Life Processes

Transportation in Human (Blood Vasculatory System)

Transportation in Humans:

In humans there is a circulatory system that uses blood or lymph as carriers of materials (fluid exchange medium).

Circulatory system consists of:

(i) **Blood circulatory system**

(ii) **Lymphatic circulatory system**

(i) Blood circulatory system in human beings It comprises:

(a) Blood

(b) Blood Vessels

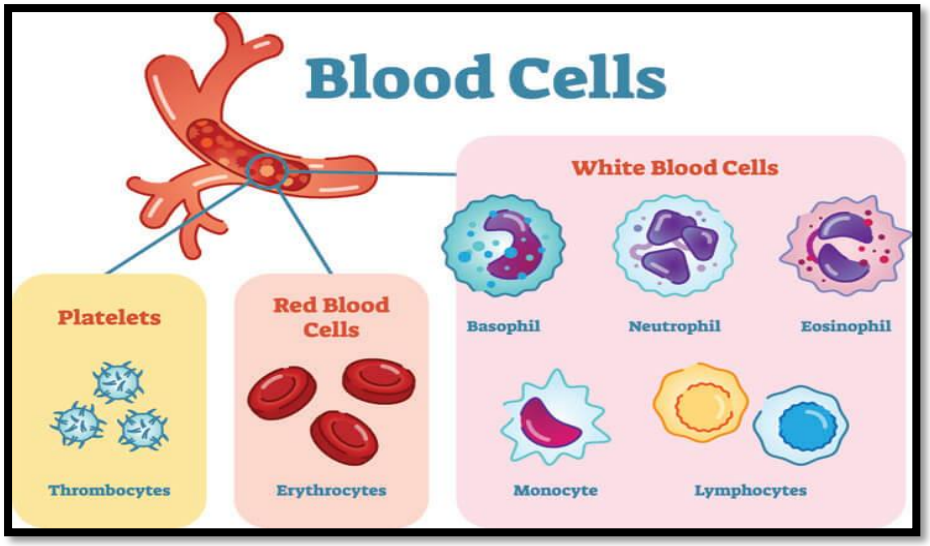
(c) Heart (Pumping organ)

(a) Blood

Blood is fluid connective tissue which is made to circulate, by the muscular pumping organ called as the heart. In adult human beings there is 5.5 to 6 liters of blood.

Composition of Blood:

Liquid part	-	(Matrix) – Blood plasma
Solid part	-	Blood corpuscles – (RBC, WBC and Platelets)



Plasma :

It composes 55 % of blood.

The plasma has 90-92 % water and remaining 8 %-10 % are other materials.

The plasma is a faint yellow viscous fluid.

Plasma contains some soluble proteins (serum albumin, serum globulins, prothrombin and fibrinogen), inorganic salts, food materials, waste products, dissolved gases, anticoagulants and antibodies.

Function of Plasma:

(i) Transportation of nutrients, respiratory gases, excretion of wasters and hormones of endocrine glands.

(ii) Prothrombin and fibrinogen plasma proteins help in blood clotting at injuries.

(iii) Globulins of blood plasma act as antibodies and provide immunity (disease resistance) to body.

(iv) Plasma also help in transportation of minerals like iron, copper ets.

(1) Blood Corpuscles:

They form 45 % part of blood. They are of three types.

- ◆ Erythrocytes or Red Blood Corpuscles (RBC)
- ◆ Leucocytes or White Blood corpuscle (WBC)
- ◆ Platelets or Thrombocytes

(i) Red Blood Corpuscles (RBCs) or Erythrocytes:

- ➢ Mammalian RBC is a biconcave / disc-like structure devoid of nucleus.
- ➢ The number of RBCs is about 5-5.5 million per mm 3 of blood (RBC count).
- ➢ The mammalian erythrocytes (RBCs) do not possess nuclei, mitochondria and endoplasmic eticulum.

  The erythrocytes contain haemoglobin.
- ➢ Haemoglobin consists of globin (protein) and $Fe^{2}+$ (haem).
- ➢ 100 ml of blood contains 15 gm of haemoglobin. if the amount of haemoglobin in blood is less, the person suffers from anaemia.
- ➢ Haemoglobin content of normal human male is 14.5 ± 2-gram percent, while it is 12 ± 2-gram percent in a normal human female.

- The haemoglobin carries oxygen to the different cells of the body.
- The life span of a RBC is 120 days.

(ii) White Blood Corpuscles (WBCs) or Leucocytes:

White blood cells are called as soldiers of the body. This is because they protect the body from the attack of disease-causing germs (pathogens) and other harmful foreign materials.

- These are rounded or amoeboid-shaped, nucleated and non-pigmented cells. These are less in number than RBCs.
- These are 5000 – 10000 per mm3 of blood (WBC count).
- The number of leucocytes increases in infections like pneumonia, blood cancer (Leukaemia) etc.
- These are large in size than RBCs and contain nucleus. White blood corpuscles are of two types

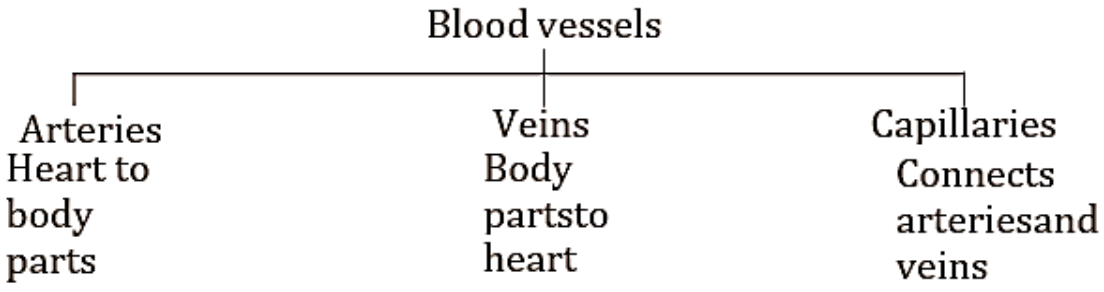
Granulocytes : In granulocytes the cytoplasm contains granules and the nucleus is multilobed. Neutrophils, Basophils and Eosinophils are three different types of granulocytes.

Agranulocytes : Monocytes and lymphocytes are two different types of agranulocytes. Lymphocytes secrete antibodies which destroy microbes.

(iii) **Blood platelets:** These are small and without nuclei. Their number varies from 0.15 to 0.45 million in 1 ml of blood. Their normal life span is one week. These help in blood clotting at the site of injury by liberating thromboplastin.

(b) Blood Vessels

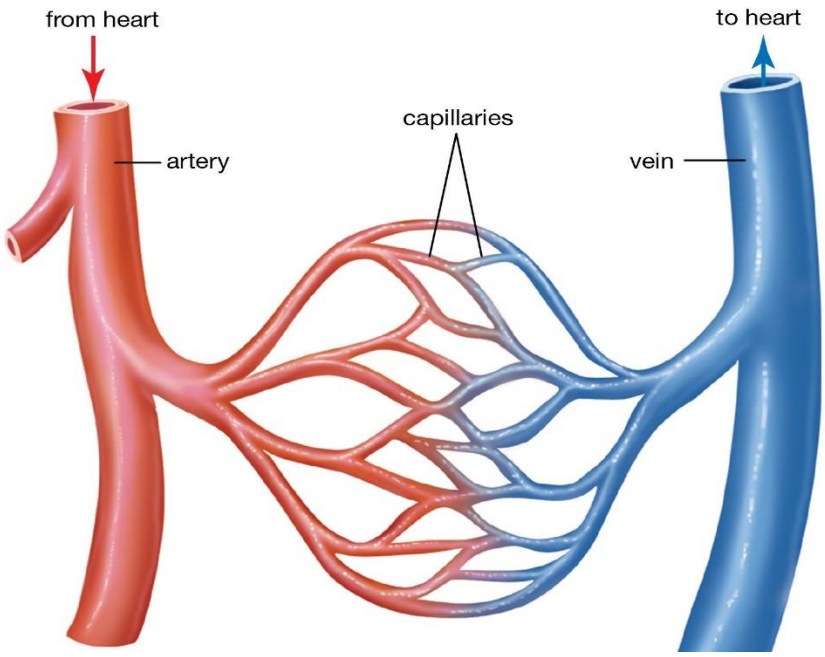
Blood Vessels are tubes in which blood flows. There are 3 types of blood vessels



(i) Arteries - are wide, thick wall and elastic; with narrow lumen and carry oxygenated blood away from heart (pulmonary artery is an exception as it carries deoxygenated blood).

(ii) Vein - thin walled, with wide lumen and contain valves to prevent back ward flow of blood. Carry deoxygenated blood towards heart (pulmonary vein is an exception as it carries oxygenated blood).

(iii) Capillaries - fine, thin wall branches that supplies to tissue and from these capillaries exchange of materials, gases take place between blood and tissues.



Difference between Artery and Veins

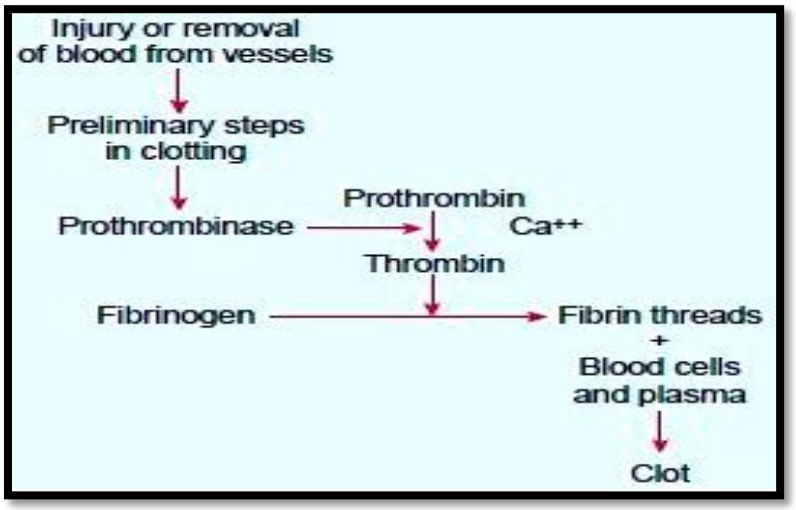
S.NO.	CHARACTERS	ARTERY	VEIN
1.	Direction of blood flow	Away from the heart.	Towards the heart.
2.	Nature of blood	Generally oxygenated.	Generally deoxygenated.
3.	Position	Deep seated.	Superficial.
4.	Nature of wall	Thicker & more elastic	Thinner & less elastic.
5.	Pressure & speed of blood.	At higher pressure & faster.	At low pressure & slower.
6.	Valves	Absent	Present

Functions of Blood:

1. Transportation of oxygen from lungs to tissues.
2. Transportation of carbon dioxide from the tissue to the lungs.
3. Transportation of excretory material from the tissues to the kidneys
4. Transportation of digested food from the small intestine to the tissue.
5. Distribution of hormones and enzymes.
6. Formation of clots to prevent blood loss.
7. Distribution of heat and temperature control
8. Protection from infection and wound healing

Blood clotting: Blood forms a clot at the site of injury and thus prevents the further loss of blood.

- Thromboplastin changes prothrombin of blood plasma into thrombin.
- Thrombin converts soluble protein fibrinogen to insoluble fibrin.
- Fibrin forms a network which entangles RBCs and blood platelets to form plug or clot over the injured area.
- Blood clotting is usually completed within 8-15 minutes.

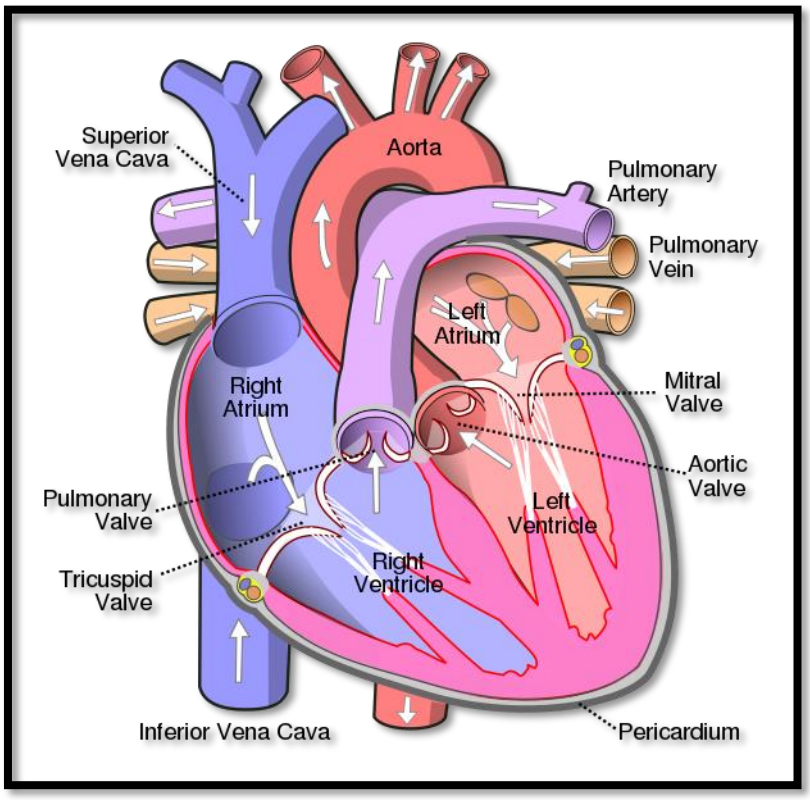


(c) Heart

Heart is muscular involuntary organ, which is as big as our fist. It is made up of cardiac muscles which work rhythmically. Heart is situated in middle of chest cavity but it is tilted towards left. Heart is divided into chambers.

Number of chambers varies in different animals:

- Heart is a hollow muscular organ that lies obliquely in the thoracic region in a cavity between the two lungs that is pericardial cavity. It is lined by 2 layers outer and inner pericardial membranes.



- These are filled with a fluid called "pericardial fluid". It protects the heart from shock and injury. Heart is made up of 4 chambers : upper 2 chambers are auricles or atrium and the lower 2 chambers are ventricles.
- Auricles are the receiving chambers and ventricles are the pumping chambers. Walls of ventricles are thicker as they have to pump the blood.
- Four pulmonary veins enter into left auricle, two from each lung bring oxygenated blood. There is one auriculoventricular aperture with a bicuspid or mitral valve in left auricles which opens into left ventricle.
- Left ventricle has aortic valve having 3 semilunar cusps for large artery i.e. dorsal aorta which takes the oxygenated blood to all body parts.
- Right auricle has openings for superior venacava that brings deoxygenated blood from head, neck and upper limbs, inferior venacava receives deoxygenated blood from rest of the body and lower limbs. Blood enters in to right ventricle through tricuspid valve. A coronary sinus that drains venous blood

from heart muscles. Right ventricle has semi-lunar valves for vein i.e. pulmonary vein which takes de-oxygenated blood to the lungs.

Types of circulation:

(1) **Single circulation** : In this, blood passes once through the heart to supply once to the body. It is found in fishes which have two chambered (one auricle and one ventricle), venous and branchial heart.

(2) **Double circulation** : A circulatory system in which the blood travels twice through the heart in one complete cycle of the body is called double circulation.

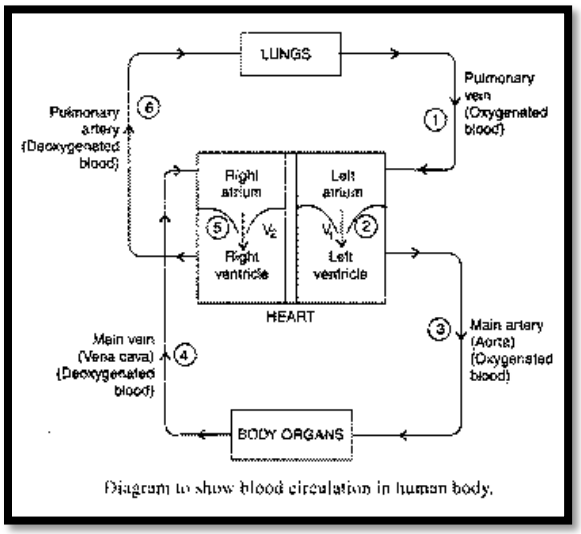


Diagram to show blood circulation in human body.

Double circulation involves two circulations :

Systemic circulation : Blood completes its circulation from left ventricle to right auricle through the body organs.

Pulmonary circulation : Blood completes its circulation from right ventricle to left auricle through the lungs.

Blood Pressure

Blood pressure (BP) is the pressure exerted by circulating blood uponthe walls of arteries, and is one of the principal vital signs. Contractionof heart called **systole** and relaxation called **diastole**. During each heartbeat, BP varies between a maximum (systolic) when heartcontracts (120 mm Hg) and a minimum (diastolic) pressure when heart expands (80 mm Hg).

Blood Pressure is measured with help **sphygmomanometer.**

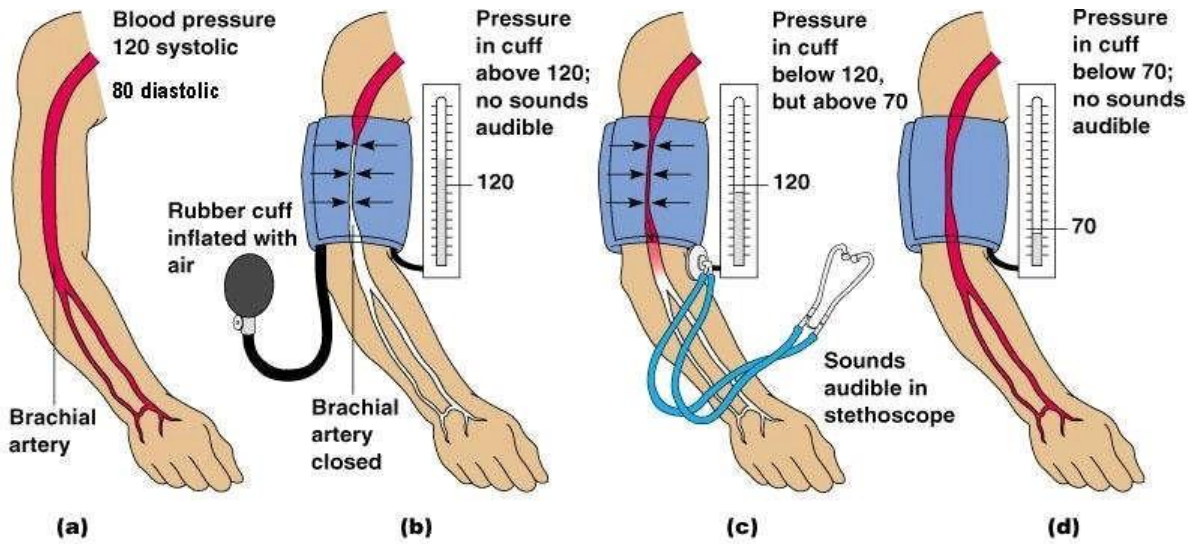


Figure: Steps of Measurement of Blood Pressure

(ii) Lymphatic system :

A system of tiny tubes called lymph vessels (or lymphatics) and lymph nodes (or lymph glands) in the human body which transports the liquid called lymph from the body tissues to the blood circulatory system is called lymphatic system. The lymphatic system consists of the following parts. lymph, lymph nodes and lymph vessels & capillaries

1. **Lymph** some amount of plasma, proteins and blood cells escape into intercellular space in thetissues to form the tissue fluid or lymph. Lymph (Blood - RBC) is an extra cellular, colourlessfluid which moves in lymphatic system (Runs parallel to veins, towards heart).

Functions of Lymph

(a) Carry digested and absorbed fat from intestine back into blood.
(b) It contains lymphocytes which help in killing germs.

2. **Lymph nodes** are kidney shaped structure. They are rich in lymphocytes.

3. **Lymph vessels and capillaries –** Tubular structure in which lymph flows, these vesselsopen into large veins of the body.

Functions of Lymph:

- It provides immunity through lymphocytes by producing antibodies.
- Fats are absorbed through lymph vessels (lacteals) in the intestine.
- It supplies digested food and oxygen to various parts of the body.
- It helps in removal of waste products like fragments of dead cells, etc.
- It returns proteins and excess tissue fluid to the blood from the tissue spaces.