

## BLOOD: GENERAL PROPERTIES AND FUNCTIONS

**Blood** is a specialized body fluid that delivers necessary substances to the body's cells — such as nutrients and oxygen — and transports waste products away from those same cells. It can be referred to as a liquid connective tissue.

It consists of solid elements made up of RBCs, WBCs and platelets (commonly referred to as the formed elements of the blood), suspended in a fluid medium, plasma which contains, water (about 92%), dissolved proteins, lipids, glucose, mineral ions, hormones, organic acids, urea and other wastes, carbon dioxide and circulates in a closed system of blood vessels

Vertebrate blood is bright red when its hemoglobin is oxygenated. By volume, the red blood cells constitute about 45% of whole blood, the plasma about 54.3%, and white cells about 0.7%.

### PROPERTIES OF BLOOD.

1. It is a viscous liquid with its flow properties adapted to flow effectively through tiny capillary blood vessels with as little resistance as possible.
2. Blood plasma, a fluid that is the blood's liquid medium, is straw-yellow in color, which comprises 55% of blood fluid, is mostly water (90% by volume)
3. The white blood cells consist of lymphocytes and monocytes with relatively clear cytoplasm, and three types of granulocytes, whose cytoplasm is filled with granules.
4. The normal pH of blood is in the range of 7.35–7.45
5. It has an average density of approximately  $1060 \text{ kg/m}^3$ .
6. The various cells of blood are made in the bone marrow in a process called hematopoiesis.
7. The proteinaceous component of blood (including clotting proteins) is produced predominantly by the liver, while hormones are produced by the endocrine glands and the watery fraction is regulated by the hypothalamus and maintained by the kidney.

### FUNCTIONS OF BLOOD

Supply of oxygen to tissues (bound to hemoglobin, which is carried in red cells)

Supply of nutrients such as glucose, amino acids, and fatty acids (dissolved in the blood or bound to plasma proteins (e.g., blood lipids))

Removal of waste such as carbon dioxide, urea, and lactic acid

Immunological functions, including circulation of white blood cells, and detection of foreign material by antibodies

Coagulation, which is one part of the body's self-repair mechanism

Messenger functions, including the transport of hormones and the signaling of tissue damage

Regulation of body pH and temperature.

### **THE RED CELL AND ITS METABOLISM**

RBCs in mammals are non-nucleated biconcave shaped cells, highly flexible and lacking intracellular organelles. They are flattened and depressed in the center. Erythrocyte content consists mainly of hemoglobin. The precursors (Pronormoblast) of erythrocytes mature in the bone marrow, in a process called erythropoiesis, closely attached to a macrophage, these precursor cells manufacture hemoglobin until it accounts for some 90% of the dry weight of the cell, and as it matures the nucleus is squeezed out of the cell and is ingested by the macrophage. In addition the no-longer-needed proteins are expelled from the cell in vesicles called exosomes. RBCs are terminally differentiated, that is, they can never divide, and live for about 120 days after which they are engulfed and phagocytosed by cells of the RES predominantly in the spleen, bone marrow and liver. They are responsible for the transport of oxygen and carbon dioxide. In addition to their major function of O<sub>2</sub> and CO<sub>2</sub> transport RBCs also play some role in immune response by release of free radicals from damaged cells to destroy invading pathogens and also release S-nitrothiols that facilitate vasodilation when they (RBCs) are deoxygenated.

In many domestic animals such as dogs and horses the spleen acts as a reservoir of erythrocytes and sequesters large numbers of red blood cells which are dumped into the blood during times of exertion stress, yielding a higher oxygen transport capacity.

### **METABOLISM**

As a result of not containing mitochondria matured RBCs do not utilize the oxygen they carry for energy unlike other cells, instead they use glucose to produce ATP by glycolytic pathway that

ends with lactic acid production. Glucose enters the red cell via specified system of transport that is not influenced by insulin.

The pentose phosphate pathway is also for energy production. Reduced glutathione is very essential in the RBC as it helps to counteract the actions of potentially toxic peroxides produced in the course of metabolism. Iron in RBC is usually maintained in the ferrous form by NADH-dependent methemoglobin reductase