



Blood

Blood is the fluid component of the cardiovascular system and accounts for about 7% of your body weight or 5-6L in males and 4-5L in females. It is considered a specialized fluid connective tissue containing plasma (fluid matrix) and formed elements (cell and platelets). Its functions include transport of gases, nutrients, and metabolic wastes; regulation of pH and ionic composition of interstitial fluids; restriction of fluid loss when vessels are broken; defence against foreign compounds and stabilization of body temperature. Together, plasma and formed elements constitute the **whole blood**. Basic physical characteristics of whole blood: temperature - roughly 38°C; high viscosity; slightly alkaline - pH 7.4.

Plasma - also called thrombocytes

- Constitutes 46-63% of the blood volume
- 92% of the plasma is water

Proteins	Percent of the Total Proteins	Function
Albumin	60%	<ul style="list-style-type: none"> - Very important for maintaining osmotic pressure of the plasma - Provides transport for fatty acids, hormones and other substances - Synthesized by liver
Globulins (Antibodies)	35%	<ul style="list-style-type: none"> - Alpha & beta globulins are synthesized by liver - Gamma globulins are produced by lymphocytes - Transport molecules such as fats
Fibrinogen	4%	Important for clotting. Fibrinogen is converted to fibrin and fibrin fibres form the frame for the blood clot.
Regulatory proteins (Includes enzymes and hormones)	< 1%	<ul style="list-style-type: none"> - Regulates responses in the body - Can affect gene expression



White blood cells (WBC) – also called leukocytes

- Neutrophils, eosinophils, basophils and monocytes contribute to the *non-specific defence* in our immune system
- Lymphocytes are part of the *specific defence* in our immune system
- White blood cells are produced in red bone marrow and some mature in the lymphatic system

Name		Percent of circulating WBC	Function	General Characteristics
	Neutrophils	70%	Attack and digest bacteria that have been “marked” with antibodies or complement proteins (by engulfing them). Release prostaglandins (lipid derivatives that increase capillary permeability) and leukotrienes (hormones that attract other phagocytes).	<ul style="list-style-type: none"> - Granules are chemically neutral - Granules contain lysosomal enzymes and bactericidal compounds - Nucleus has two to five lobes - Highly mobile
	Eosinophils (acidophils)	2-4%	Attack organisms, especially parasites, primarily by exocytosis of toxic compounds. They can also engulf antibody “marked” bacteria, protozoa, or cellular debris. Release enzymes that reduce inflammation, controlling the process.	<ul style="list-style-type: none"> - Granules stain dark with eosin, a red and acidic dye - Nucleus has two lobes - Increase during parasitic infection and allergic reactions
	Basophils	Less than 1%	Migrate to damaged sites, cross the capillary endothelium and discharge their granules into the interstitial fluid. The granules contain histamine, which dilates blood vessels, and heparine, which prevents blood clotting.	<ul style="list-style-type: none"> - Granules stain darkly with basic dyes - Relatively rare



<u>Agranulocytes</u> = cells that do NOT exhibit granules	Monocytes	2-8%	Active phagocytes. They release chemicals that attract and stimulate other phagocytes and fibroblast to produce scar tissue at the injured area.	- Bigger than other blood cells
	Lymphocytes	20-30%	There are three functional classes: <i>T cells</i> - coordination of the immune response (cell-mediated immunity) <i>B cells</i> - produce and distribute antibodies (humoral immunity) <i>Natural killers</i> - detection and destruction of abnormal tissues (immune surveillance)	- Relatively large and round nucleus with a thin halo of cytoplasm - Continuously migrate to and from the bloodstream

Red blood cells (RBCs) - also called erythrocytes

- Constitutes 99.9% of the formed elements
- Contain hemoglobin (red pigment that gives blood its colour) which carries oxygen (in the form of oxyhemoglobin) or carbon dioxide (in the form of carbaminohemoglobin). When hemoglobin is not bound to oxygen, it is called deoxyhemoglobin.
- Formed from hemocytoblasts in red bone marrow
- Life span of 120 days

Medical Terms	Definition
Anemia	When the hematocrit is low or the hemoglobin content of RBC is reduced.
Hemoglobinuria	When an abnormally large number of RBC breaks down in the bloodstream, urine may turn red or brown.
Hematuria	When intact RBCs are found in the urine. Generally occurs because of kidney damage or damage to blood vessels along the urinary tract.
Erythropoiesis	Red blood cell formation. Occurs only in red bone marrow (also called myeloid tissue).
Jaundice	When circulating levels of bilirubin (the waste product made during the breakdown of hemoglobin) rise. Bilirubin diffuses to the peripheral tissues, giving both skin and eyes a characteristic yellow color.



Antigen	Substance that can trigger an immune response.
Thrombocytopenia	Abnormally low platelet count.
Thrombocytosis	Increased platelet count. Generally associated with accelerated platelet formation.
Hemostasis	The cessation of bleeding. Consists of three phases: the vascular phase (contraction of the vessel wall), the platelet phase (attachment of platelets to the endothelial surface of the vessel), and the coagulation phase (blood clotting).
Fibrinolysis	Normal breakdown of clots.
Hematocrit	The percentage of RBC in blood.

ABO Blood Types

All humans can be typed for their ABO blood type. There are four principal blood types: A, B, AB, and O. Two antigens and two antibodies are responsible for the ABO blood types. The combination of these four components determines an individual's blood type. The table below shows the possible combinations of antigens and antibodies with the corresponding ABO type ("yes" indicates the presence of a component and "no" indicates its absence in the blood of an individual).

ABO Blood Type	Antigen A	Antigen B	Antibody Anti-A	Antibody Anti-B
A	yes	no	no	yes
B	no	yes	yes	no
O	no	no	yes	yes
AB	yes	yes	no	no

