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**SAMPATH
LANKADHEERA**

B.Sc. (Hons), M.Sc.

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**UNIT
05** **Animal Form and Function**
Circulation 1

**SAMPATH
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B.Sc. (Hons), M.Sc.

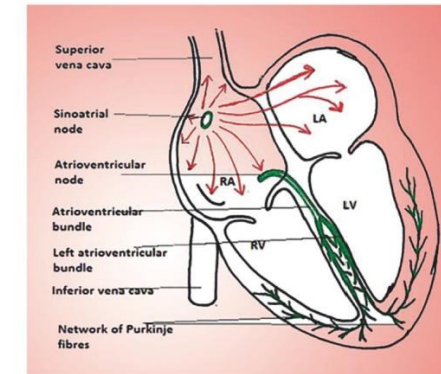


Circulatory Systems in Animals

Need of a circulatory system

- A circulatory system is required in animals for of materials within the body and exchange of materials with the external environment.
- The (e.g. Cnidarians, Flat worms) lack specialized system for the transport and distribution of material because many or all cells are in direct contact with the external environment.
- In these animals exchange of materials over the body surface through is sufficient for their needs. In these animals those materials can be transported by diffusion through short distance within the body.

3. initiate and
4. conduct impulses.
5. The conducting system of the heart consists of following specialized system.
6. SA node (Sinoatrial node)
7. AV node (Atrioventricular node)
8. Atrioventricular bundle (bundle of His),
9. bundle branches
10. and Purkinje fibres **SA node / Sinoatrial node**
11. SA node is a small mass of specialized cells.
12. It lies in the myocardium of the right atrium
13. near the opening of the superior vena cava.
14. The stimulus for contraction of the heart originates in the 'SA node'.
15. The SA node initiates the heart beat and sets the rhythm of the heart beat
16. so it is called the pace maker.
17. But the heart rate can be varied by the stimulation from the autonomic nervous system,
18. hormones such as adrenaline,
19. thyroxine
20. and temperature. **AV node**
21. AV node is also a small mass of specialized cells.
22. It is situated between wall of the left and right atria.
23. The AV node transmits the electrical signals from the atria
24. into the ventricles. **Atrioventricular bundle and Purkinje fibres**
25. AV bundle is a mass of fibers.
26. It originates from the AV node.
27. The AV bundle crosses the fibrous rings
28. that separate atria and ventricle at the upper end of the ventricular septum
29. it divides into right
30. and left bundle branches.
31. Within the ventricular myocardium the branches break up into fine fibres.
32. These fine fibers are Purkinje fibers.
33. The AV bundle branches and the Purkinje fibers transmit electrical impulse from the AV node
34. to the apex of the myocardium.
35. As a result of this impulse, wave of ventricular contractions begin.
36. Then the contraction sweeps upwards and outwards
37. pumping blood simultaneously into the pulmonary artery
38. and the aorta.



2023 A/L Answer

3. Structure of Human heart wall

- 1,2,3, Heart wall is composed of pericardium, myocardium and endocardium.
- 4, Pericardium is the outermost layer which is
- 5,6 Made up of two sacs (outer) fibrous pericardium and inner serous pericardium
- 7, Myocardium is the middle layer which is.
- 8, Composed of cardiac muscles
- 9, Network of specialized conducting fibers run through myocardium
10. Endocardium is the inner layer which is
11. A smooth membrane
12. Consisting of flattened epithelial cells.

(a) Describe the location and the gross structure of human heart.

Answer

(a) Location

1. In the thoracic cavity.
2. Between lungs/Mediastinum
3. More towards the left of bodies mid line.

Gross structure:

4. Cone shaped
5. Enclosed in a pericardium

Wall

6. Outer
7. Epicardium/ visceral pericardium
8. Middle
9. Myocardium
10. Inner

Endocardium

Epicardium

Endocardium

Endocardium

Endocardium

Myocardium

Myocardium

Myocardium

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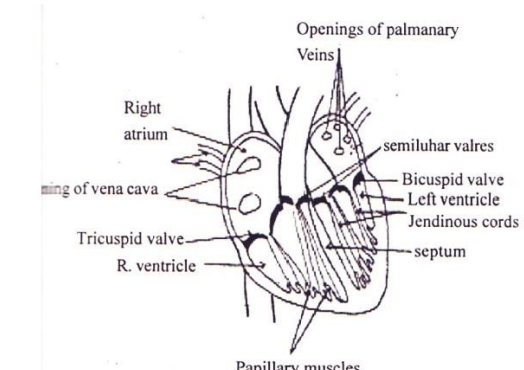
Myocardium

Myocardium

Myocardium

Myocardium

5. Atrial systole
6. Superior vena cava and inferior vena cava pour blood into RA.
7. 4 pulmonary veins pour blood into LA.
8. AV valves open.
9. Both atria contracts simultaneously.
10. Caused by stimulation of
11. Forcing blood into ventricles.
12. Takes 0.1 sec.
13. Ventricular systole
14. Both ventricles contracts simultaneously.
15. Caused by stimulation of AV node.
16. And spread of impulse via AV bundle.
17. And perkinji fibres.
18. Semilunar valves open.
19. Forcing blood out through pulmonary artery
20. And aorta
21. AV valves closed
22. Takes 0.3 sec.
23. Atrial and ventricular diastole/complete cardiac diastole
24. Both atria and ventricles relax together
25. Blood flow s into atria
26. From vena cava and pulmonary veins
27. Takes 0.4 sec.



1. Fully labeled correct diagram - 20marks
2. Partially labeled correct diagram - 10marks
3. Unlabeled correct diagram - 5 marks
4. Fully labeled diagram is with the labeling of
5. RA , RV, LV septum, tricuspid valve
6. Bicuspid valve, semilunar valves and any two of the following, Tendinous cords, papillary muscles, 4 openings LA, 2 openings in RA

Model
1. Describe the structure and function of conduction system of the heart

Answer
1. Describe the structure and function of conduction system of the heart

1. It consists of small group of specialized neuromuscular cells
2. in the myocardium

- As organisms increase in and, the amount of materials moving in and out of the body also increases. The that materials have to be within the body also increases and many cells are not in direct contact with their external environment.
- Therefore diffusion is to transport materials throughout the body. Therefore have evolved in such organisms to exchange materials between cells and their immediate surroundings

Substances that are transported in the body

- (oxygen, carbon dioxide), (glucose, amino acids, fatty acids, vitamins, etc.), products of metabolism (urea, ammonia, etc),

AL 2004

2. (A) (i) What is the overall function of the circulatory system of animals?
.....
.....
- (ii) What are the most important features of the circulatory system in animals?
.....
.....
- (iii) What is a closed blood circulatory system?
.....
.....
- (iv) How does a closed blood circulation differs from an open blood circulation?
.....
.....
- (v) Name a phylum having multicellular animals without a blood circulatory system
.....

AL 2013

3. (C) (i) What are the essential components of a blood circulatory system?
.....
.....
- (ii) Name the three components of the conducting system of human heart.
.....
.....
- (iii) State three functions of human lymphatic system.
.....
.....

AL 2018

- (A) (i) State the location of the pacemaker in the human heart.
.....
.....
- (ii) Name the arteries that arise first from the aorta and state the structure to which they supply blood.
- | Arteries | Structure |
|----------|-----------|
| | |
| | |
- (iii) State how blood circulatory system contributes to maintain constant body temperature in man.
.....
.....

- It is a circulatory system in which a fluid called that bathes the tissues and organs directly. There is between the and the surrounding cells. The heart pumps hemolymph through the circulatory vessels into the spaces (interconnected sinuses) which surround body tissues. occurs directly between the and Back flow of the hemolymph takes place via the pores (ostia) with valves found in the heart during the relaxation. The open circulatory system has evolved in some invertebrate phyla such as Arthropoda and Mollusca (some mollusc groups).

The closed circulatory system:

-
.....
Blood is pumped by the heart/s into large vessels. These large blood vessels into small vessels and they penetrate into the organs. Chemical exchange occurs between the blood and the interstitial fluid and interstitial fluid and body cells. It contain or hearts. This type of circulatory systems can be seen in and such as In comparison to open circulatory system enable effective delivery of oxygen and nutrients to the cells of larger and more active animals due to relatively high blood pressure.

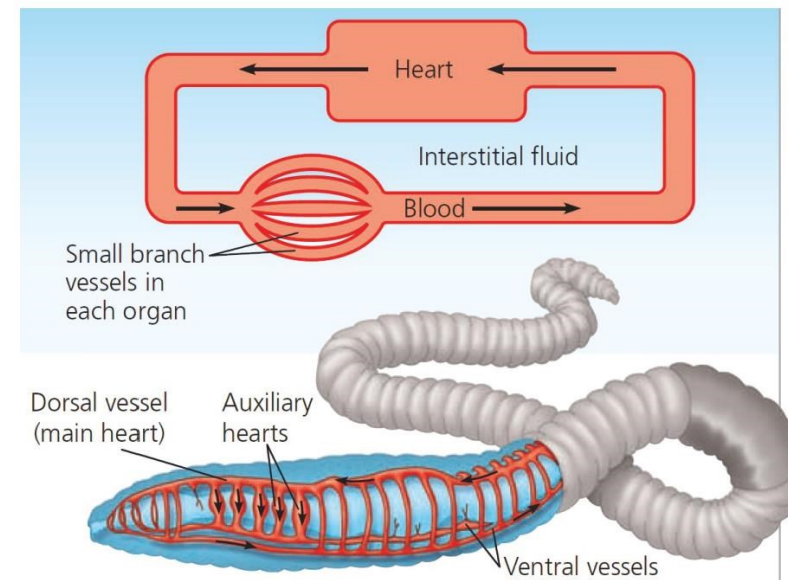


Fig 5.14: Closed blood Circulatory system of an Annelid

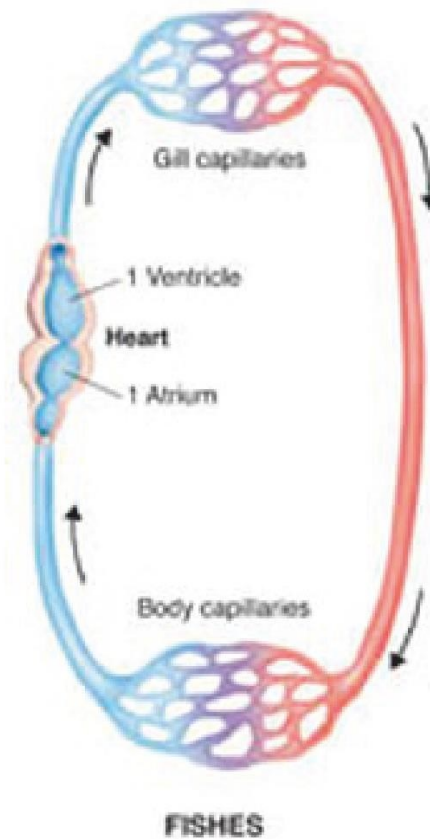
Organization of vertebrate circulatory systems: Single circulation and double circulation

- Vertebrates have a system where there are three main types of blood vessels: arteries, veins and capillaries. Within each type blood flows in only one direction. The blood vessels which carry blood from the heart to organs are called When these arteries branch into smaller vessels within organs they are called They pass blood to capillaries which are vessels with thin and porous walls. These are the places where materials exchange occurs between blood and interstitial fluid surrounding body cells through diffusion. Capillaries converge into venules and they converge into veins which carry blood back to the heart.

Single circulation

- During single circulation, in a

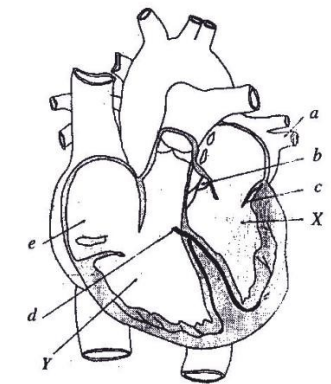
 In animals that demonstrate single circulation, posses chambers in the heart. They are and During a single circulation, the oxygen blood returning from the blood enters atrium and pass into the Then the ventricle is contracted, blood is pumped into the capillary bed in the There gas exchange occurs between the and the external environment. The O₂ is diffused into the blood while CO₂ is removed from the blood. Next the oxygen blood circulates throughout the body and reaches the body cells through blood capillaries.
 e.g.: Bony fishes, Cartilaginous fishes such as rays and sharks.



(B) The questions (i) – (iii) are based on the following diagram of a longitudinal section of the human heart

(i) Name the Structures labelled as a, b, c, d, and e .

- a
- b
- c
- d
- e



(ii) What is the function of c ?

.....

(iii) Why is the wall of X more muscular than that of Y?

.....

(iv) What is the pacemaker of the human heart?

.....

(v) Where is the pacemaker located in the human heart?

.....

(C) (i) What are the major events that take place in the human heart during the completion of one heart beat?

.....

(ii) What is the blood pressure of a normal healthy adult man at rest?

.....

(D) (i) What is the blood pigment found in annelids?

.....

(ii) Name the human white blood corpuscle that has a kidney shaped nucleus.

.....

(iii) What is the percentage range of these white blood corpuscles in the blood of a normal healthy adult person?

.....

(iv) State a major function of these white blood corpuscles.

.....

- (2) Left atrium will not completely empty during atrial systole.
- (3) Amount of blood that flows into right atrium . will be reduced,
- (4) Amount of blood that flows into lungs will be reduced.
- (5) Some amount of blood will flow into left atrium from left ventricle during ventricular systole. (AL 2021/20)

38. Which of the following statements regarding the lymphatic system of man is correct?
- (1) Lymph vessels differ from arteries due to absence of valves.
 - (2) Lymph drains into the arteries at the base of the neck via two large ducts.
 - (3) Composition of lymph is the same as blood plasma.
 - (4) Lymphatic system is involved in the absorption of vitamin C in the small intestine.
 - (5) Lymph nodes are mainly composed of connective tissues and white blood cells. (AL 2021/22)

39. The correct route of blood through the human heart from systemic circulation to pulmonary circulation and back to systemic circulation via aortic valve.
- (1) Left atrium, bicuspid valve, left ventricle, pulmonary valve, right atrium, tricuspid valve, right ventricle
 - (2) Right atrium, tricuspid valve, right ventricle, pulmonary valve, left atrium, bicuspid valve, left ventricle
 - (3) Left atrium, Tricuspid valve, left ventricle, pulmonary valve, right atrium, bicuspid valve, right ventricle
 - (4) Left ventricle, bicuspid valve, left atrium pulmonary valve, right atrium, tricuspid valve, right ventricle
 - (5) Right atrium, bicuspid valve, right ventricle, pulmonary valve, left atrium, tricuspid valve, left ventricle
- AL 2023 /20

Structured Essay

AL 2001

1. (A) (i) Explain briefly why a blood circulatory system developed during the evolution of animals.

.....

.....

.....

.....

.....

- (ii) What is an open blood circulatory system?

.....

.....

.....

.....

.....

- (iii) Name a phylum which includes animals with an open blood circulatory system?

.....

.....

.....

.....

.....

- (iv) What is meant by double circulation?

.....

.....

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.....

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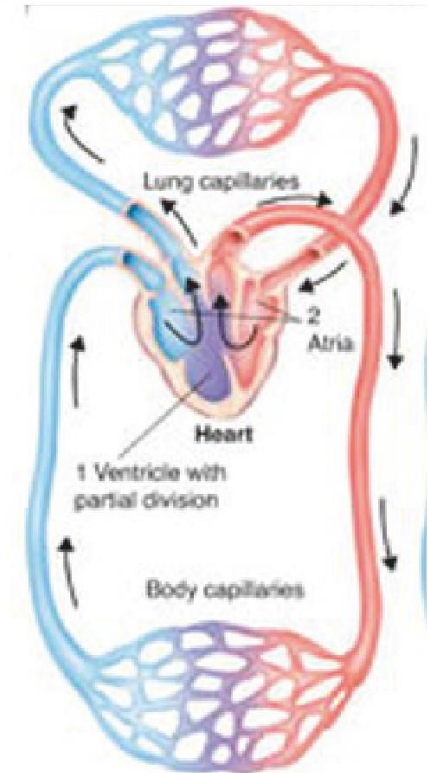
- (v) Name a class which includes animals with a complete double circulation.

.....

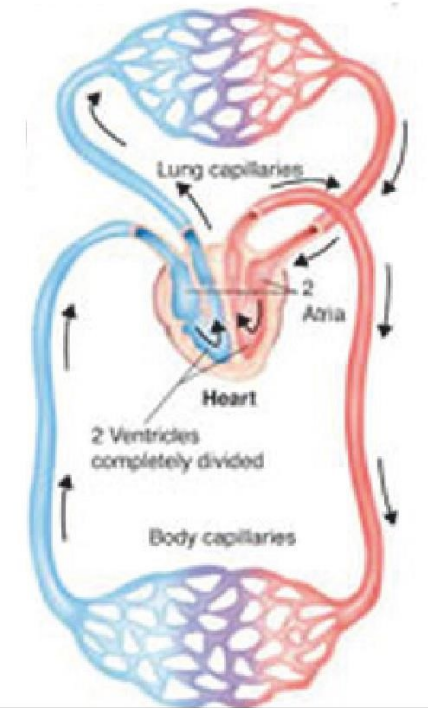
.....

Double circulation

- During double circulation,
.....
.....
- Such circulatory system consists of separate and circuits in which blood passes through the heart after completing
Eg. Amphibians, Reptiles.
- Amphibians and most reptiles have a chambered heart: two atria and one ventricle. and have a chambered heart where heart is completely divided into and sides. This arrangement allows the complete separation of oxygen enriched and oxygen poor blood. The oxygen poor blood from systemic circulation flows to the right atrium of the heart and then to the right ventricle. Right ventricle pumps blood into the lungs. Oxygen blood from the lungs reaches the left atrium and pass to the left ventricle. The ventricle pumps oxygen enriched blood into the systemic circulation. Double circulation is more effective in supplying blood to all body organs and tissues especially and due to the higher exerted by the heart in the circulation. This in contrast to single circulation where blood flows under reduced pressure from the gas

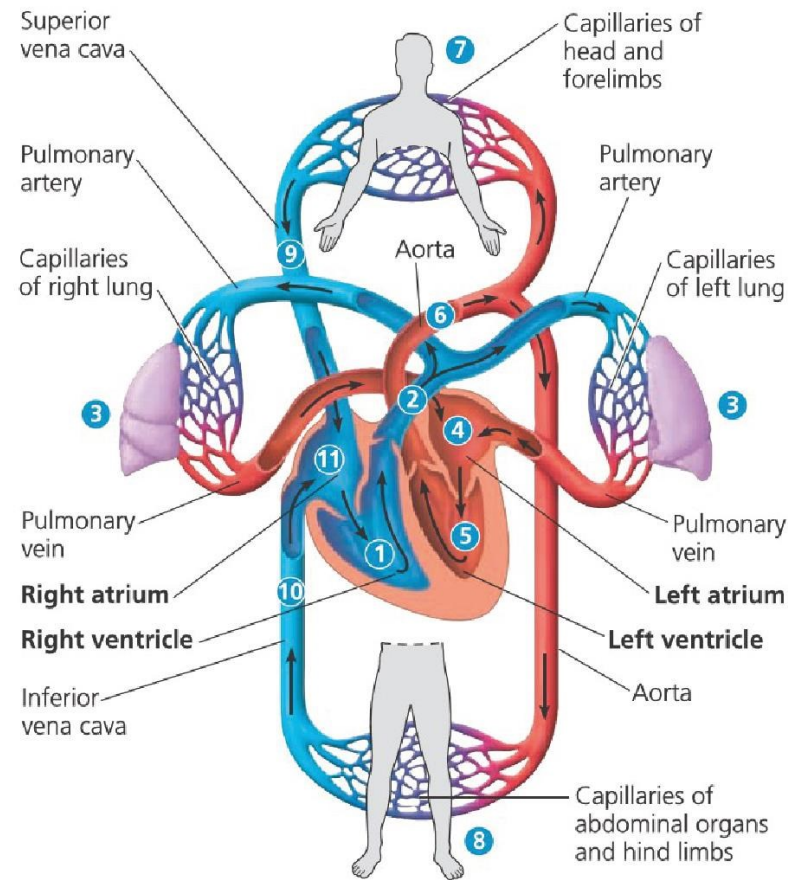


MOST REPTILES



Basic plan of human blood circulatory system and lymphatic system

Basic plan of human blood circulatory system



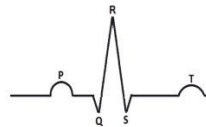
Basic plan of the human blood circulatory system

- Figure depicts the basic plan of the human blood circulatory system. The human heart consists of four chambers; they are two ventricles and two atria. There is a dual circuit which operates The pulmonary circuit takes oxygen poor blood to the respiratory surface, the lungs and the oxygen blood back to the heart, while the systemic circuit supplies oxygen blood to all and in the body and returns oxygen blood from organ and tissues back to the heart. Each circuit consists of major,, beds, and major veins. During ventricular contraction. the right ventricle pumps the oxygen poor blood into the two lungs via the pulmonary arteries.

- Pace-maker is made up of
(1) Cardiac muscles (2) Striated muscles (3) Visceral muscles (4) Neurons (5) None of these
- The typical Lubb-dup sound heart in the heart beat of a healthy person is due to,
(1) Closing of the tricuspid and bicuspid valves followed by the closing of the semilunar valves
(2) Closing of the semilunar valves (3) Closing of the tricuspid and bicuspid valves
(4) Blood flow through aorta (5) Contraction of atriums and ventricles
- Blood circulation that starts in capillaries and ends in capillaries is called
(1) Portal circulation (2) Hepatic circulation (3) Lymphatic circulation (4) Renal circulation (5) None
- The oxygenated blood is carried by all the following arteries except the,
(1) Renal artery (2) Coronary artery (3) Carotid artery (4) Pulmonary artery (5) Coronary artery
- Which of the following has the thickest wall?
(1) Left auricle (2) Right auricle (3) Right ventricle (4) Left ventricle (5) Interventricular septum
- Which of the following blood vessels normally carry largest amount of urea?
(1) Hepatic portal vein (2) Hepatic vein (3) Renal artery (4) Hepatic artery (5) Carotid artery
- The wall of heart is made of
(1) Epicardium (2) Myocardium (3) Endocardium (4) Pericardium (5) All of the above
- Which one of the following receives oxygenated blood only?
(1) Gill (2) Lung (3) Liver (4) Spleen (5) Heart
- What is the dissimilarity between lymph and blood?
(1) Both have leucocytes (2) Both have plasma proteins (3) Both have nutrients (4) Both have waste materials
(5) Both have hormones
- At diastolic phase blood in inferior vena cava flow Right atrium. This is due to
(1) Gravitation force. (2) Closure of valves. (3) Due to the pressure difference of chambers.
(4) SA node activity. (5) Contractions of vena cava wall. (AL 1990)
- Which one of the following statements regarding human heart is correct?
(1) It is made up of long and cylindrical fibres. (2) The right atrioventricular valve is bicuspid.
(3) The rate of heart beat is increased by stimulation of the parasympathetic nervous system. -, ,
(4) Duration of atrial systole is 0.1 seconds.
(5) Ventricular depolarization is represented by T wave in the electrocardiogram (ECG). (AL/2014)
- Which of the following is not a part of the conducting system of human heart?
(1) Chordae tendineae (2) Atrioventricular (AV) node (3) Bundle of His (4) Sino -auricular (SA) node
(5) Purkinje fibres (AL/2016/14)
- Select correct statement regarding the blood circulatory system of animals
(1) Nematods and echinodermates do not have blood circulatory systems
(2) Insects and tapeworms posses open blood circulatory systems
(3) Annelids and fishes have closed blood circulatory system
(4) Chlorocruorin function as a respiratory pigment in crustaceans
(5) Atrioventricular (AV) node function as a pacemaker of the human heart. (2017/17)
- Which of the following statements regarding circulatory system of animals is correct?
(1) Open circulatory system with ventral heart is present in mollusks.
(2) Closed circulatory system is found in nematodes.
(3) Haemoerythrin is the blood pigment of crustaceans.
(4) AV node is the pacemaker of human heart.
(5) In human heart, mitral valve is found between the left auricle and left ventricle. (2018/14)
- Which of the following is most likely to happen if -tricuspid valve of the human heart does not close properly?
(1) Right atrium will not completely empty during atrial systole.



5. This question is based on the blood circulatory systems of the following animals.
 a. Turtle b. Slug c. *Ichthyophis* d. Cockroach e. Octopus f. Spider g. Nereis
 Which of the above animals have an open blood circulatory system?
 (1) a, c and g only (2) a and c only (3) b and e only (4) b, d, e and f only (5) b, d and f only (AL/2013 New)
6. Which of the following indicates the blood vessels in correct sequence that a molecule of urea passes from its site of production to site of excretion in man?
 (1) Hepatic vein → inferior vena cava → pulmonary vein → pulmonary artery → aorta → renal artery
 (2) Capillaries → venules → veins → inferior vena cava → renal vein
 (3) Hepatic vein → inferior vena cava → pulmonary artery → pulmonary vein → aorta → renal artery
 (4) Capillaries → venules → veins pulmonary vein → pulmonary artery → aorta → renal artery
 (5) Capillaries → arterioles → arteries → aorta → dermal arteries → arterioles capillaries (AL/2010)
7. Select the correct statement regarding human heart.
 (1) Myocardium of left atria is thicker than that of the right atria.
 (2) Cuspid valves are closed by its muscle fibres.
 (3) Right atrium receives deoxygenated blood only by superior and inferior vena cava.
 (4) Chorda tendineae join atrio-ventricular valves to papillary muscles.
 (5) Coronary circulation is associated with systemic circulation. (Proto type 2011)
8. Which of the following statements regarding human lymphatic system is incorrect?
 (1) This system collects most of the interstitial fluids. (2) It is connected with the blood circulatory system.
 (3) Tonsils are part of the lymphatic system. (4) It is involved with immune responses.
 (5) Like veins, lymph vessels lack valves. (AL /2012)
9. The diagram given below represents a normal ECG tracing of man. Contractions of ventricle is represented by
 (A) Q. (B) P. (C) R. (D) S. (E) T. (AL / 2012 old)
10. Which one of the following statements regarding SA node of man is correct?
 (1) It is located in the wall of right auricle close to inter-auricular septum.
 (2) Purkinje fibres originate from it.
 (3) It is stimulated by the impulses received from the pacemaker of heart.
 (4) Stimulus for heart beat originates from it.
 (5) It consists of nervous tissue. (AL /2013 New)
11. The cells constituting walls of the blood capillaries are known as
 (1) Parietal cell (2) Haemocytes (3) Podocytes (4) Endothelial cells (5) Visceral
12. The correct pathway of blood is,
 (1) Ventricles, atria, veins, arteries (2) Atria, ventricles, arteries, veins (3) Ventricles, veins, arteries, atria
 (4) Atria, veins, arteries, ventricle (5) All are incorrect
13. The dorsal aorta starts from the
 (1) Right ventricles (2) Left ventricles (3) Right atrium (4) Left atrium (5) Pulmonary artery
14. The pace-setter in heart is called
 (1) Purkinje fibres (2) Sinu-atrial node (3) Papillary muscles (4) Atria-ventricular node (5) Bundle of His
15. The heart sound “dup” is produced when
 (1) Tricuspid valve opens (2) Semilunar valves closes (3) Mitral valve closes (4) Mitral valve opens
 (5) Tricuspid valve closes
16. Pulmonary artery originates from the
 (1) Left ventricle (2) Left atrium (3) Right ventricle (4) Aorta (5) Right atrium
17. The origin and conduction of beat is represented by
 (1) SAN, AVN, Bundle of His, Purkinje fibres (2) SAN, AVN, Purkinje fibres, Bundle of His
 (3) AVN, Bundle of His, Purkinje fibres (4) AVN, SAN, Bundle of His, Purkinje fibres
 (5) AVN, Purkinje fibres, Bundle of His



Three empty rectangular boxes stacked vertically for answer input.

A 2x2 grid of empty square boxes for answer input.

One empty rectangular box for answer input.

One empty square box for answer input.

Four empty rectangular boxes stacked vertically for answer input.

- Then in the lungsis loaded into the blood through diffusion while is unloaded from blood into the external environment.
- This process occurs in the in the left and right Then the oxygen rich blood is transported into the left atrium via the two pairs of pulmonary veins. During atrial contraction, this oxygen blood is transported into the left ventricle. During ventricular contraction oxygen rich blood is pumped into the Through arteries the aorta conveys this oxygen rich blood throughout the body. First the aorta branches into the arteries which supplies blood into the heart muscles. Then the aorta branches into arteries, arterioles leading to capillary beds in the head and arms and the capillary beds in the abdominal organs and legs. The exchange of gases occurs in the capillary beds Where O₂ is diffused into the tissues while the CO₂ diffused into the blood capillaries. These blood capillaries rejoined to form venules which direct oxygen poor blood into veins. Oxygen poor blood from and is drained into the inferior vena cava and oxygen poor blood from the head, neck and fore limbs are directed into the superior vena cava. The blood from both inferior and superior vena cava is transported into the atrium where it is passed into the right ventricle. This blood is directed to the pulmonary circuit as explained above.

Basic plan of human lymphatic system

- The lymphatic system is connected with the system both and It consists of through which lymph travels. Other structures in the lymphatic system includes, (cg. tonsils) and (e.g. spleen and thymus). Lymph vessels consist of tiny vessels and larger vessels. lymph vessels are in close contact with the of the blood circulatory system. Lymph nodes are composed of and cells.
- The lymphatic system lost and proteins from the blood capillaries back into the blood. The lost fluid from the blood capillaries is called when they are inside the lymphatic system. The composition of the lymph is same as Lymph vessels have That prevents the of the lymph. The lymph is drained into veins at the base of the neck via two large ducts. The rhythmic contraction of the lymph vessel walls

- Names the major parts of the lymphatic system
.....
- Describes the structure and functions of the human heart by using a suitable diagram (essay)**
- Describes the three major steps of the human cardiac cycle;
.....
- States what is stroke volume
.....
- Briefly explains what is E.C.G.
.....
- Identifies the peaks of an E.C.G. of a healthy person and name them
.....
- States how the functions of the heart can be discovered by the aid of an E.C.G.
.....

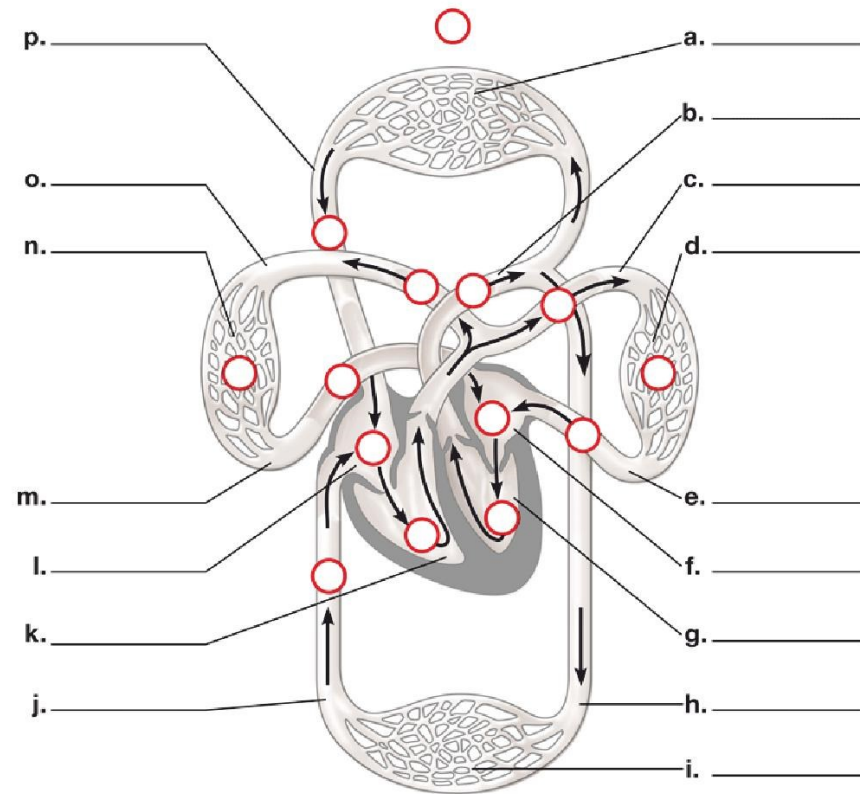
MCQ

- What are the characteristic features of circulatory system of insect?
(1) Network of blood capillaries. (2) Blood bathe organs. (3) Blood without cells. (4) Pigments dissolved in blood plasma. (5) Muscular heart with chambers. (AL 1988)
- Vertebrates differ from invertebrates due to presence of
(1) Closed circulatory system (2) Coelom (3) Ventral heart (4) Internal gills (5) Joint appendages
- A student examining a specimen of an earth-worm dissected by the teacher, observed that the
(1) hearts lie in the middle area. (2) hearts lie ventrally to the digestive tract (alimentary canal) (3) hearts contain ostia (4) hearts occur in pairs. (5) hearts lie bathed in blood in blood sinuses (AL/2002)
- Blood circulatory system found among animals are as follows.
(A) Open circulatory system (B) Closed single circulatory system. (C) Closed double circulatory system. Which of the following indicates in correct order, the animals which posses the above circulatory system A, B and C?
(1) Spider, snail and rat (2) Centipede, Ichthyophis and bat (3) Crab, earthworm and turtle (4) Sea urchin, Shark and crow (5) Cockroach, Nereis and octopus (AL/2011)

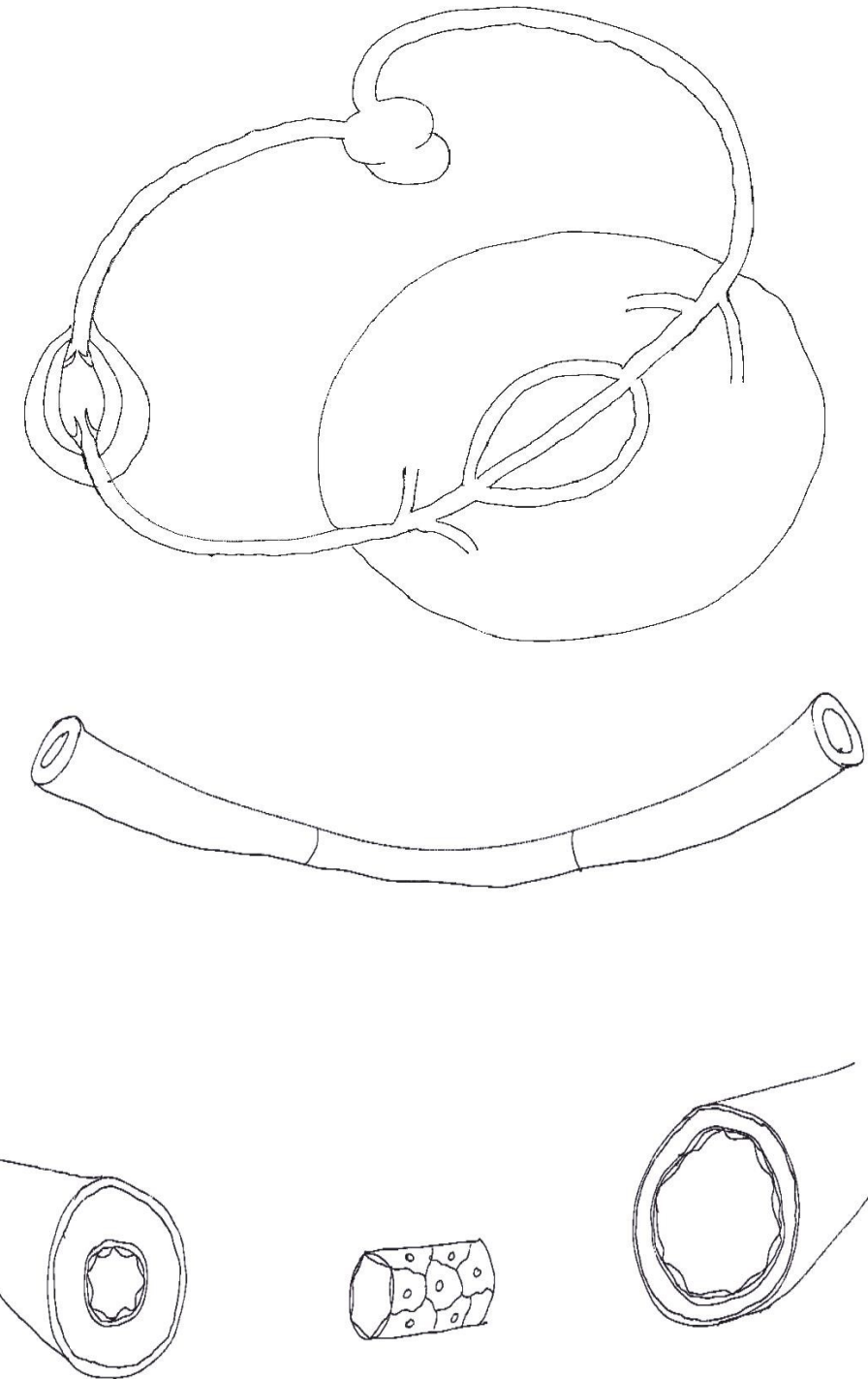
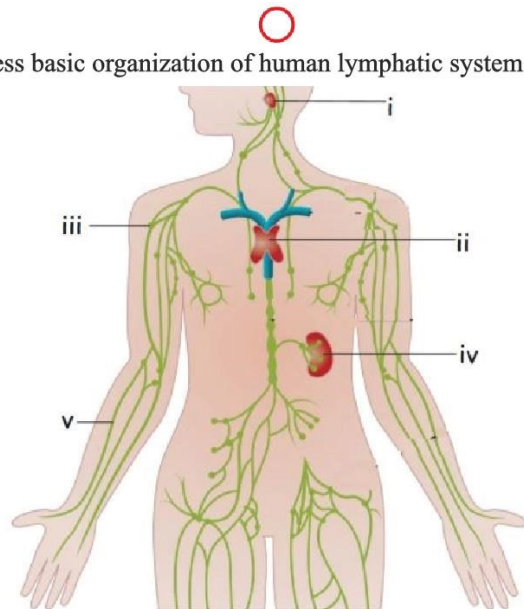
5.3.2 Relates the structure of then human circulatory system to its functions

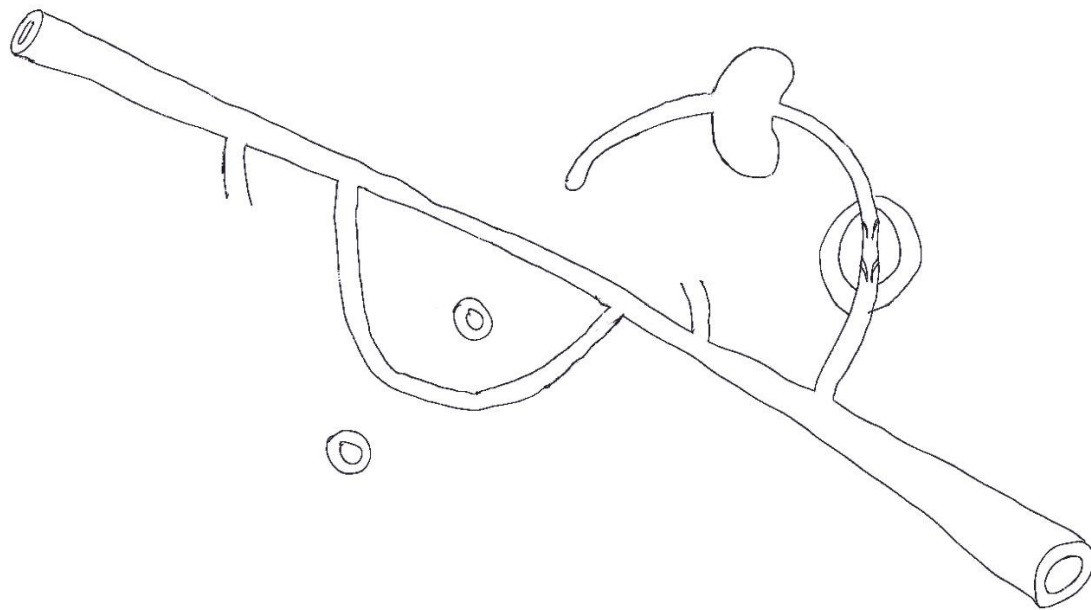
Learning Outcomes:

- Briefly explains the basic plan of the human blood circulatory system by using a flow chart



- label the sketch to express basic organization of human lymphatic system



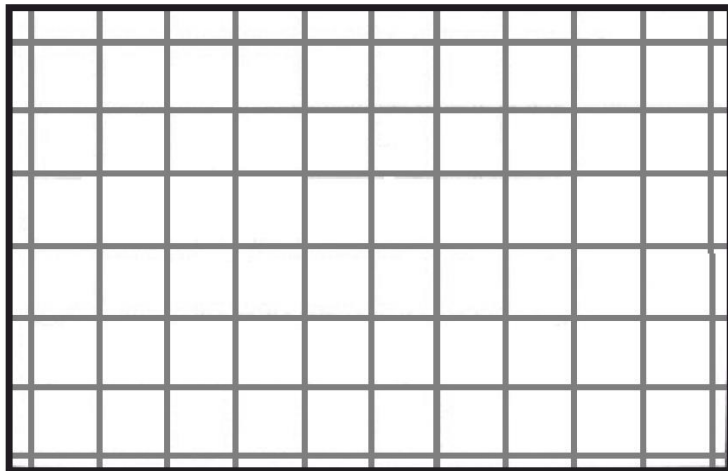


5.3.1 : Investigates the organization of circulatory systems in animals

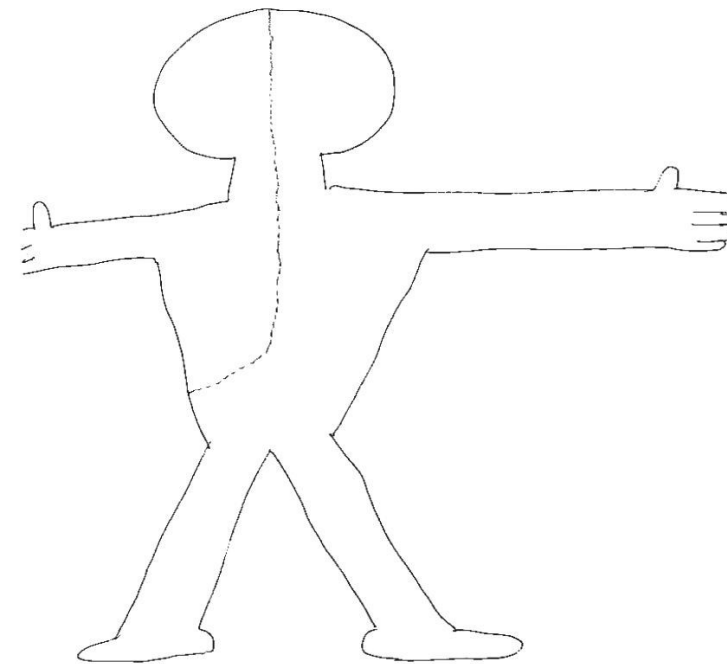
Learning Outcomes:

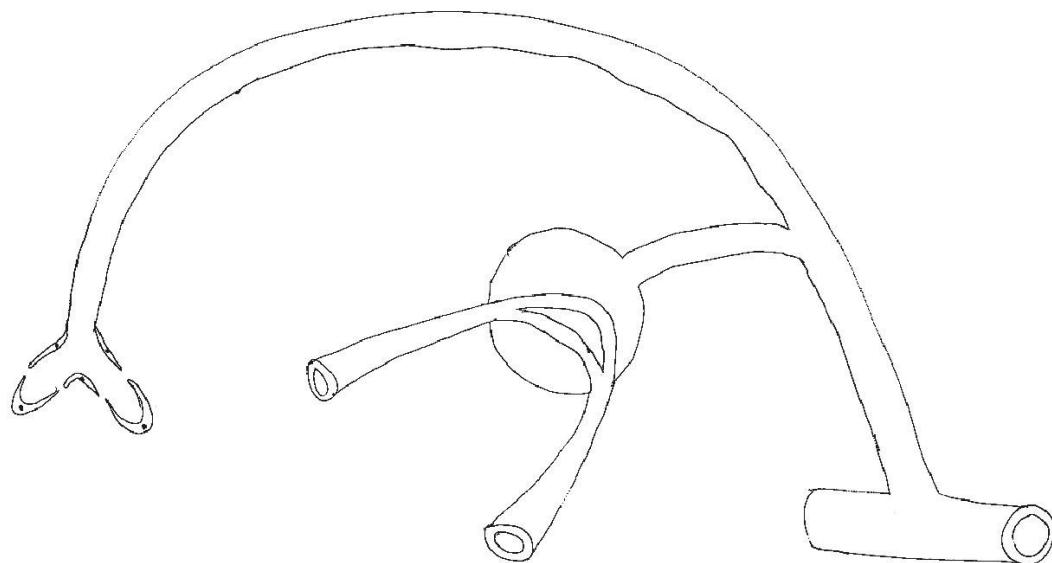
1. States the need of a circulatory system for animals
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.....
2. Lists the substances that are transported in the animal body
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.....
.....
3. Name the major components of a blood circulatory system?
.....
.....
.....
4. Names the types of various circulatory systems in the animal kingdom
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.....
.....
5. Compares the basic features of the open and closed circulatory systems
.....
.....
.....
.....
6. Names the animal phyla related to the open and closed circulatory systems
.....
.....
.....
7. Compares the basic features of single and double circulation to describe the organization of vertebrate circulatory systems
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.....
.....
8. States the importance of double circulation
.....
.....
.....
9. Appreciates the importance of circulatory systems for the functioning of complex multi-cellular organisms
.....
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.....
.....

- **P wave** - It represents the impulse from the SA node as it sweeps over the atria (atrial depolarization).
- **QRS wave complex** — Represents rapid spread of impulse from the AV node throughout the ventricles and electrical activity of the ventricular muscles. (ventricular depolarization)
- **T wave** — Represents ventricular repolarization and relaxation of the ventricular muscles. Due to the larger QRS complex, atrial repolarization which occurs during ventricular contraction is not seen.
- Information about the heart function of a person (state of the myocardium and the cardiac conduction system) can be obtained by examining the pattern of waves and the time interval between cycles and parts of cycles.



and muscle contraction help to move the lymph. The functions of human lymphatic system include to maintain the blood volume in the blood circulatory system, from the small intestine and for

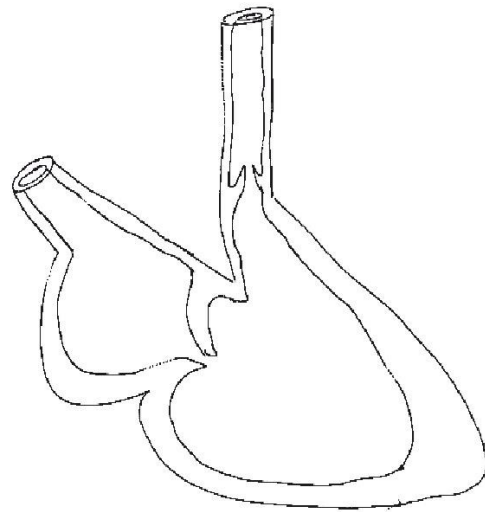
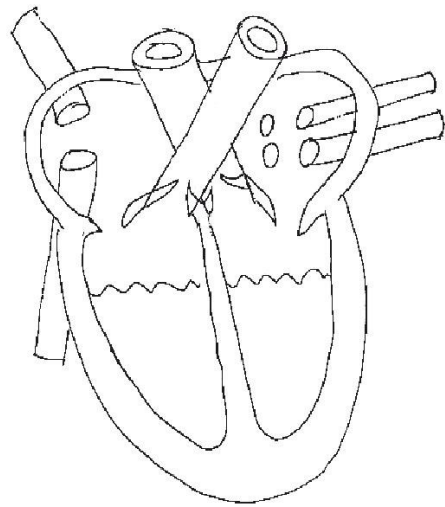
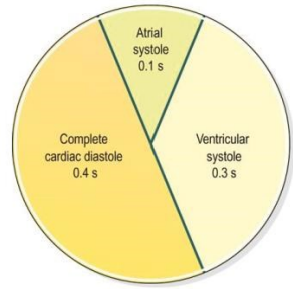




Electrocardiogram (ECG)

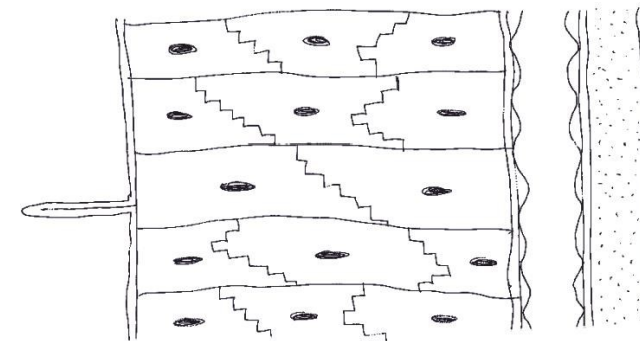
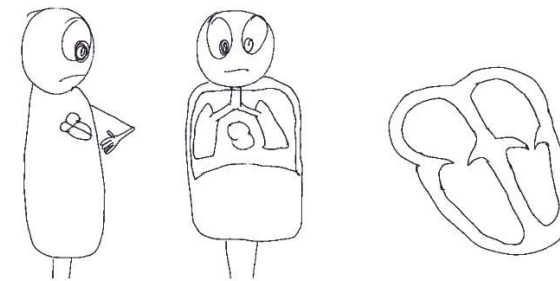
- Electrical activity in the heart can be detected on the surface of the skin by placing electrodes on the chest or limbs as the body tissues and fluids conduct electricity well. Such a recording is called an electrocardiogram (ECG). The ECG indicates the spread of the electrical signal generated by the SA node as it travels throughout the heart. The normal ECG tracing of a healthy individual shows five waves which by convention have been named P, Q, R, S and T.





Structure and function of the human heart

- The human heart is roughly a cone shaped hollow muscular organ. The heart wall is composed of three layers of tissues: Pericardium, Myocardium, Endocardium.
- Pericardium: The pericardium is the most layers. It is made up of two sacs: The outer pericardium and inner pericardium.
- Myocardium: Myocardium is the layer of the heart wall. It is composed of specialized cardiac muscle found only in the heart. Running through the myocardium is also a of conducting fibres responsible for transmitting the heart's signals.
- Endocardium: Endocardium is the layer of the heart wall. It lines the chambers and valves of the heart. It is a smooth membrane and consists of flattened epithelial cells. It is continuous with the endothelium lining of the blood vessels.



Complete cardiac diastole

- This lasts for second. Both atria and ventricles are relaxed and blood return to the heart. The superior vena cava and the inferior vena cava transport oxygen poor blood into the right atrium. At the same time as the four pulmonary veins bring oxygen rich blood into the left atrium.

Atrial systole

- When blood flows into the atrium SA node is stimulated. The electrical impulses generated in the SA node, trigger a wave of contractions that spreads over the myocardium of both atria. Hence the remaining blood in the atria flows into the ventricles thereby emptying the atria. This lasts for second.

Ventricular systole

- Through the atrial muscles the electrical impulses reaches the AV node. However, atrio - ventricular transmission is (by a fraction of a second) at the This allows the atria to emptying into ventricles before ventricles start to contract. After this delay, AV node triggers its own electrical impulses which quickly spread to the ventricular muscles via the AV bundle. the bundle branches, and Purkinje fibers. This results in a wave of contractions which sweep upwards from the apex of the heart across the wall of the ventricles. As a result both contract. The pressure in the right ventricle is more than the pressure in the pulmonary artery and the pressure in the left ventricle is more than pressure in the aorta. Therefore pulmonary valve and aortic valves open and blood flows into pulmonary artery and aorta respectively.
- The high pressure generated during ventricular contractions force the atrioventricular valves to preventing of blood into the atria. Ventricular systole lasts for seconds. When ventricles, the pressure within them falls. The and valves Pressure within the pulmonary artery and aorta is more than pressure within the ventricles. The valves of the heart and great vessels open and close according to the pressure within the chambers of the heart. The sequence of and of ensure that blood flows only in direction.

SA node / Sinoatrial node

- SA node is a small mass of specialized cells.
.....
The stimulus for contraction of the heart originates in the "SA node". The SA node
..... the heart beat and sets the of the heart beat so it is called
the But the heart rate can be varied by the stimulation from
the nervous system, such as adrenaline thyroxine
and temperature

AV node

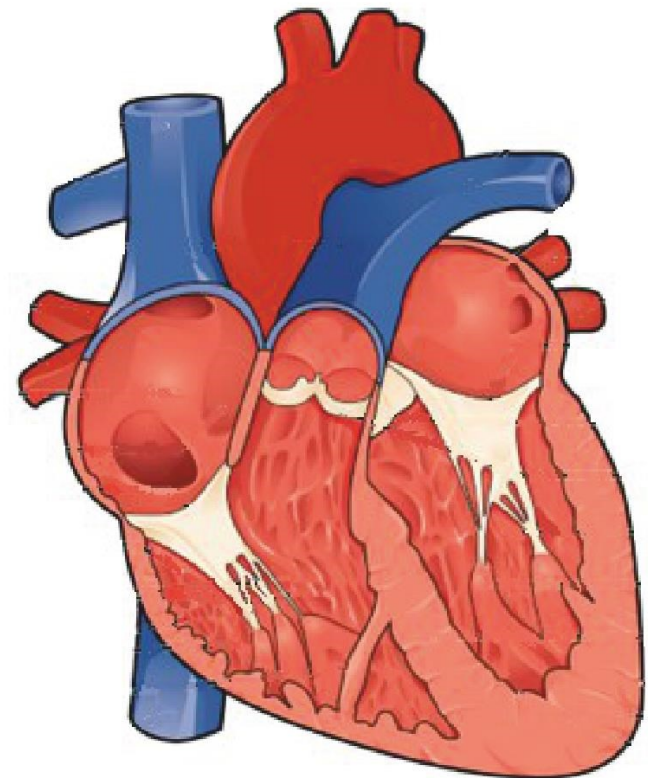
- AV node is also a small mass of specialized cells.
.....
The AV node transmits the electrical signals from the atria into the ventricles.

Atrioventricular bundle (bundle of His), bundle branches and Purkinje fibres

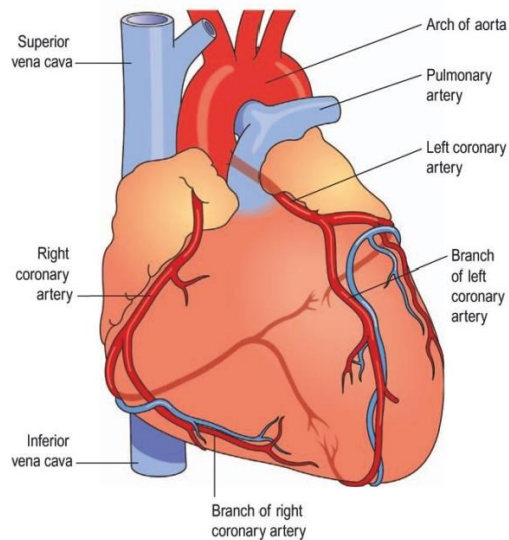
- AV bundle is a mass of specialized fibers. It originates from the AV node. The AV bundle
crosses the that atria and
ventricle at the upper end of the It divides into
right and left bundle branches. Within the ventricular myocardium the branches break up in-
to fine fibres. These fine fibers are fibers. The AV bundle branches and
the Purkinje fibers transmit electrical impulse from the AV node to the apex of the myocardi-
um. As a result of this impulse, wave of ventricular contractions begin. Then the contraction
..... and pumping blood
into the pulmonary artery and the aorta.

The cardiac cycle

-
..... During this process one complete cy-
cle of pumping and filling of blood into the heart occurs. Complete cardiac cycle lasts for
..... second. It occurs as follows:
1. - Contraction of the atria
2. - Contraction of the ventricles
3. - Relaxation of the atria and ventricles
- At rest the healthy adult heart is likely to beat at a rate of beats per minute.
During a single heart beat, the heart contracts (systole) and then relaxes (diastole).
During a single contraction the amount of blood pumped by a ventricle is called the



- There are four chambers in the heart : two upper atria and two lower ventricles.
..... Wall of the left ventri-
cle is thicker than walls of the right ventricle because the right ventricle pumps blood to the
lungs which are to the heart whereas the ventricle has to
pump blood throughout the body. Therefore the blood entering the aorta from the left ventri-
cle is at much blood pressure than the blood entering the pulmonary
artery from the right ventricle.



- The heart is completely divided into a right and left side by a septum. The atria and ventricles on each side are divided by an atrio-ventricular valve (AV). The right atrioventricular valve has three flaps hence known as tricuspid valve and the left atrioventricular valve has two flaps hence known as bicuspid valve. Conical shaped papillary muscles are extensions of the inner wall of the ventricles. Atrio-ventricular valves attached to the papillary muscles by fibrous cords which are called chordae tendineae. Atrio-ventricular valves are anchored by strong fibres. This prevents the valves from being turned inside out. Semilunar valves are found at the points where the pulmonary artery and aorta leave the right and left ventricles respectively. These valves prevent the back flow of blood into the ventricles.
- The pulmonary artery with oxygen poor blood leaves the heart from the upper part of the right ventricle. This pulmonary artery divides into left and right pulmonary arteries and carries Oxygen poor blood to the lungs. Two pulmonary veins from each lung carry oxygen rich blood back to the left atrium. The aorta with oxygen rich blood leaves from the upper part of the left ventricles. The superior vena cava and inferior vena cava open into the right atrium and empty their contents into the right atrium. The heart is supplied with arterial blood by the right and left coronary arteries which branch from the aorta immediately after the aortic valve.

The conducting system of the heart

- Heart generates its electrical impulses and beats of or control. However it is supplied with both and nerve fibers which and respectively the heart rate. In addition to that heart responds to a number of circulating including and Small group of specialized cells in the initiate and conduct The conducting system of the heart consists of following specialized system.

1. (Sinoatrial node)
2. (Atrioventricular node)
3. (bundle of His), bundle branches and Purkinje fibres

