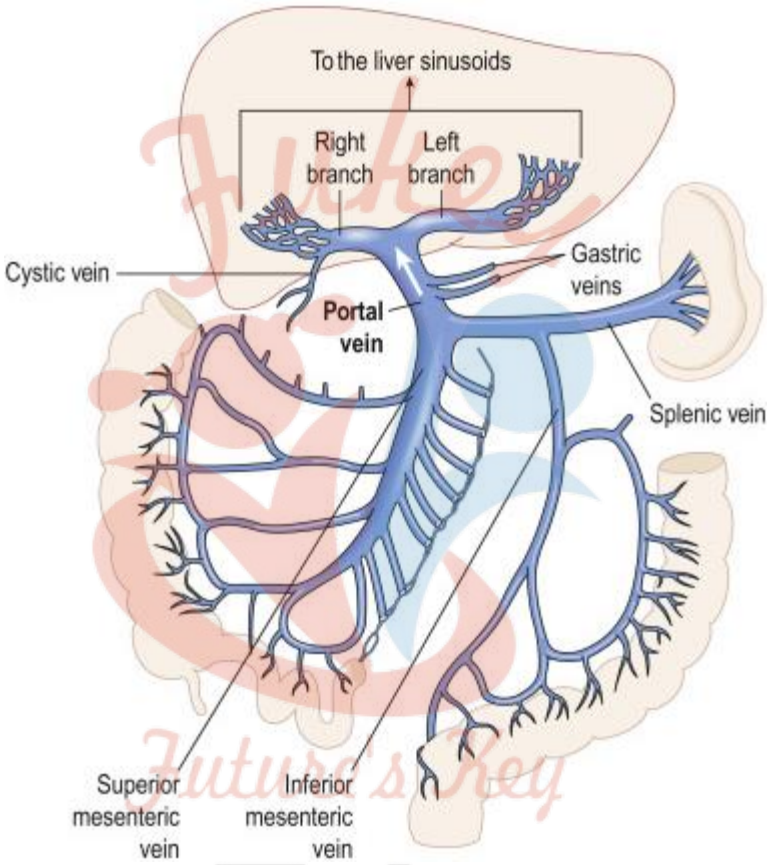
   (b) Answer:



Representation of double circulation in animals.

2. Answer: Portal system: A portal system is the circulatory system in which blood collected from one set of organs or tissues is conveyed to another organ through capillaries before entering the heart.

   For example, in the hepatic portal system, blood collected from the alimentary -canal is first conveyed to the liver by the hepatic portal vein. After passing through the capillaries of the liver, it passes directly to the posterior vena cave by the hepatic vein.



Hepatic portal circulation

Use of hepatic portal system:

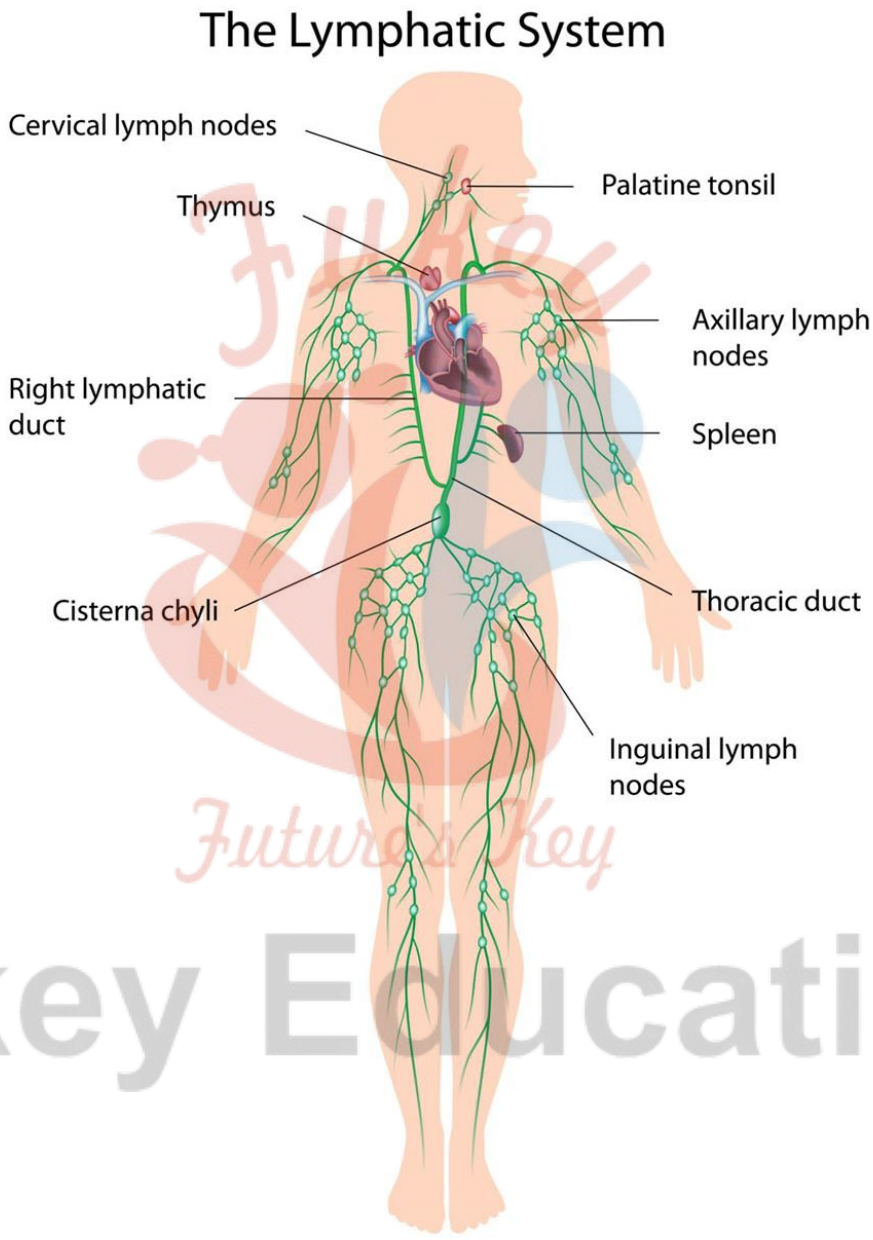
(i) Veins coming from the various parts of the alimentary canal carry deoxygenated and food-laden blood. Through the portal vein, it reaches the network of portal vein capillaries in the liver. The excess of food is filtered and stored in the liver as glycogen. Thus, heavily food loaded blood is not allowed to go to the heart, which may have to work more in pumping the blood.

(ii) Liver also consumes drugs and toxins present in the blood coming from the intestine. So, that heart can be saved from their harmful effects.

3. Answer: The lymphatic system consists of vessels and lymph organs, like lymph nodes, bone marrows, spleen and thymus. The fluid present in the lymphatic system is called lymph. This fluid has a composition similar to that of plasma except it is low in protein.

Fine channels present in the tissue are called lymph vessels, these are similar to veins. Besides these, a number of lymph nodes are present. The lymphatic vessels are distributed in the limbs, abdomen, thorax and neck.

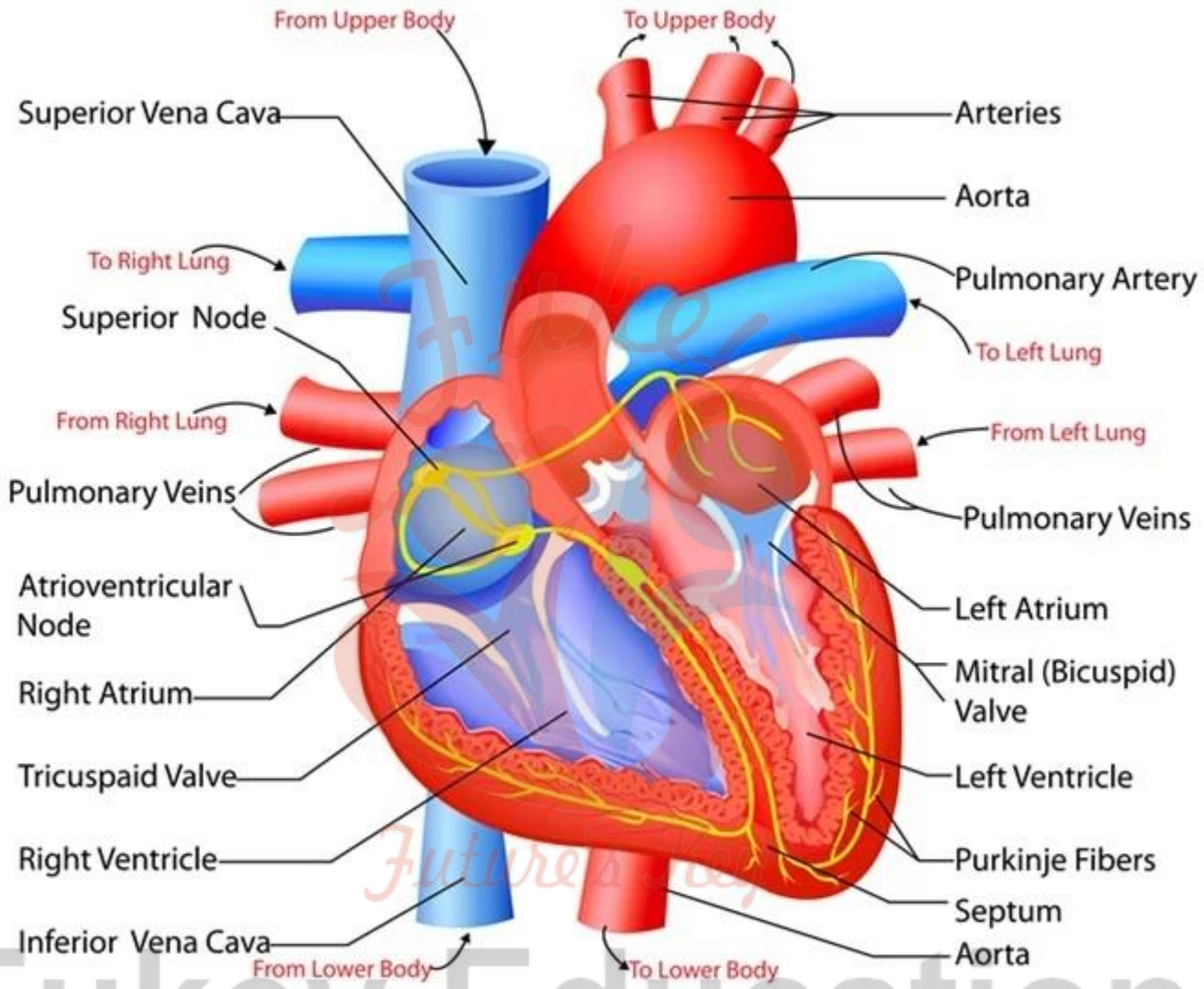
The lymphatic system provides an accessory route for the flow of interstitial fluid into the blood. The lymphocytes present in the lymphatic system play important role in the defence against foreign agents or microbes.



Shows the various lymphatic organs in the human body

4. Answer: The human heart consists of four chambers: Two upper thin layered (Atrium) and two lower thick layered ventricles. The atria are situated at the broader end while the ventricles are situated at the lower conical end. Externally a transverse groove is present between the atria and ventricles, called the anterior interventricular sulcus and posterior intraventricular sulcus.

The right and left atria receive blood from different body parts. The right atrium receives deoxygenated blood from all parts of the body except the lungs, through the superior and inferior vena cava. Pulmonary veins bring oxygenated blood to the left atrium horn of the lungs.



Extma1 features of the human heart

The right and left atria pump their blood into the right and left ventricles. From the right ventricle, the pulmonary trunk arises which bifurcates into right and left pulmonary arteries, which supply deoxygenated blood to the lungs. The left ventricle gives rise to an ascending aorta from 'which the oxygenated blood is supplied to the coronary- arteries and the systemic circulation of the body occurs.

5. Answer: The circulatory system is of open type. It consists of the heart and dorsal blood vessel, sinuses and haemolymph. The haemocoel is divided into three chambers or sinuses dorsal, middle and ventral. The dorsal chamber is called the pericardial sinus, the middle is the perivisceral sinus whereas the ventral is the perineural sinus. The dorsal and ventral diaphragms bear a number of pores through which haemolymph flows.

The heart of a cockroach is an elongated tubular structure, closed behind and open in front. It has thirteen funnel-shaped and segmentally arranged chambers i.e. three in the thoracic segment and ten in the abdominal segment. Valves, ensuring the unidirectional flow of blood, guard the passage of each heart chamber.

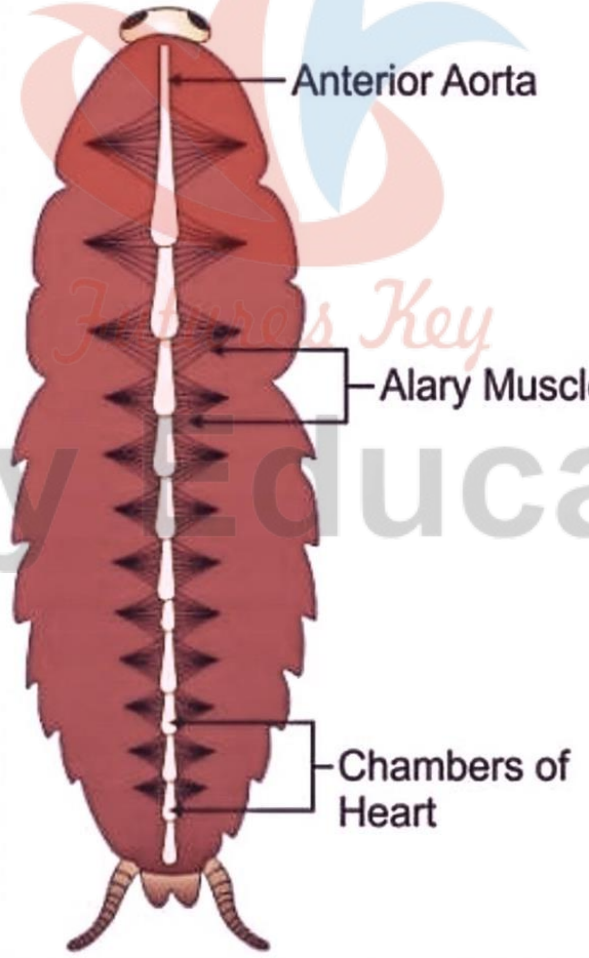
Blood flows from the posterior to the anterior end and is discharged into the tissue space of the head. Laterally each heart chamber bears a pair of apertures called Ostia which communicates with the pericardial sinus.

In each segment, a pair of triangular alary muscles is present on either side of the heart.

The blood of the cockroach is not responsible for the transportation of respiratory gases but serves for

- the transportation of nutrients.
- maintains hydrostatic pressure and
- acts as a reservoir of water.

The haemolymph of cockroach circulates due to contraction and relaxation of the heart and ciliary muscles,



Open type of circulatory system in cockroach

Assertion Reason Answer-

1. (b) If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

   Explanation: During wound, germs are removed by the process of phagocytosis by WBC. WBCs accumulate at the site of wound by diapedesis. It is the squeezing of leucocytes out from the endothelium of capillaries to fight against foreign agent.

2. (b) If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

   Explanation: Matured mammalian RBCs lacks cell organelles including nucleus, mitochondria, ribosomes, centrioles and endoplasmic reticulum. It increases the surface area of RBCs and enables them to contain more haemoglobin. Thus, almost entire cytoplasm is filled with haemoglobin.