



Al mustaqbal university college

Medical laboratories techniques

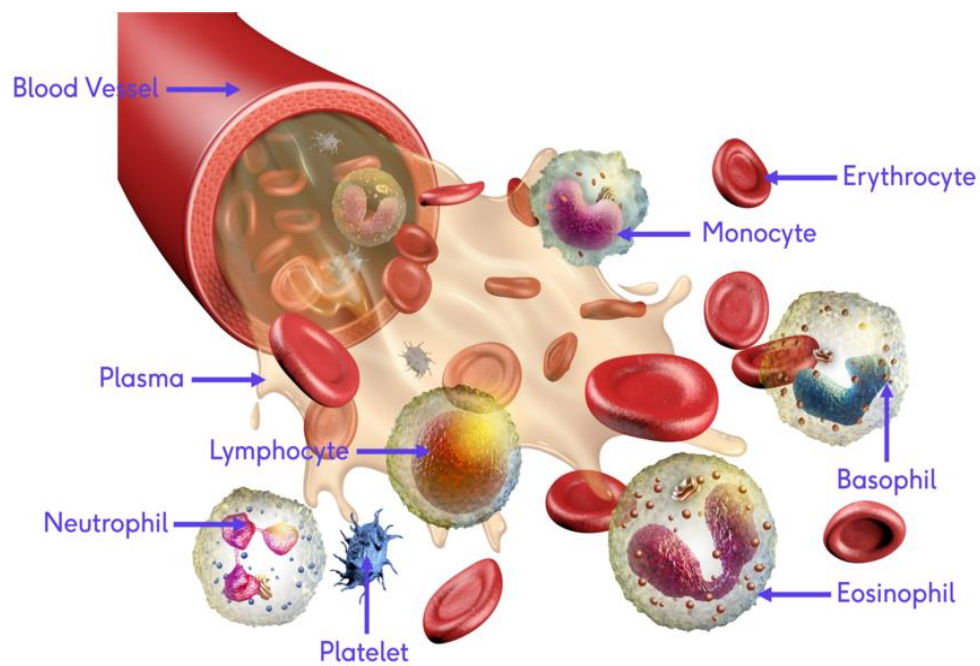
Human physiology

*Blood composition*

By

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## Introduction

-It is a red liquid tissue among the forms of connective tissue that runs inside the body from Through the blood vessels (Veins ,Arteries ,Capillaries).

-Blood is a combination of plasma and cells that circulate through the body. It supplies essential substances, such as sugars, oxygen, and hormones, to cells and organs, and removes waste from cells.

Approximately 8% of an adult's body weight is made up of blood.

- **Females** have around **4-5** litres , while **males** have around 5-6 liters. This difference is mainly due to the differences in body size between men and women.
- It has a pH of 7.35-7.45, making it slightly basic (less than 7 is considered acidic).
- Whole blood is about **4.5-5.5** times as viscous as water, indicating that it is more resistant to flow than water. This viscosity is vital to the function of blood because if blood flows too easily or with too much resistance, it can strain the heart and lead to severe cardiovascular problems.

## Composition of blood

The main components of blood are:

- plasma
- red blood cells
- white blood cells
- platelet

### 1- Blood Plasma

It is a transparent liquid that tends to yellow and has an important role in the transmission of water and salts, as well as materials

Food such as sugars, vitamins, hormones, and others, and it is found in 45% of the blood as the substance

The interstitium is in the blood, and the plasma contains the following elements:

Plasma accounts for around 55% of blood fluid in humans. Plasma is 92% water, and the contents of the remaining 8% include:

- glucose
- hormones
- proteins
- mineral salts
- fats
- vitamins

## **Proteins**

-These are the most abundant substance in plasma by weight and play a part in a variety of roles including clotting, defence and transport. Collectively, they serve several functions:

**1** - They are an important reserve supply of amino acids for cell nutrition. Cells called macrophages in the liver, gut, spleen, lungs and lymphatic tissue can break down plasma s are used by other cells to proteins so as to release their amino acids. These amino acid synthesise new products.

**2**- Plasma proteins also serve as carriers for other molecules. Many types of small molecules bind to specific plasma proteins and are transported from the organs that absorb these proteins to other tissues for utilization.

The proteins also help to keep the blood slightly basic at a stable pH.

**3**- The plasma proteins interact in specific ways to cause the blood to coagulate, which is part of the body's response to injury to the blood vessels (also known as vascular injury), and helps protect against the loss of blood and invasion by foreign microorganisms and viruses.

There are three major categories of plasma proteins, and each individual type of proteins has its own specific properties and functions in addition to their overall collective role:

### **1-Albumins**

which are the smallest and most abundant plasma proteins. Reductions in plasma albumin content can result in a loss of fluid from the blood and a gain of fluid in the interstitial space (space within the tissue), which may occur in nutritional, liver and kidney disease. Albumin also helps many substances dissolve in the plasma by binding to them, hence playing an

important role in plasma transport of substances such as drugs, hormones and fatty acids.

## **2. Globulins**

which can be subdivided into three classes from smallest to largest in molecular weight into alpha, beta and gamma globulins. The globulins include high density lipoproteins (HDL), an alpha-1 globulin, and low density lipoproteins (LDL), a beta-1 globulin.

-HDL functions in lipid transport carrying fats to cells for use in energy metabolism, membrane reconstruction and hormone function.

HDLs also appear to prevent cholesterol from invading and settling in the walls of arteries.

- LDL carries cholesterol and fats to tissues for use in manufacturing steroid hormones and building cell membranes, but it also favours the deposition of cholesterol in arterial walls and thus appears to play a role in disease of the blood vessels and heart.

HDL and LDL therefore play important parts in the regulation of cholesterol and hence have a large impact on cardiovascular disease.

## **3. Fibrinogen**

- which is a soluble precursor of a sticky protein called fibrin, which forms the framework of blood clot. Fibrin plays a key role in coagulation of blood, which is discussed later in this article under Platelets

The remaining 45% of blood mainly consists of red and white blood cells and platelets. Each of these has a vital role to play in keeping the blood functioning effectively.

## **Amino acids**

These are formed from the breakdown of tissue proteins or from the digestion of digested proteins.

## **Nitrogenous waste**

Being toxic end products of the break down of substances in the body, these are usually cleared from the bloodstream and are excreted by the kidneys at a rate that balances their production.

## Nutrients

Those absorbed by the digestive tract are transported in the blood plasma. These include glucose, amino acids, fats, cholesterol, phospholipids, vitamins and minerals.

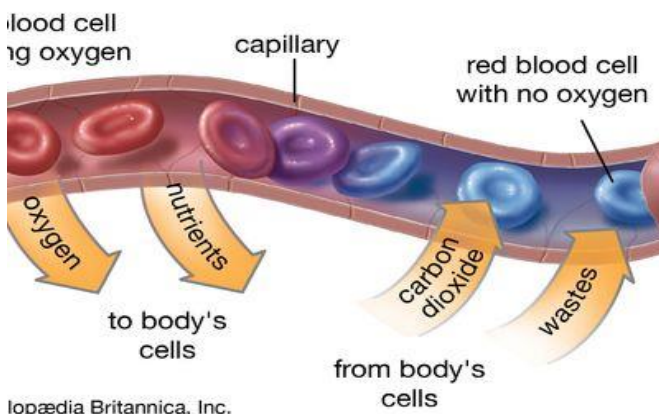
## Gases

Some oxygen and carbon dioxide are transported by plasma. Plasma also contains a substantial amount of dissolved nitrogen.

## Electrolytes

The most abundant of these are sodium ions, which account for more of the blood's osmolarity than any other solute.

## 2-Red Blood Cells



Red Blood Cell, also called erythrocyte, cellular component of blood, millions of which in the circulation of vertebrates give the blood its characteristic colour and carry oxygen from the lungs to the tissues. The mature human red blood cell is small, round, and biconcave; it appears dumbbell-shaped .

Red blood cells (or erythrocytes or erythrocytes) are devoid, concave cells

The nucleus contains the pigment HB called hemoglobin, which is a red protein

The color is estimated from 4 b to 5 million globules per cubic mm of blood, each glob million - a molecule of lymoglobin. The diameter of the pellet is up to 7 contains 220-250 micrometers and is considered the diameter of Too small.

It arises from the red marrow of the bones and dies after a period of about 200 days

to the spleen and liver

## Red blood cells (RBCs) have two main functions:

1. To pick up oxygen from the lungs and deliver it to tissues elsewhere
  2. To pick up carbon dioxide from other tissues and unload it in the lungs
- An erythrocyte is a disc-shaped cell with a thick rim and a thin sunken center.

The plasma membrane of a mature RBC has glycoproteins and glycolipids that determine a person's blood type. On its inner surface are two proteins called spectrin and actin that give the membrane resilience and durability.

This allows the RBCs to stretch, bend and fold as they squeeze through small blood vessels, and to spring back to their original shape as they pass through larger vessels.

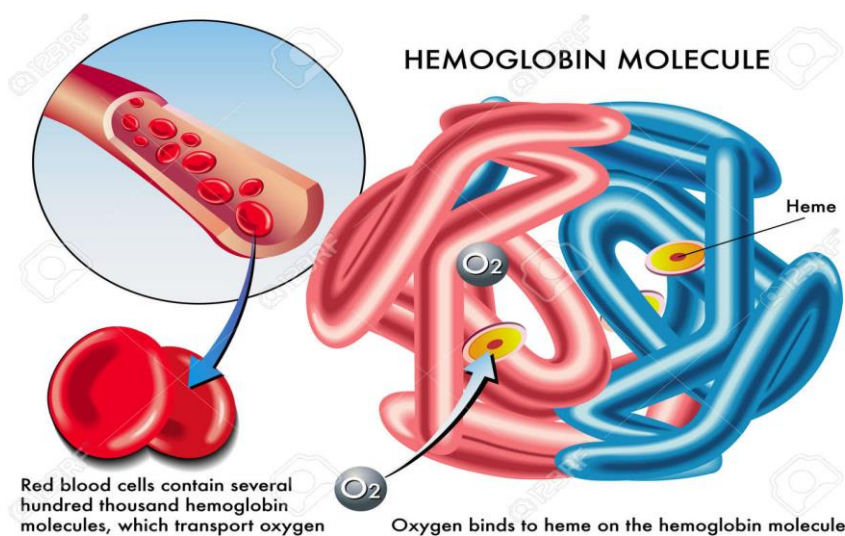
RBCs are incapable of aerobic respiration, preventing them from consuming the oxygen they transport because they lose nearly all their inner cellular components during maturation. The inner cellular

components lost include their mitochondria, which normally provide energy to a cell, and their nucleus, which contains the genetic material of the cell and enable it to repair itself. The lack of a nucleus means that RBCs are unable to repair themselves.

However, the resulting biconcave shape is that the cell has a greater ratio of surface area to volume, enabling O<sub>2</sub> and CO<sub>2</sub> to diffuse quickly to and from Hb.

The cytoplasm of a RBC consists mainly of a 33% solution of haemoglobin (Hb), which gives RBCs their red colour.

Haemoglobin carries most of the oxygen and some of the carbon dioxide transported by the blood.



Circulating erythrocytes live for about 120 days. As a RBC ages, its membrane grows increasingly fragile. Without key organelles such as a nucleus or ribosomes, RBCs cannot repair themselves.

Many RBCs die in the spleen, where they become trapped in narrow channels, broken up and destroyed.

Hemolysis refers to the rupture of RBCs, where haemoglobin is released leaving empty plasma membranes which are easily digested by cells known as macrophages in the liver and spleen.

The Hb is then further broken down into its different components and either recycled in the body for further use or disposed of.

## 2-White blood cells(WBCs)

are also known as leukocytes. They can be divided into granulocytes and agranulocytes.

The former have cytoplasm that contains organelles that appear as coloured granules through light microscopy, hence their name. Granulocytes consist of neutrophils, eosinophils and basophils. In contrast, agranulocytes do not contain granules. They consist of lymphocytes and monocytes.

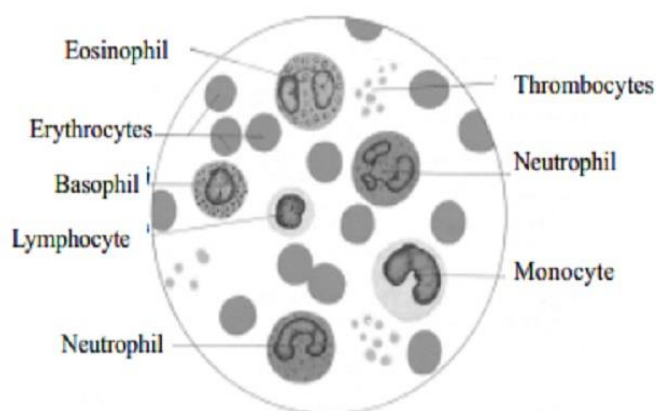


Fig. - Blood cells viewed through a microscope

## Granulocytes

**1. Neutrophils:** These contain very fine cytoplasmic granules that can be seen under a light microscope. Neutrophils are also called polymorphonuclear (PMN) because they have a variety of nuclear shapes.

They play roles in the destruction of bacteria and the release of chemicals that kill or inhibit the growth of bacteria.

**2-Eosinophils:** These have large granules and a prominent nucleus that is divided into two lobes. They function in the destruction of allergens and inflammatory chemicals, and release enzymes that disable parasites.

**3. Basophils:** They have a pale nucleus that is usually hidden by granules. They secrete histamine which increases tissue blood flow via dilating the blood vessels, and also secrete heparin which is an anticoagulant that promotes mobility of other WBCs by preventing clotting.

## A granulocytes

**1-Lymphocytes:** These are usually classified as small, medium or large. Medium and large lymphocytes are generally seen mainly in fibrous connective tissue and only occasionally in the circulation bloodstream. Lymphocytes function in destroying cancer cells, cells infected by viruses, and foreign invading cells.

- activate other cells of the immune system. They also coordinate the actions of other immune cells, secrete antibodies and serve in immune memory.

**2. Monocytes:** They are the largest of the formed elements. Their cytoplasm tends to be abundant and relatively clear. They function in differentiating into macrophages, which are large phagocytic cells, and digest pathogens, dead neutrophils, and the debris of dead cells. Like lymphocytes, they also present antigens to activate other immune cells.

## Platelets

Platelets are small fragments of bone marrow cells and are therefore not really classified as cells themselves.

Platelets have the following functions:

1. Secrete vasoconstrictors which constrict blood vessels, causing vascular spasms in broken blood vessels

2. Form temporary platelet plugs to stop bleeding

3. Secrete procoagulants (clotting factors) to promote blood clotting

4. Dissolve blood clots when they are no longer needed

5. Digest and destroy bacteria

6. Secrete chemicals that attract neutrophils and monocytes to sites of inflammation

7. Secrete growth factors to maintain the linings of blood vessels

The first three functions listed above refer to important haemostatic mechanisms in which platelets play a role in during bleeding: vascular spasms, platelet plug formation and blood clotting (coagulation).



## **Functions of blood**

1-Respiratory function

2-Nutritional function .

3-The excretory function (subtraction) .

4-Regulating body temperature .

5-Regulating Metabolism .

6-Protection .

7-Regulating and protecting the secretion of hormones .

8-Water balance .

9-Blood clot .