THE CIRCULATORY SYSTEM

The main features of a circulatory system are:

1) A transport or circulatory fluid: Blood and Lymph
2) A system of tubes: Blood Vessels
3) A pumping mechanism: Heart

Structure and working of heart:

The human heart is triangular in shape. It is enclosed by two membranes called the pericardium which have a fluid in between to protect the heart from any shock.

- Two upper chambers: Auricles (Separated by interatrial septum)
- Two lower chambers: Ventricles (Separated by interventricular septum)
- Ventricles are thick-walled because they pump blood out with force. The left ventricle specifically is the thickest because it pumps blood to organs far away from the heart.
- Each atria opens into the ventricle of its side through an atrio-ventricular aperture which is guarded by a valve.
- Bicuspid Valve: Present between the left atrium and left ventricle. Also known as Mitral Valve. Consists of 2 flaps or cusps.
- Tricuspid Valve: Present between the right atrium and right ventricle. Consists of 3 flaps.
- Valves are attached to chordae tendinae which are in turn attached to the papillary muscles of the ventricles.
- Heart is made up of Cardiac Muscle Fibres.
- Superior and inferior vena cava: Brings deoxygenated blood to the right atrium.
- Pulmonary Vein: Brings oxygenated blood from the lungs to the left atrium.
- Pulmonary Artery: Brings deoxygenated blood from right ventricle to the lungs.
- Aorta: Carried oxygenated blood from the left ventricle to the rest of the body.

Blood vessels:

Heart—Artery—Arteriole—Capillary—Venule—Vein—Heart

The exchange of food material, gases and wastes takes place through the capillaries.
1. **Arteries:**
   - Three layers: External, Muscle (thick) and Endothelium
   - Thick walls and narrow lumen
   - Thick and elastic in order to withstand high pressure of blood coming from heart

2. **Veins:**
   - Thin muscle layer.
   - Thin walls and large lumen.
   - Contain semi-lunar valves to prevent backflow of blood

3. **Capillaries:**
   - Smallest blood vessels.
   - Only have one layer: Endothelium
   - Permeable to water and small molecules only.

**Composition of Blood:**

- Two components: Plasma and Cells
- Three types of cells: RBCs (Erythrocytes), WBCs (Leucocytes), and Platelets (Thrombocytes)
- Blood Plasma is pale yellow and slightly alkaline.

1. **RBCs:**
   - Biconcave and have no nucleus.
   - Red due to presence of haemoglobin.
   - Transport oxygen.
   - Formed in red bone marrow
   - No nucleus provides more space in cell for haemoglobin
   - Absence of mitochondria so that oxygen is not utilized by the cell itself
   - Biconcave shape provides more surface area for the diffusion of gases and also helps them flow through thin capillaries in a single line.

2. **WBCs:**
   - Round or irregular in shape, and have nucleus.
   - Colorless
   - Destroy harmful germs by engulfing them by **phagocytosis**
   - Formed in white bone marrow
   - Two main types: Granulocytes and Agranulocytes
   - Granulocytes: Eosinophils, Basophils and Neutrophils
   - Agranulocytes: Monocytes and Lymphocytes
   - **Diapedesis:** Squeezing out of WBCs from blood capillaries
3. **Platelets:**
   - Very small and irregular in shape with no nucleus.
   - Colorless
   - Help in clotting of blood
   - Formed in large bone marrow cells

**Lymph and Tissue Fluid:**

- **Tissue Fluid:** Fluid present in the intercellular cells of the capillaries.
- **Lymph Capillaries:** Tiny, thin-walled, blind ending tubes
- **Lymph:** Straw colored fluid that contains blood plasma without RBCs, platelets and plasma proteins.
- Contains special WBCs called **lymphocytes** that fight against infection.
- Open circulatory system
- Unidirectional
- Bring tissue fluid back to heart
- Slow and low-pressure movement
- Tiny semi-lunar valves
- Examples of lymph nodes: Tonsils and Spleen
- Absorbs fats from intestine
- Collects waste products

**Blood Coagulation:**

- Blood platelets are responsible for clotting
- Thromboplastin—prothrombin—thrombin—fibrinogen—fibrin—blood clot

**Serum**

- Serum in blood plasma without fibrinogen.
- Colorless and doesn’t clot

**Blood Groups**

- **Agglutination:** Clumping of cells due to antigen-antibody reaction
- **Blood Group A:** Contains A antigen and B antibody
- **Blood Group B**: Contains B antigen and A antibody
- **Blood Group O**: Contains no antigens and A&B antibodies
- **Blood Group AB**: Contains A&B antigens and no antibodies
- **Rhesus Factor**: Presence of a protein on the surface of RBCs
- **Disease in fetus due to Rh Factor**: erythroblastosis foetalis

**Double Circulation:**
- Blood passes through the heart twice to complete one circulation.
- One circulation is between the heart and body organs called **Systematic Circulation**.
- Other circulation is between the heart and the lungs called **Pulmonary Circulation**.

**Portal System:**
- It is a system in which a vein first collects blood from one capillary system and then branches out again into another capillary system.
- The vein involved is called a portal vein.

**Cardiac Cycle:**
- **Systole**: Contraction of heart chambers
- **Diastole**: Relaxation of heart chambers
- **Joint Diastole**: Relaxed state of both atria and ventricles
- **Pulse**: Wave of distention followed by constriction, felt in the arteries as a result of ventricular systole and diastole
- **Blood Pressure**: Pressure exerted by blood against the walls of arteries
- **Sphygomanometer**: Used to measure blood pressure
- **Sinoatrial Node**: Pacemaker; Generates each wave of cardiac impulse.