

## → Blood and its Composition

Blood, fluid that transports oxygen and nutrients to the cell and carries away  $\text{CO}_2$  and other waste products. Blood is a transport liquid pumped by the heart to all parts of the body, after which it is returned to the heart to repeat the process.

Blood is both a tissue and a fluid. It is a tissue because it is a collection of similar specialized cells that serve particular functions. Blood is a highly specialized tissue composed of more than 4,000 different kinds of components. Four of the most important ones are red cells, white cells, platelets and plasma.

1. Red Cells → Red cells or erythrocytes, are relatively large microscopic cells without nuclei. They are similar to the primitive prokaryotic cells of bacteria. Red cells normally make up to 40-50% of the total blood volume. They transport oxygen from the lungs of all of the living tissues of the body and carry away  $\text{CO}_2$ . The red cells are produced continuously in our bone marrow from stem cells.

Hemoglobin is the gas transporting protein molecule that makes up 95% of red cell.

The red colour of blood is primarily due to oxygenated red cells. Human fetal hemoglobin molecules differ from those produced by ~~adult~~ adults in the number of amino acid chain.

White Cells → White blood cells or leukocytes exist in variable numbers and types but make up a very small part of blood's volume - normally only about 1% in healthy people.

Leukocyte are not only found in the spleen, liver, elsewhere in the body as well, in lymph glands. A major distinguishing feature in the presence of granules, while blood cells are often characterized as granulocytes or a granulocyte.

(A) Granulocytes - Granulocytes, also known as polymorphonuclear leukocytes are characterized by differently stained granules. There are three types of Granulocytes -

- Neutrophils - Defend against bacterial or fungal infections and other very small inflammatory processes. They are usually the first responders to microbial infections. Their activity and death in large numbers from pus.
- Eosinophils - primarily deal with parasitic infections. are also the predominant inflammatory cells in allergic reactions.
- Basophils - Agranulocytes or mononuclear leukocytes and leukocytes characterized by absence of granules in the cytoplasm. Agranulocytes contain lysosomes which are small vesicles containing digestive enzymes that break down any foreign matter that is endocytosed by the cells. include -

1. Lymphocytes - 3 types -

- (i) B-lymphocytes - which produce antibodies in the humoral immune response.
- (ii) T-lymphocytes - which participate in cell-mediated immune response.
- (iii) Null Group which contains Natural Killer, Cytotoxic T-cells that participate in the innate immune response.

(2) Monocytes - Present pieces of pathogens or T-cells. The pathogens may be recognized again & killed so that an antibody response may be mounted.

(2) **Macrophages** - are monocytes that have migrated out of the blood stream and into the body tissues. They take up and destroy necrotic cell debris and foreign material including viruses, bacteria and tattoo ink.

3. **Platelets**  $\Rightarrow$  Platelets or thrombocytes are cell fragments without nuclei that work with blood clotting chemicals at the site of wounds. They do this by adhering to the walls of blood vessels, thereby plugging the rupture in the vascular walls. They also can release coagulating chemical which cause clots to form in the blood that can plug up narrowed blood vessels.

4. **PLASMA**  $\Rightarrow$  Plasma is the relatively clear, yellow tinted water (92%), sugar, fat, protein and salt solution which carries the red cells, white cells and platelets. Normally, 55% of our blood's volume is made up of plasma. Plasma helps maintain blood pressure and regulates body temperature. These substances include minerals, salts, hormones and proteins.

Three important proteins found in plasma are -

(a) **Albumin** - Serum albumin, often referred to simply as blood albumin, (a type of globular protein). Albumin cleans the blood, carries substance around the body, and helps maintain the correct amount of fluid circulating in the body, without albumin, a high pressure in the blood vessels would force more fluids out into the tissues. It also act as a plasma carrier by non-specifically binding several hydrophobic steroids hormones.

Human albumin solution can be used as a treatment to help people with severe burn sepsis, liver disease or kidney disease.

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(b) **Globulin**  $\Rightarrow$  The globulins are a family of globular proteins that have higher molecular weights than albumins and are insoluble in pure water but soluble in dilute salt solutions. Some globulins are produced in the liver, while others are made by the immune system. The normal conc<sup>n</sup> of globulins in human blood is about 2.6-4.6g/dL. Immunoglobulins are part of the immune system. (the body's natural defence against infection and illness)

Immunoglobulins are antibodies that the body produces to fight a variety of infections. For eg. they're used to fight health conditions such as chickenpox, hepatitis, rabies.

(c) **Fibrinogen**  $\Rightarrow$  Fibrinogen (factor I) is a glycoprotein in vertebrates that helps in the formation of blood clots. The fibrinogen molecule is a soluble, large and complex plasma glycoprotein, that is converted by thrombin into fibrin during blood clot formation. The conc<sup>n</sup> of fibrinogen in the blood-plasma is 200-400mg/dL.

$\rightarrow$  Functions of Blood

$\rightarrow$  **Transportation**  $\Rightarrow$

- Respiration

- Nutrient- B<sup>r</sup> Carrier from GIT.

- Transportation of hormones from endocrine glands

- Transports Metabolic Waste.

$\rightarrow$  **Regulation**  $\rightarrow$

- Regulates pH

- Adjusts & maintain body Temperature

- Maintains water content of cells.

- Protection -
- WBC protects against disease by phagocytosis
  - Reservoir for substances like water, electrolytes
  - Performs haemostasis.

### \* Haemopoiesis

Haematopoiesis (Haem = blood, poiesis - to make) is the formation of blood cellular components. All cellular blood components are derived from haematopoietic stem cells.

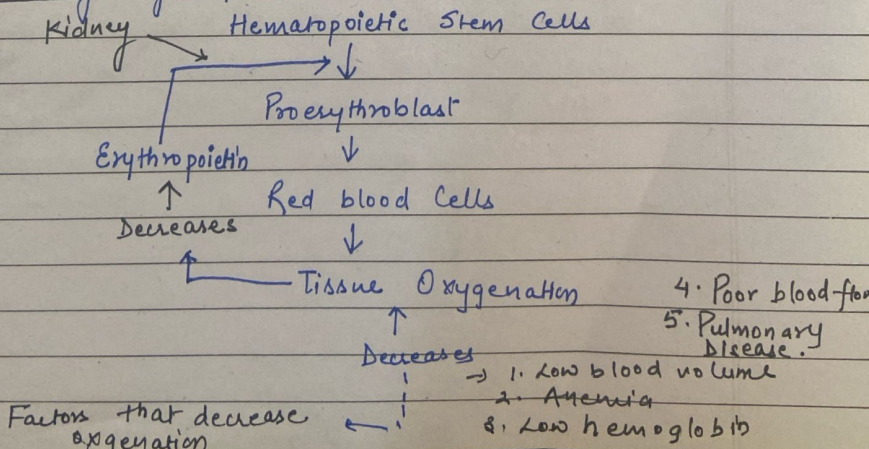
- It includes → Erythropoiesis  
Leucopoiesis  
Thrombopoiesis

→ Regulation of Red blood Cells Production - Role of Erythropoietin

→ The total mass of red blood cells in the circulatory system is regulated within narrow limits, so that:

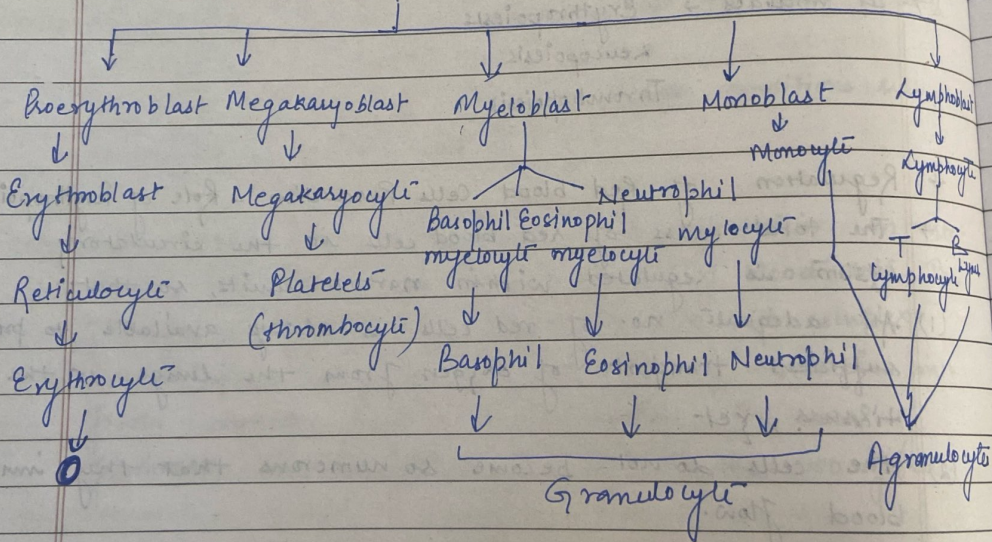
- (1) An adequate no. of red cells is always available to provide sufficient transport of oxygen from the lungs to the tissues, yet
- (2) the cells do not become so numerous that they impede blood flow.

### → Function of Erythropoietin



The process of formation of blood cells i.e. RBCs, WBCs and platelets is called hematopoiesis and the sites where it occurs are known as hematopoietic tissues or organs (bone marrow, liver and spleen). Hematopoiesis is completed through five processes - Erythropoiesis, lymphopoiesis, granulopoiesis, monopoiesis and thrombopoiesis.

### Pluripotent Stem Cells.



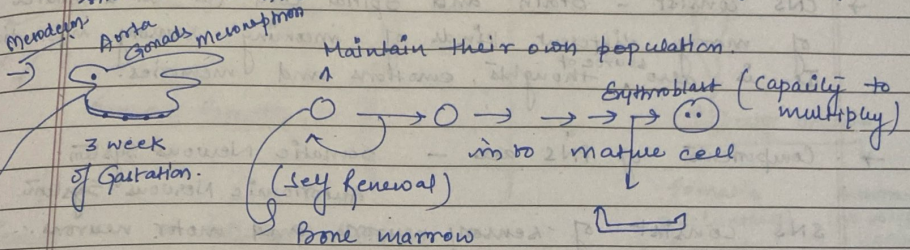
# Erythropoiesis

- \* Erythropoiesis is a process in which human erythrocytes are produced. The process is triggered by erythropoietin which is a kidney hormone and is released during hypoxia.

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- Erythroblast present in cytoplasm has large nucleus with blue cytoplasm and differentiates to become progressively smaller in size.



- Capable of dividing asymmetrical

Stem cells transfer into liver

3 months

Red → Active B.M. (Highly vascular)

Yellow → Inactive B.M.  
↳ Populated with fat cells.

↳ As Age

Res

Remains active in the membranes.

