



Body Fluids and Circulation

Blood (Special Connective Tissue)

- ❖ Blood cells are synthesised in red bone marrow.

Functions:

- ❖ Transport of nutrients, O_2 , glucose, etc.
- ❖ Removal of harmful substances.

Components:

(1) Plasma (Matrix, 55%)

Water: 90-92%

Proteins: 6-8%

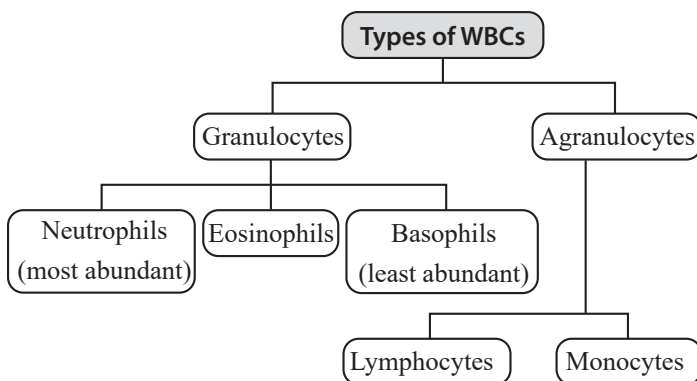
- ❖ Fibrinogens – Clotting
- ❖ Albumins – Osmotic balance
- ❖ Globulins – Defense

Minerals: Na^+ , Ca^{2+} , Mg^{2+} , HCO_3^- , Cl^-

Nutrients: Glucose, amino acids, lipids

(2) Formed Elements (45%)

- ❖ RBCs – 5-5.5 million/ mm^3
- ❖ WBCs – 6000-8000/ mm^3
- ❖ Platelets – 1,50,00-3,50,00/ mm^3



Blood Groups

- ❖ ABO blood grouping depends on the presence or absence of two surface antigens on RBC, and plasma contains antibodies.
- ❖ AB – Universal recipient
- ❖ O – Universal donor

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	A, B, AB, O
O	nil	anti-A, B	O

- ❖ Rh–ve person upon exposure to Rh+ve blood will form Rh specific antibodies.
- ❖ Erythroblastosis foetalis is the special case of Rh incompatibility.
- ❖ Administration of anti-Rh antibodies to the mother immediately after 1st delivery, save baby during 2nd pregnancy.

Blood Clotting/Coagulation

- ❖ Coagulum is formed by fibrins.
- ❖ Ca^{2+} play important role.

Lymph (Tissue Fluid)

- ❖ No colour.
- ❖ Blood – (Larger proteins + most formed elements).
- ❖ **Lacteals** are lymph vessels in intestinal villi to **absorb fats**.

Circulatory System

Vertebrates	Atrium	Ventricle	Circulation
Fishes	1	1	Single
Amphibians, most reptiles	2	1	Incomplete
Crocodiles, Aves, Mammals	2	2	Double

Human Circulatory System

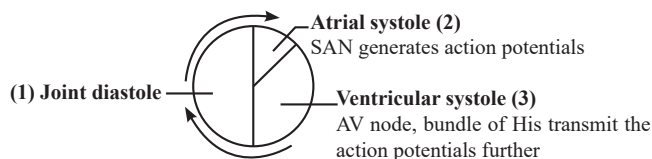
Heart

- ❖ **Mesodermally** derived organ.
- ❖ Protected by a double walled, membranous bag – **pericardium** with **pericardial fluid**.
- ❖ **4 chambers** — $\begin{cases} \rightarrow 2 \text{ upper, smaller – Atria} \\ \rightarrow 2 \text{ lower, larger – Ventricles} \end{cases}$

- ❖ **Septum**
 - Between atria: Inter-atrial (thin, muscular).
 - Between ventricles: Inter-ventricular (thick walled).
 - Between atrium & ventricle: atrio-ventricular (thick fibrous).
- ❖ **Heart valves**
 - Between right atrium & right ventricle – Tricuspid valve
 - Between left atrium & left ventricle – Bicuspid/Mitral valves
 - At the base of pulmonary trunk
 - At the base of aorta
 - Semilunar valves
- ❖ **Cardiac muscles**
 - Contractile tissue
 - Nodal tissue
 - SA Node
 - AV node
 - AV Bundle
 - Purkinje fibres

Cardiac Cycle

- ❖ Sequential events in the heart which are cyclically repeated.
- ❖ Heart rate = 72 beats/min.
- ❖ Duration of 1 heart beat = 0.8 sec.

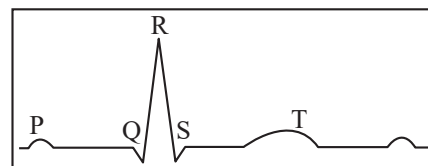


- ❖ Heart sounds (lub & dub) can be heard by **stethoscope** and have clinical diagnostic significance.
- ❖ **Cardiac output** = Stroke volume \times Heart rate = $70 \times 72 = 5040 \sim 5$ litres
- ❖ Cardiac output of athletes is higher than a normal man.
- ❖ Stroke volume = EDV – ESV

Electrocardiogram (ECG)

- ❖ A graphical representation of electrical activities of heart during a cardiac cycle.
- ❖ **Instrument** – Electrocardiograph
- ❖ For a standard ECG – **3 leads** are connected to monitor heart activity – Right wrist, left wrist and left ankle.

Graphical standards	Represent	Event associated
P wave	Depolarisation of atria	Contraction of atria
QRS complex	Depolarisation of ventricles	Contraction of ventricles
T wave	Repolarisation of ventricles	Relaxation of ventricles



Types of Circulation

❖ Double circulation

+ Pulmonary :

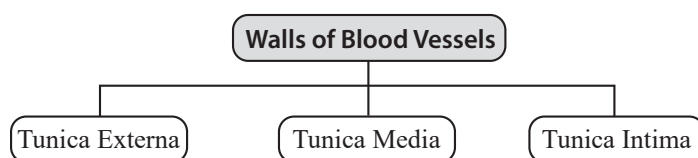
• Right ventricle $\xrightarrow{\text{Pulmonary artery}}$ Lungs $\xrightarrow{\text{Pulmonary veins}}$ Left atrium

+ Systemic :

• Left ventricle $\xrightarrow{\text{Aorta}}$ Tissues $\xrightarrow{\text{Vena cava}}$ Right atrium

- ❖ No mixing of deoxygenated and oxygenated blood occurs.
- ❖ **Hepatic portal circulation** – Digestive tract $\xrightarrow{\text{Hepatic portal vein}}$ Liver
- ❖ **Coronary circulation** – Blood flow to and from the cardiac musculature.

Structure of Blood Vessels



Regulation of Cardiac Cycle

- ❖ Activities of heart are regulated intrinsically, i.e., autoregulated as human heart is **myogenic**.

Medulla oblongata can moderate



Cardiac functions through ANS (sympathetic and parasympathetic nervous systems)

Parameter	Sympathetic	Parasympathetic
Heart rate	Increase	Decrease
Strength of ventricular contraction	Increase	Decrease
Cardiac output	Increase	Decrease

- ❖ Hormones of adrenal medulla increase cardiac output.

Disorders of Circulatory System

- ❖ Cardiac Arrest, Heart Failure, Coronary Artery disease (Atherosclerosis), High Blood pressure, Angina Pectoris, Heart attack.