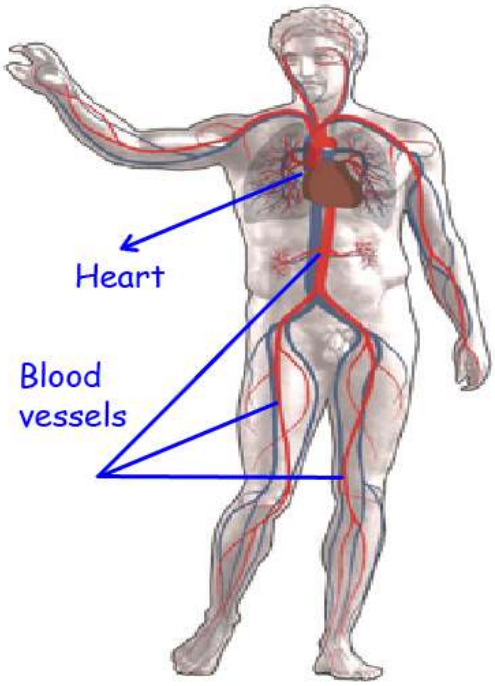
Life Processes – 2

Human Circulatory System

Circulatory system is responsible for transportation of various substances in human beings. It is composed of heart, arteries, veins and blood capillaries. Blood plays the role of the carrier for substances in the body.

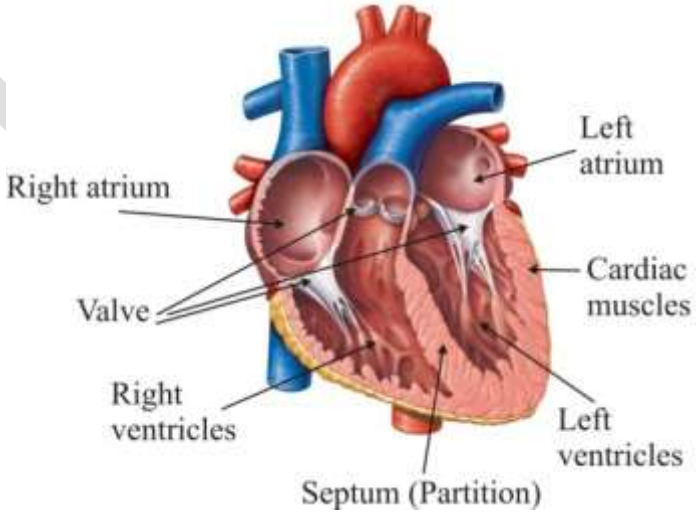


Heart –

- Heart is a muscular organ which is composed of cardiac muscles. The heart is a pumping organ which pumps the blood throughout the body.
- Heart is a triangular shaped structure. It is located in thoracic cavity inside ribcage between lungs above diaphragm and tilted towards left.

Anatomy of Heart –

The human heart is composed of four chambers, viz. right atrium, right ventricle, left atrium and left ventricle.



- **Valve** allows one way flow of liquid.
- Heart is surrounded by a thin layer called **Paricardium.** It protects the heart and maintains the shape of heart.
- **Septum** is a partition which separates right and left heart.

Blood Circulation through the Heart –

There are some terms related to blood circulation through the heart which are given below.

Oxygenated Blood: Blood in which oxygen is mixed is called Oxygenated Blood.

Deoxygenated Blood: Blood in which carbon dioxide is mixed is called Oxygenated Blood.

Left atrium: It collects blood from lungs and passes to left ventricle.

Left ventricle: It pumps blood so that it can reach to all body parts.

Right atrium: Collects blood from body organs and passes to right ventricle.

Right ventricle: It pumps deoxygenated blood to lungs.

Pulmonary Circulation: Deoxygenated blood moves from heart to lungs and converts into oxygenated blood and then this oxygenated blood moves back to heart. This one circulation of blood is called Pulmonary Circulation.

Systemic Circulation: In another cycle of blood circulation, oxygenated blood moves from heart to other organs and converts into deoxygenated blood and then this deoxygenated blood moves back to heart. This circulation of blood is called Systemic Circulation.

- Thus in the human body, blood passes through the heart twice. This type of circulation is called double circulation.
- Double circulation ensures complete segregation of oxygenated and deoxygenated blood which is necessary for optimum energy production in warm-blooded animals.

Blood Vessels –

Blood vessels are of three types:

(i). Arteries ***(ii). Veins*** ***(iii). Capillaries***

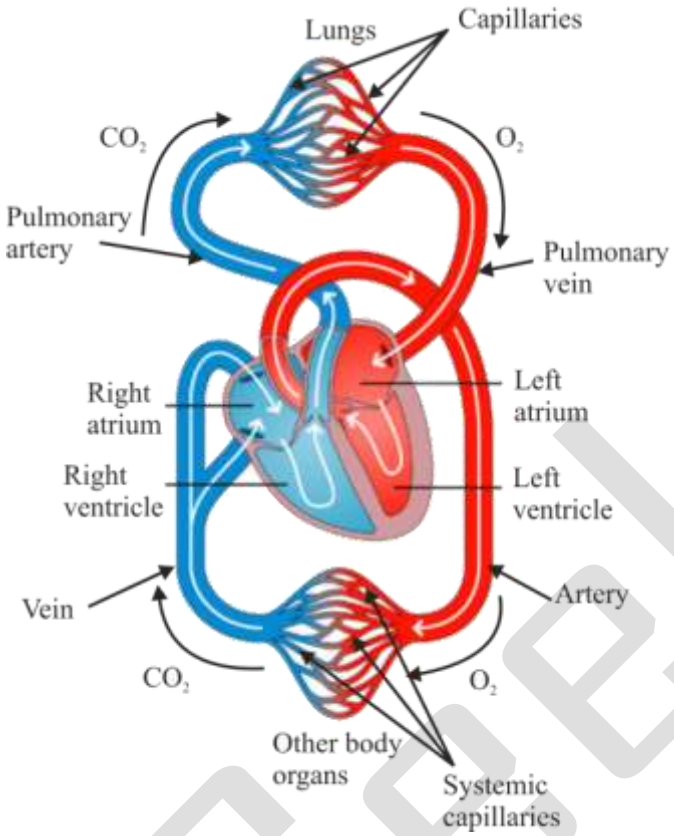
Arteries: These are thick-walled blood vessels which carry oxygenated blood from the heart to different organs. Pulmonary arteries are exceptions because they carry deoxygenated blood from the heart to lungs; where oxygenation of blood takes place.

Veins: These are thin-walled blood vessels which carry deoxygenated blood from different organs to the heart. Pulmonary veins are exceptions because they carry oxygenated blood from lungs to the heart. Valves are present in veins to prevent backflow of blood.

Arteries	Veins
Arteries carry blood from heart to different organs.	Veins carry blood from different organs to heart.
In arteries, blood flows with high pressure.	In veins, blood flows with low pressure.
No valves are present in arteries.	Valves are present in arteries to prevent back flow of blood.
These are thick-walled blood vessels.	These are thin-walled blood vessels.
Walls of arteries are elastic in nature.	Walls of veins are non-elastic in nature.
Arteries are present generally deep in body.	Veins are present deep as well as near the surface of body.

Capillaries:

Capillaries are narrow, thin walled blood vessels between arteries and veins through which small molecules/gases can easily diffuse and thus they are responsible for exchange of gases, food etc. between blood and body parts.



Circulation of Blood through the heart:

Systemic Vein → Right Atrium → Right Ventricle → Pulmonary Artery →Lungs → Pulmonary Vein → Left Atrium → Left Ventricle →Systemic Artery.

Note: The blue colour shows deoxygenated blood, while the red colour shows oxygenated blood.

Functions of Circulatory System or Blood –

- Blood transports oxygen from lungs to body and carbon dioxide from body to lungs.
- Blood transports food from simple intestine to body.
- Blood transports hormones from glands to organs.
- Blood transports waste substances from body to kidney.
- Blood protects us from many diseases.
- Blood maintains body temperature to 37°C.

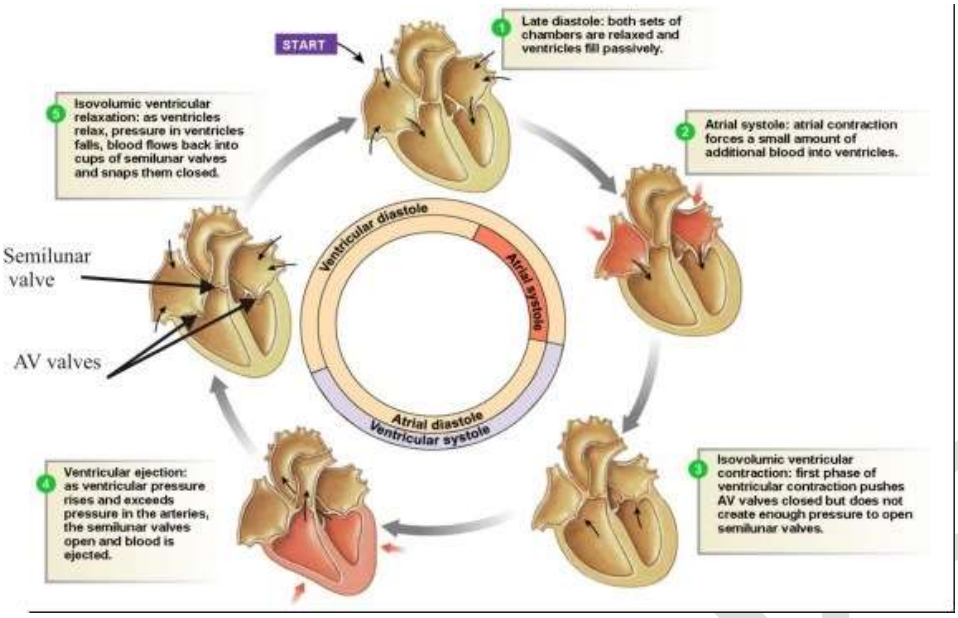
Relaxation and Contraction of Heart –

Cardiac Cycle: It is a periodic relaxation and contraction of muscles of heart.

Heart Beat: It is produced due to contraction and relaxation of heart.

- One complete cardiac cycle is equal to one heartbeat.
- The heart beats about 70 – 72 times per minute in a normal adult. In one cardiac cycle, the heart pumps out 70 mL blood and thus about 4900 mL blood in a minute.

Pulse: Pulse is the periodic movement of artery due to periodic forceful movement of blood through it.



Systole: Contraction of cardiac muscles is called systole.

Diastole: Relaxation of cardiac muscles is called diastole.

Blood –

Blood is a connective tissue which plays the role of the carrier for various substances in the body. Blood is composed of plasma, blood cells and platelets.

Blood Plasma: Blood plasma is a pale coloured liquid which is mostly composed of water. Blood plasma forms the matrix of blood.

Blood Cells: There are two types of blood cells, viz. Red Blood Cells (RBCs) and White Blood Cells (WBCs).

Red Blood Corpuscles (RBCs): These are of red colour because of the presence of haemoglobin which is a pigment. Haemoglobin readily combines with oxygen and carbon dioxide. The transport of oxygen happens through haemoglobin. Some part of carbon dioxide is also transported through haemoglobin.

White Blood Corpuscles (WBCs): These are of pale white colour. They play important role in the immunity.

Platelets: Platelets are responsible for blood coagulation. Blood coagulation is a defense mechanism which prevents excess loss of blood; in case of an injury.

Lymphatic System –

Lymph: It is similar to blood but RBCs are absent in lymph. Lymph is formed from the fluid which leaks from blood capillaries and goes to the intercellular spaces in the tissues. This fluid is collected through lymph vessels and finally returns to the blood capillaries.
Lymphatic system picks lymph from body parts and dumps it to veins going to heart.

Function of Lymphatic System:

- It collects left over plasma from various body parts.
- It is responsible for taking big molecules of proteins, fats etc. to blood.
- When lymph passes through lymphatic nodes germs are killed by WBC.

Transportation in Plants –

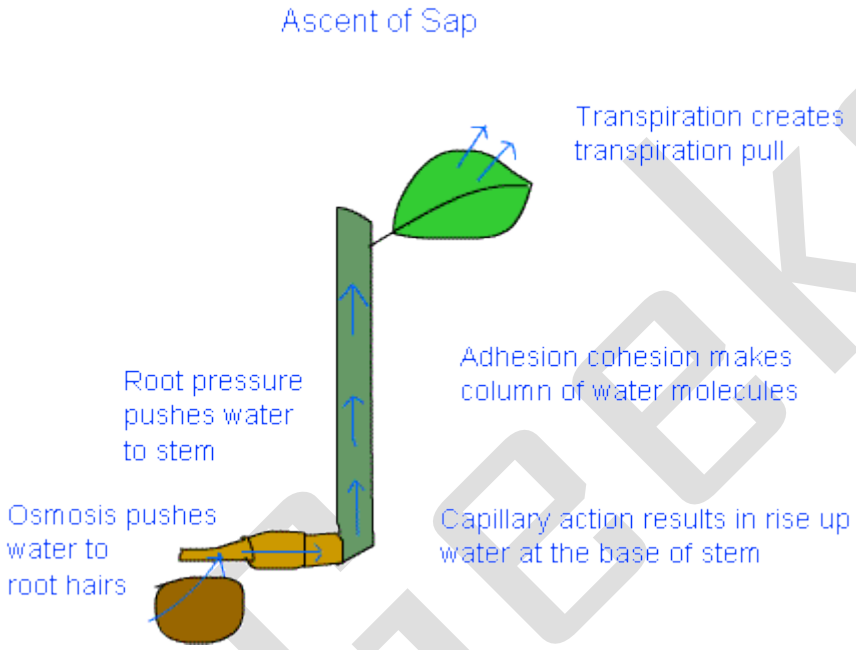
Plants have specialized vascular tissues for transportation of substances. There are two types of vascular tissues in plants, viz. xylem and phloem.

Xylem: Xylem is responsible for transportation of water and minerals. It is composed of trachieds, xylem vessels, xylem parenchyma and xylem fibre. Trachieds and xylem vessels are the conducting elements. The xylem makes a continuous tube in plants which runs from roots to stem and right up to the veins of leaves.

Phloem: Phloem is responsible for transportation of food. Phloem is composed of sieve tubes, companion cells, phloem parenchyma and bast fibres. Sieve tubes are the conducting elements in phloem.

Ascent of Sap:

The upward movement of water and minerals from roots to different plant parts is called ascent of sap. Many factors are at play in ascent of sap and it takes place in many steps. They are explained as follows:



Root Pressure: The walls of cells of root hairs are very thin. Water; from soil; enters the root hairs because of osmosis. Root pressure is responsible for movement of water up to the base of the stem.

Capillary Action: A very fine tube is called capillary. Water; or any liquid; rises in the capillary because of physical forces and this phenomenon is called capillary action. Water; in stem; rises up to some height because of capillary action.
Adhesion-cohesion of Water Molecules: Water molecules make a continuous column in the xylem because of forces of adhesion and cohesion among the molecules.

Transpiration Pull: Loss of water vapours through stomata and lenticels; in plants; is called transpiration. Transpiration through stomata creates vacuum which creates section; called transpiration pull. The transpiration pull sucks the water column from the xylem tubes and thus water is able to rise to great heights in even the tallest plants.

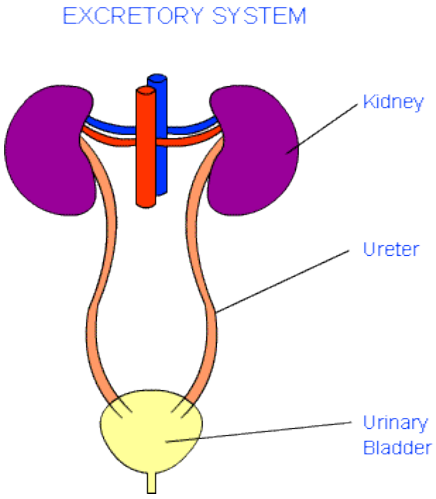
Transport of Food: Transport of food in plants happens because of utilization of energy. Thus, unlike the transport through xylem; it is a form of active transport. Moreover, the flow of substances through phloem takes place in both directions, i.e. it is a two-way traffic in phloem.

Excretion –

Removal of harmful waste from the body is called excretion. Many wastes are produced during various metabolic activities. These need to be removed in time because their accumulation in the body can be harmful and even lethal for an organism.

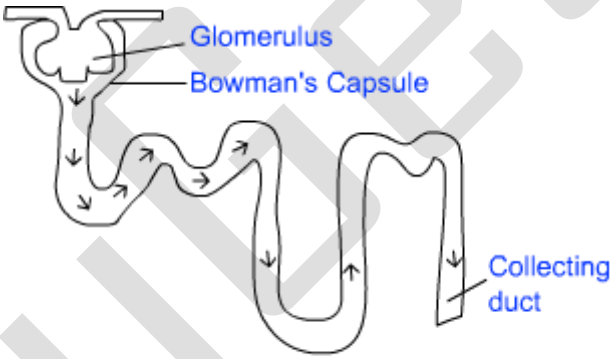
Human Excretory System –

The human excretory system is composed of a pair of kidneys. A tube called ureter; comes out of each kidney and goes to the urinary bladder. Urine is collected in the urinary bladder, from where it is expelled out through urethra as and when required.



Kidney: Kidney is a bean-shaped organ which lies near the vertebral column in the abdominal cavity. The kidney is composed of many filtering units; called nephrons. Nephron is called the functional unit of kidney.

Nephron: It is composed of a tangled mess of tubes and a filtering part; called glomerulus. Glomerulus is a network of blood capillaries to which renal artery is attached. The artery which takes blood to the glomerulus is called afferent arteriole and the one receiving blood from the glomerulus is called efferent arteriole. Glomerulus is enclosed in a capsule like portion; called Bowman's capsule. The Bowman's capsule extends into a fine tube which is highly coiled. Tubes from various nephrons converge into collecting duct; which finally goes to the ureter.



Structure of Nephron

Filtration in Glomerulus: Filtration happens because of very high pressure inside the glomerulus. The lumen of efferent arteriole is smaller than that of afferent arteriole. Due to this, the blood entering the glomerulus experiences very high pressure and due to this, the waste products are filtered out through the thin membrane of capillaries in the glomerulus. The filtered blood is sent to the systemic circulation through efferent arteriole and the filtrate goes to the Bowman's capsule. That is how urine is formed inside the kidneys. Reabsorption of water and some other filtrates takes place in the tubular part of the nephron. This increases the concentration of urine. The human urine is mainly composed of water and urea.

Excretion in Plants – Plants do not have an excretory system. They remove waste substances through various parts of their body. Oxygen and carbon dioxide are removed through diffusion. Many waste products get collected in old leaves and are removed with shedding of leaves. Resin and gum also contain waste substances.