

# Blood: Its Composition and Function

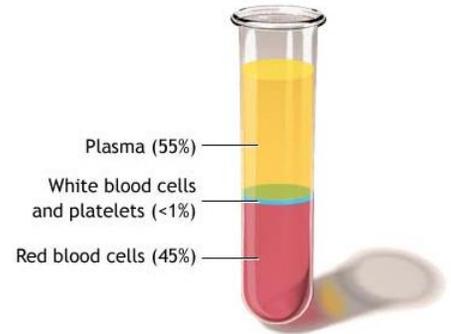
The blood in our circulatory system is a watery based fluid and consists of two basic components:

- 1) Plasma (55%) and,
- 2) Formed elements (45%)

## Part A: Plasma

The **Plasma** is the light yellow liquid portion of the blood and is about 90% water. Dissolved in the plasma are:

- 1) Gases (e.g. nitrogen carbon dioxide, and oxygen)
- 2) Ions (e.g. sodium, chloride and calcium)
- 3) Nutrients (e.g. glucose, amino acids)
- 4) Hormones
- 5) Proteins (*most abundant*)
- 6) Lipid molecules
- 7) Various wastes



Proteins are the most abundant of all dissolved substances in the plasma. Some plasma proteins serve as carrier proteins. There are three types:

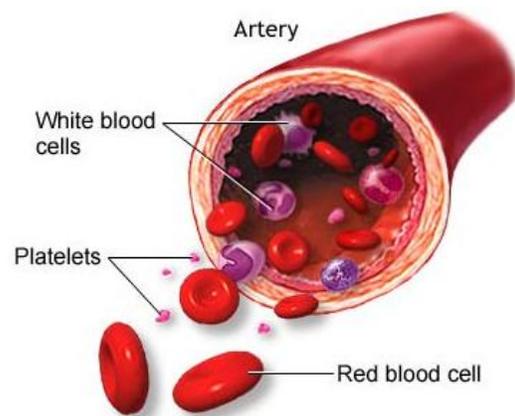
**Table 1:** Summary of plasma proteins

Protein	Function
Albumins	<ol style="list-style-type: none"> <li>1. Maintain osmotic pressure by drawing water back into capillaries to help maintain body fluid levels.</li> <li>2. Transport smaller molecules such as hormones and ions</li> </ol>
Globulins	<ol style="list-style-type: none"> <li>1. Help protect against invading microbes by binding to foreign substances</li> <li>2. Transport hormones and fat soluble vitamins</li> </ol>
Fibrinogens	<ol style="list-style-type: none"> <li>1. Converted into fibrin networks that form blood clots.</li> </ol>

## Part B: Formed elements

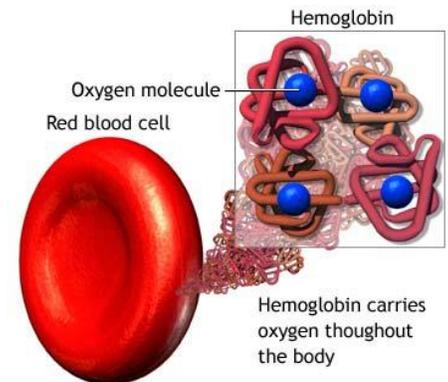
There are three types of formed elements that are suspended in the plasma:

- 1) Red blood cells
- 2) White blood cells
- 3) Platelets



## Red Blood Cells (*Erythrocytes*)

The red blood cells are the most abundant cells in the human blood. They are highly flexible (*as they must bend and twist as they pass through the capillaries*), **biconcave disks** that transport oxygen, and to a lesser degree, carbon dioxide in the blood. The unique shape of the red blood cells simply increase its surface area.



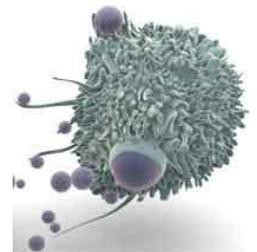
**Hemoglobines**, the oxygen-transporting protein found in the RBC's contains a ring of iron. Inside the RBC's, oxygen binds to the ring of iron in hemoglobine molecules for transport through the circulatory system. In facet, 98% of oxygen is transported bound to iron in hemoglobine while the other 2% dissolves in the blood plasma.

**Anemia** is a condition resulting in a decrease in the ability to transport oxygen in the blood. A deficiency in either hemoglobine or in red blood cells decreases the oxygen transported to the tissue. This condition is characterised by weakness and fatigues. People suffering from anemia often:

- i. Are pale and end to faint easily
- ii. Become short of breath easily
- iii. Have an increased heart rate
  - i. This is to offset the reduction in the oxygen in the oxygen carrying capacity of the blood.

## White Blood Cells (*Leukocytes*)

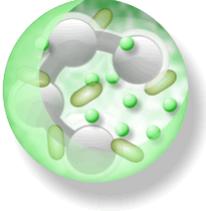
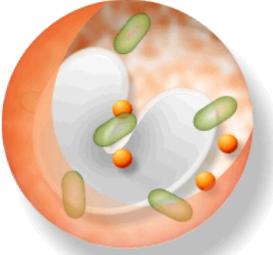
White blood cells are **nucleated** cells that are a very important part of the body protective mechanism. This type of cell that constitutes less then 1% of the blood volume attacks harmful microorganisms such as viruses and bacteria.



Once arrived at the “scene”, most white blood cells destroy invading microbe by phagocytosis (a form of endocytosis). Once the microbe is engulfed, the leukocyte releases an enzyme that then digests the microbe.

Although **WBC's** are officially blood cells, they do most of their work outside of the blood stream, in the tissue. The blood vessels simply transport the WBC's to sites of infection where they can “Squeeze” between endothelium cells escaping the walls of the capillaries.

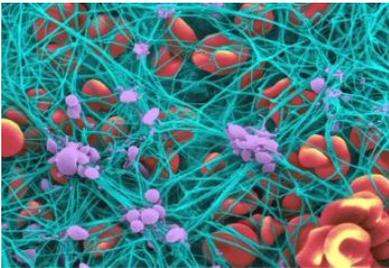
The three most numerous leukocytes are:

	Neutrophil	Monocyte	Lymphocyte
Picture			
Description	<ul style="list-style-type: none"> <li>• Approximately twice the size of RBC's</li> <li>• Multi lobes nucleus</li> <li>• Most abundant WBC</li> </ul>	<ul style="list-style-type: none"> <li>• Larger than a Neurophil</li> <li>• U or kidney shaped nucleus</li> </ul>	<ul style="list-style-type: none"> <li>• Slightly smaller than a neutrophil</li> <li>• Large, round nucleus that fills most of the cell.</li> <li>• Second most abundant WBC</li> </ul>
Life Span	6 hours to a few days	Many months	Can persist many years
Function	<p><b><u>First Line of Defence</u></b></p> <ul style="list-style-type: none"> <li>• Circulate in the blood awaiting and microbial invasion.</li> <li>• Usually the first to arrive on the "scene".</li> <li>• Phagocytize microorganisms preventing the spread of bacteria.</li> <li>• The cell then dies the becomes part of the yellowish liquid (pus) that exudes from a wound</li> </ul>	<p><b><u>Clean-up Crew</u></b></p> <ul style="list-style-type: none"> <li>• Will also leave the bloodstream to migrate to infected body issue.</li> <li>• Like watchful soldiers, they remain stationary in the connective tissue of organs ready to attack invaders.</li> <li>• Also phagocytic cells.</li> <li>• Engulf microorganisms, dead cells, and dead neutrophils.</li> </ul>	<ul style="list-style-type: none"> <li>• Most lymphocytes exit outside the circulatory system in the lymphoid organs (spleen, thymus, lymph nodes) where they attack microbial intruders.</li> <li>• Unlike Neurophil and Monocyte, these cells are not phagocytic</li> <li>• Cells antibodies bind to "Foreigners", coats them and neutralizes them.</li> </ul> <p><b><u>Two types of lymphocytes:</u></b></p> <ul style="list-style-type: none"> <li>• T Lymphocytes</li> <li>• B Lymphocytes</li> </ul>

## Platelets

Among the most important agent of blood clotting are the **platelets**, tiny formed elements produced in the bone marrow. Like RBC's, platelets lack nuclei and organelles, and are unable to divide.

Carried passively in the blood stream, platelets are coated by a layer of sticky material which causes them to adhere to irregular surfaces such as tears in blood vessels. As more and more platelets stick, a clot is created to seal the hole in the vessel.



Once the temporary clot is in place, **fibrinogen** in the plasma is converted into long strands of **fibrin**, forming a mesh that traps more platelets and blood cells. This permanent clot stops the leakage of blood and allows time for the injury to heal. Once healed, the clot is absorbed in the body.