

Topic: HUMAN PHYSIOLOGY

BA PART I, 1ST PAPER, By: Dr. AMARJEET KUMAR, Home Science Department, Rohtas Mahila College, Sasaram. E-mail ID: amarjeetkumar011@gmail.com

CIRCULATORY SYSTEM

The components of the circulatory system are the blood, the heart and the blood vessels. Blood is the principal transport system which is composed of straw-coloured fluid and the formed elements. Blood carries oxygen and nutrients to various parts of the body during the process of respiration and digestion and helps in eliminating carbon - di-oxide and the waste materials from the body. The heart, the great pumping organ maintains the circulation throughout the body. The blood is pumped through, the blood vessels from the heart. The major blood vessels divide into smaller ones thereby giving rise to many minute branches. These are referred to as arteries and veins, which help in normal functioning of the circulatory system.

Blood

Blood is a fluid tissue found only in the higher animals. It is composed of two parts. The intracellular substance is a straw-coloured fluid called **plasma**, in which are present the blood cells or corpuscles which performs some important functions. Blood transports:

1. Oxygen from the lungs to all cells of the body and carbon dioxide from the cells to the lungs.
2. Nutrients from the digestive organs to the cells.
3. Waste products from the cells to the kidneys, lungs and sweat glands.
4. Hormones from endocrine glands to the cells.
5. Enzymes to various cells.

Some of the functions of blood are

1. Blood regulates normal body temperature because it contains a large volume of water.
2. It prevents body fluid loss through the clotting mechanism.
3. Blood protects against toxins and foreign microbes through special combat - unit cells.

Composition of blood

The total volume of blood forms about one-twelfth of the weight of the body or about 5 liters. About 55 percent, a little over half the volume is fluid, called plasma and the remaining 45 percent of the volume being made up of the blood cells.

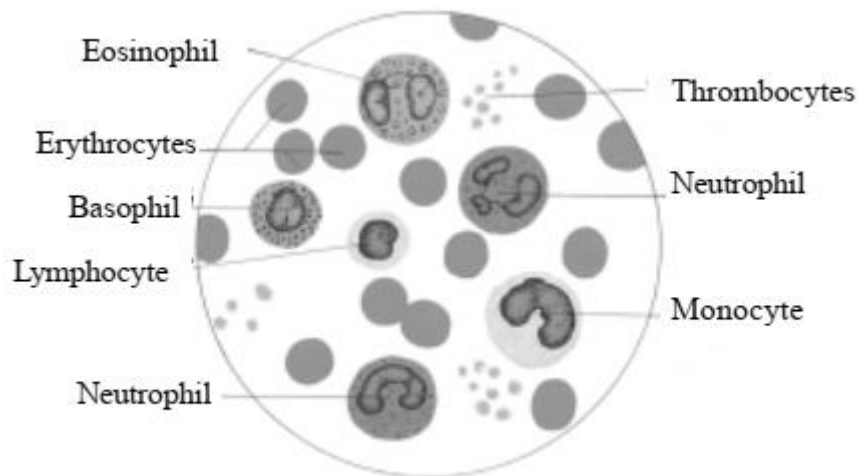


Fig. 1 - Blood cells viewed through a microscope

Plasma

Blood serum or plasma is a straw-coloured liquid. The plasma is composed mainly of water, i.e. 91 percent; and 7 percent of proteins as plasma proteins which have very important functions to perform. Plasma also contains substances like glucose, sodium chloride, sodium bicarbonate, salts of calcium, phosphorous, magnesium and iron, urea, uric acid, cholesterol and amino acids. Plasma also carries gases, oxygen and carbon-di-oxide and the internal secretions like enzymes and antigens. Plasma proteins are albumin, globulin, prothrombin and fibrinogen. **Albumin** which constitute the majority of plasma proteins are responsible for viscosity of the blood. **Globulin**, a small component of plasma protein is able to form an antigen -antibody.

Prothrombin and **fibrinogen** take part in the blood clotting mechanism along with the platelets.

Blood Cells

These are the formed elements that float in the plasma. There are three types of blood cells namely Red blood cells, White blood cells and platelets.

Red blood cells

They are also called **erythrocytes** or R.B.C. They are circular disc-shaped cells possessing no nucleus. The central portion of the cell is much thinner than the circumference. This construction gives the cell a biconcave contour. The red cells show a tendency to adhere to one another by their flat surfaces like a pile of coins known as **Rouleaux** formation. The R.B.C originate in bone marrow. There are about 5 million red cells in each cubic millimeters of blood. They contain a red pigment called **haemoglobin**. It constitutes about 33 percent of the cell volume and is responsible for the red colour of the blood. The haemoglobin molecules consist of protein called **globin** and a pigment called **haem** which contains iron. It has an affinity for oxygen and combines with it forming **oxy-haemoglobin** in the red cells. By means of this function, oxygen is carried to the tissues from the lungs.

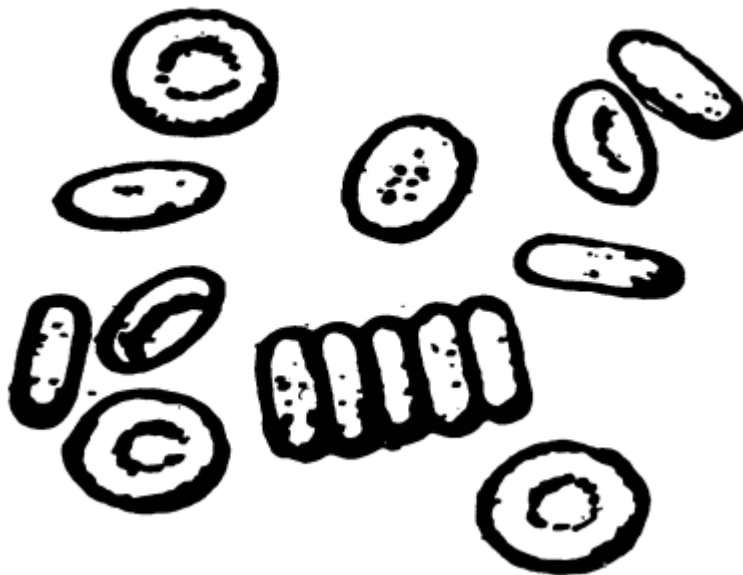


Fig. 2 - Rouleaux formation of red blood cells

The amount of haemoglobin present in normal blood is about 15 grams per 100 ml of blood. The decrease of haemoglobin in the blood results in **anaemia**.

Erythropoiesis

The formation of red blood cells is called **erythropoiesis**. The red blood cells are produced in the bone marrow and are derived from a cell known as **hemocytoblast**. The hemocytoblast passes through several stages of development, becoming first a basophil erythroblast. Then a polychromatophil erythroblast, a normoblast, a reticulocyte and finally an erythrocyte as illustrated in figure 21. During the earlier stages the cells divide many times. There is progressive formation of more haemoglobin. In the normoblastic stage, the nucleus degenerates, becomes very small and forms the reticulocyte. After the

release of the reticulocyte from the bone marrow, the cell becomes the mature red blood cell, the erythrocyte. The average life span of an erythrocyte is 120 days.

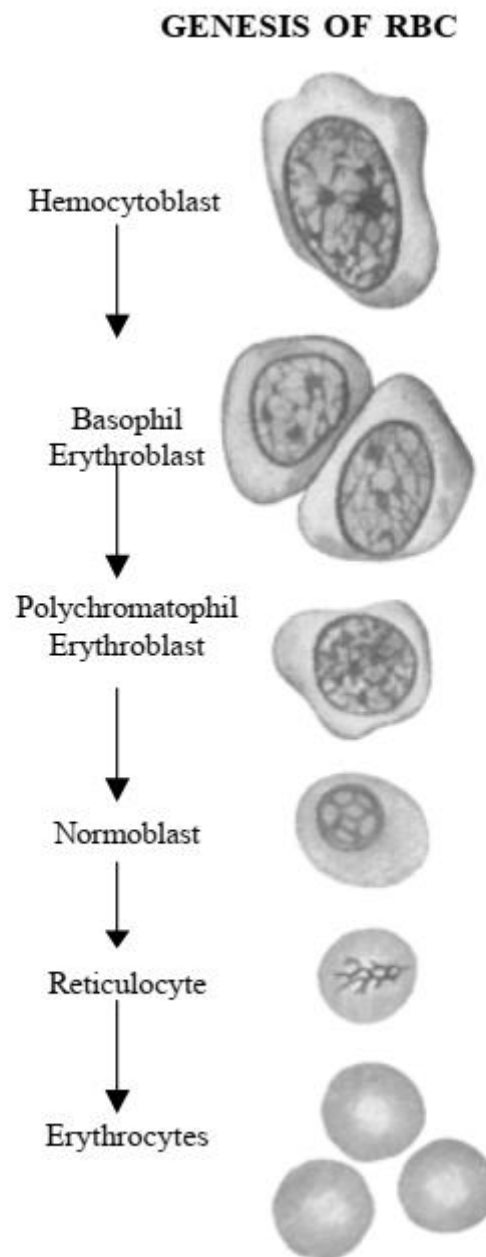


Fig. 3- Erythropoiesis

Factors regulating RBC production

1. Anaemia.
2. High altitudes.
3. Degree of physical activity.

4. Erythropoietin - a hormone released by the kidneys in response to hypoxia or low O₂ levels acts on the bone marrow to produce more RBC. **Vitamins needed for formation of RBC**

1. Vitamin B12: Necessary for nuclear maturation and division. Lack of this vitamin inhibits rate of RBC production.

2. Folic Acid: Folic acid is required for formation of DNA.

Anaemia

Anaemia means a deficiency of red blood cells, which can be caused either by too rapid loss or by too slow production of red blood cells. These are often caused by blood loss, destruction of bone marrow, pernicious anaemia because of lack of vitamin B12 or folic acid and haemolysis of red cells, that is rupture of the cells.

Polycythaemia

Refers to an abnormal increase in the number of red blood cells, i.e. increase of 2 or 3 million cells per cu. mm. of blood are considered to be having polycythaemia. This disorder is harmful because the viscosity of the blood is greatly increased due to the extra red blood cells. The viscosity contributes to thrombosis and haemorrhage. It also causes a rise in the blood pressure.