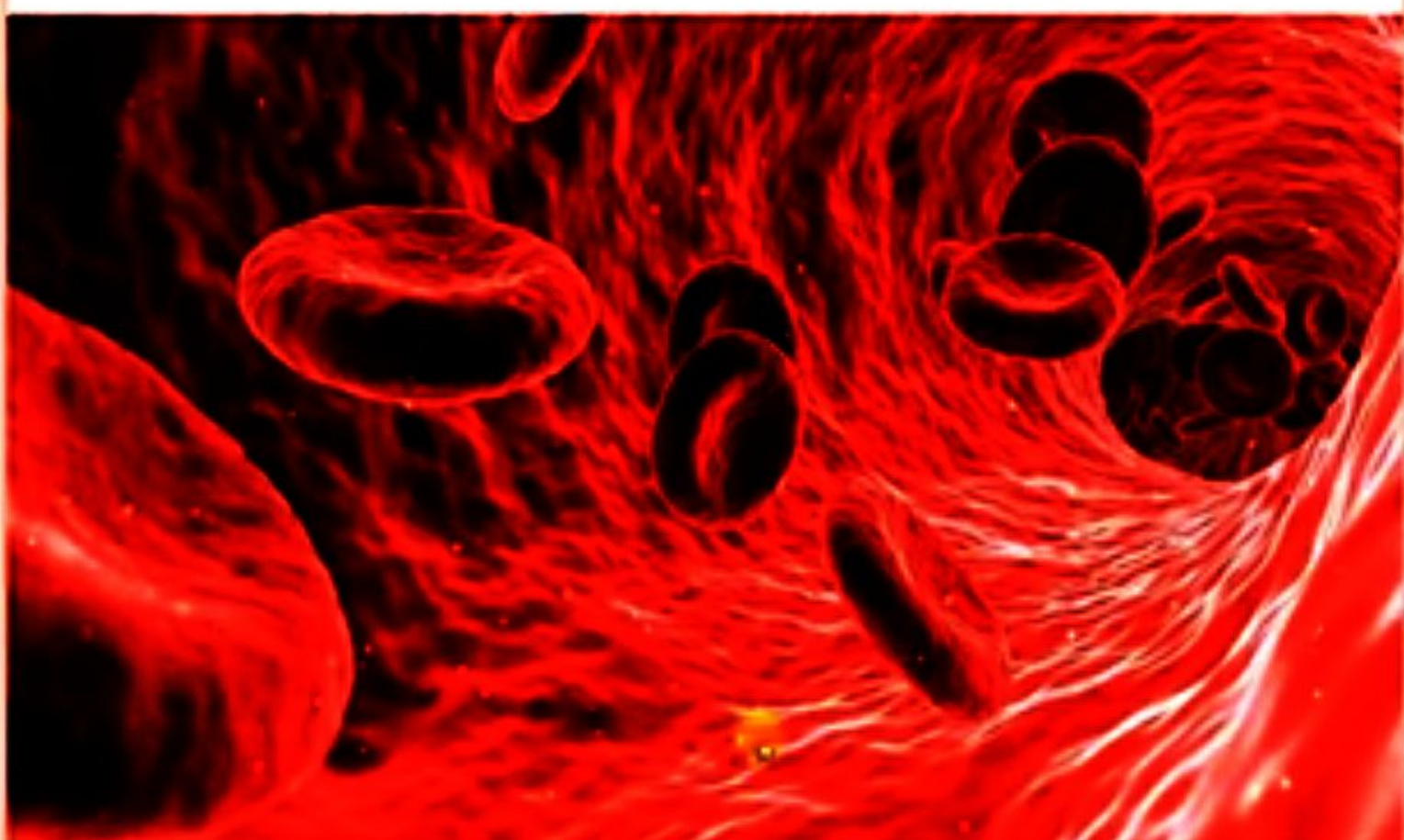


BLOOD



Blood is essential to life. Blood circulates through our body and delivers essential substances like oxygen and nutrients to the body's cells. It also transports metabolic waste products away from those same cells. There is no substitute for blood. It cannot be made or manufactured. Generous blood donors are the only source of blood for patients in need of a blood transfusion.

A microscopic image of connective tissue, showing a dense network of fibers and cells. The fibers are stained pink and purple, and the cells are stained blue. The overall appearance is a complex, fibrous structure.

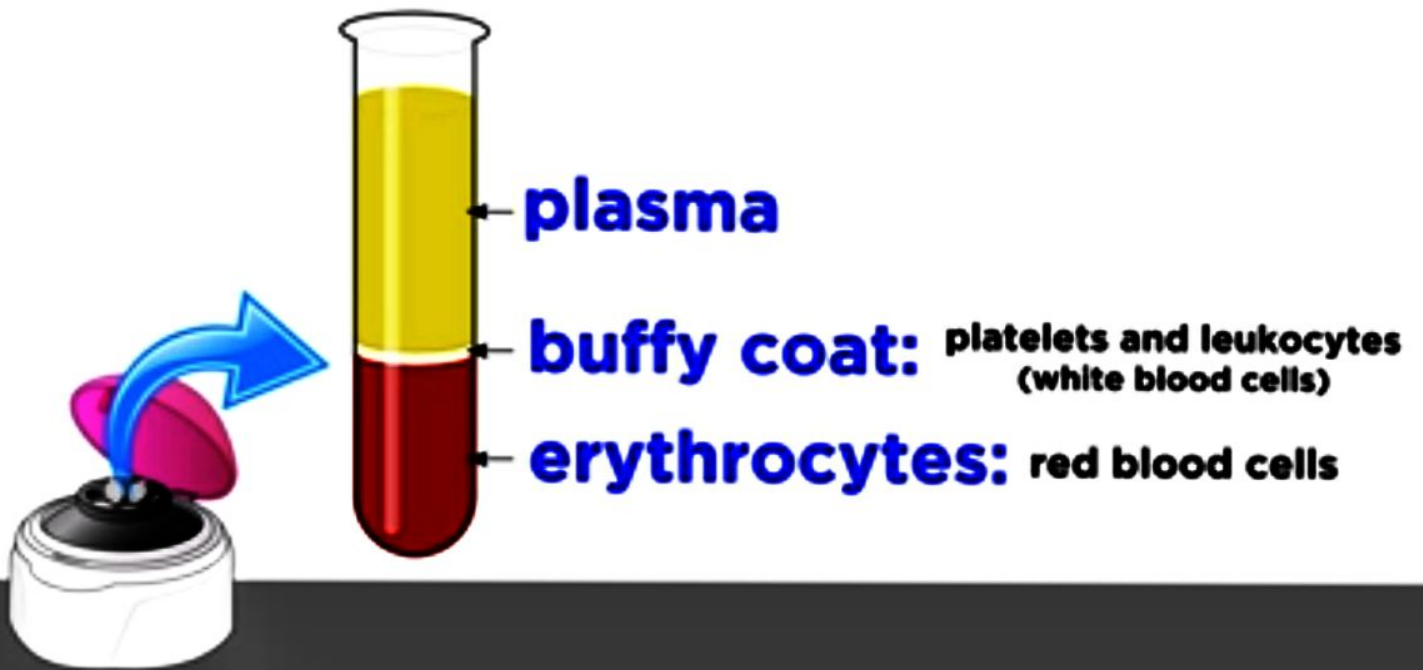
types of connective tissue

connective tissue proper

cartilage

bone

blood



centrifuge

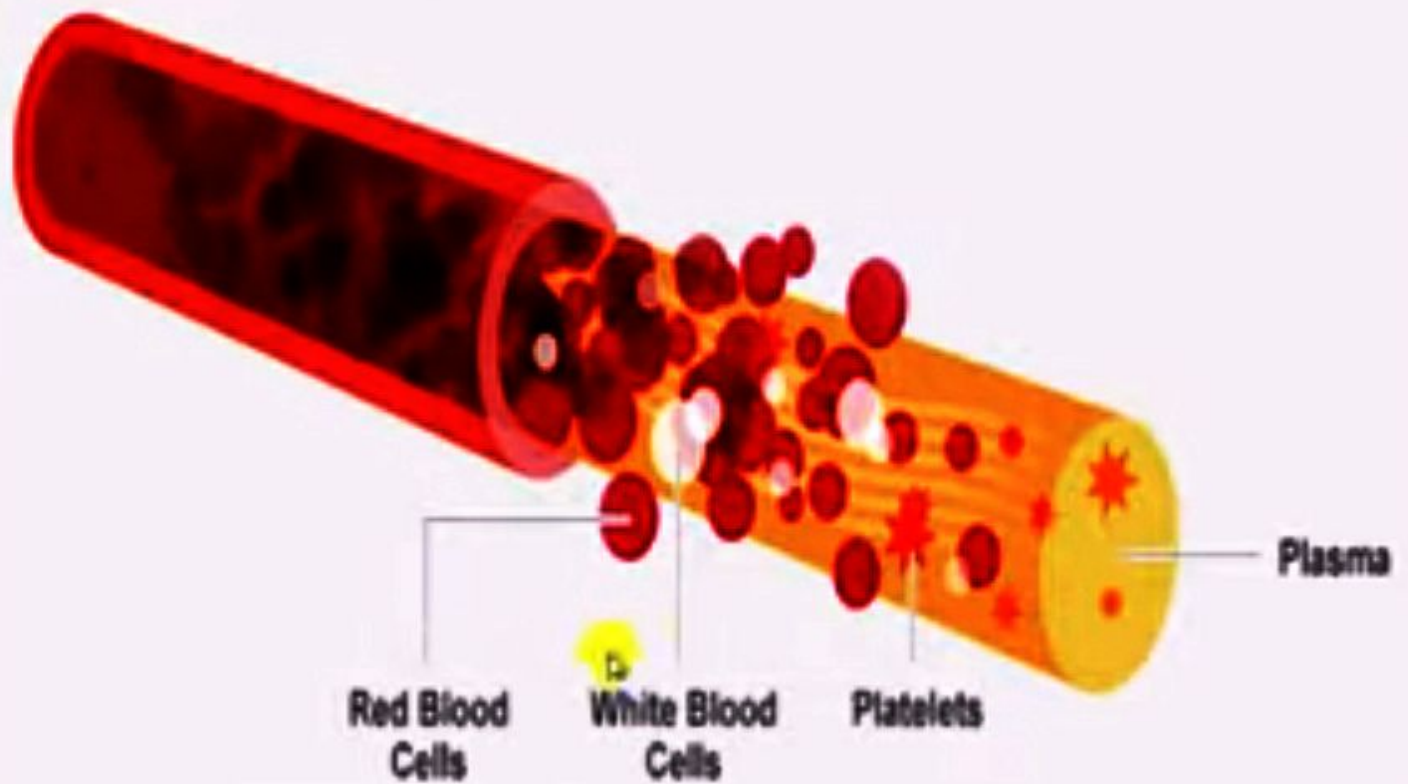
BLOOD COMPONENTS

There are four basic components that comprise human blood:

- 1. Plasma (Liquid)**
- 2. Red blood cells (which carry oxygen to the tissues)**
- 3. White blood cells (which fight infections)**
- 4. Platelets (smaller cells that help blood to clot)**



BLOOD COMPONENTS



PLASMA

Plasma is the liquid portion of your blood. Plasma is yellowish in color and is made up mostly of water, but it also contains proteins, sugars, hormones and salts. It transports water and nutrients to your body's tissues.

Plasma: This constitutes approximately 55% of blood fluid in humans.

The remaining 45% of the blood mainly consists of red and white blood cells and platelets.



PLASMA

- Clear, straw colored fluid
- 55% of total blood volume
 - 91% water
 - 9 % solids
 - 1% inorganic molecules : Na^+ , Ca^{2+} , Cl^- , HCO_3^- , K^+ , Mg^{2+} , Cu^{2+} , PO_4^{3-}
 - 8% organic molecules : 7% plasma proteins, 1% Non-protein Nitrogen (NPN) substances, sugars, fats, enzymes, hormones



RED BLOOD CELLS


Red blood cells(RBC) also called Erythrocytes

Red blood cells represent 40%-45% of your blood volume. They are generated from your bone marrow at a rate of four to five billion per hour.

RBC life cycle : 120 days in the body.

WHITE BLOOD CELLS

Although white blood cells (leukocytes) only amount for about 1% of your blood, they are very important. White blood cells are essential for good health and protection against illness and disease. Like red blood cells, they are constantly being generated from your bone marrow. They flow through the bloodstream and attack foreign bodies, like viruses and bacteria. They can even leave the bloodstream to extend the fight into tissue.



PLATELETS

Platelets also called Thrombocytes.

Platelets are the smallest of our blood cells and literally look like small plates in their non-active form. Platelets control bleeding. Wherever a wound occurs, the blood vessel will send out a signal. Platelets receive that signal and travel to the area and transform into their "active" formation, growing long tentacles to make contact with the vessel and form clusters to plug the wound until it heals.

Plasma is 92 percent water, and the contents of the remaining 8 percent include:

- Carbon dioxide**
- Glucose**
- Hormones**
- Proteins**
- Mineral salts**
- Fats**
- Vitamins**



composition of blood:

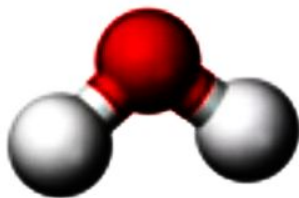
formed elements suspended in **plasma**

plasma



platelets

erythrocytes
(red blood cells)



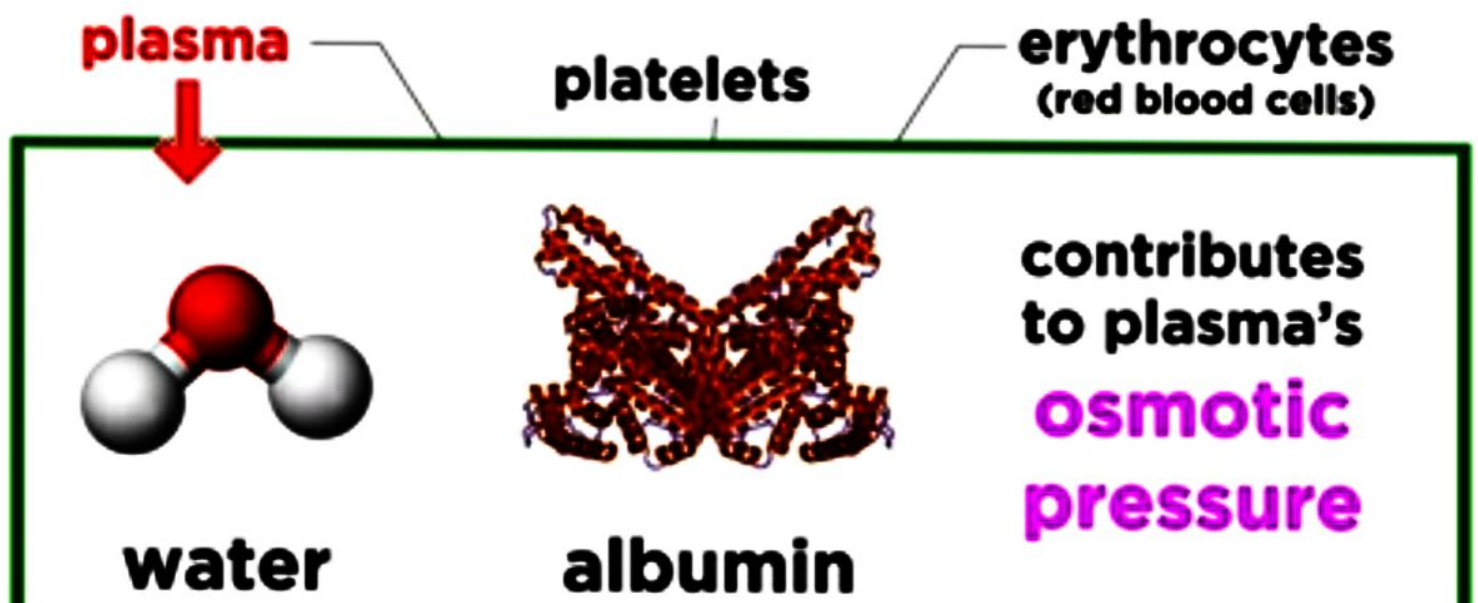
water

plus:

**proteins, nutrients,
ions, gases, hormones**

composition of blood:

formed elements suspended in **plasma**



composition of blood:

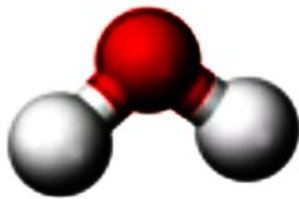
formed elements suspended in **plasma**

plasma

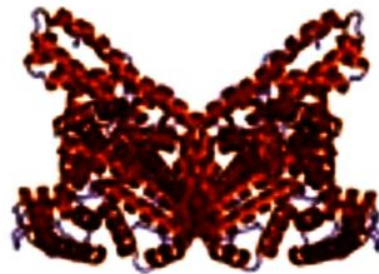


platelets

erythrocytes
(red blood cells)

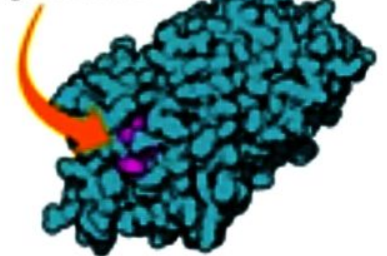


water



albumin

thyroxine



globulin

TABLE 6.3. Composition of Vascular Tissues

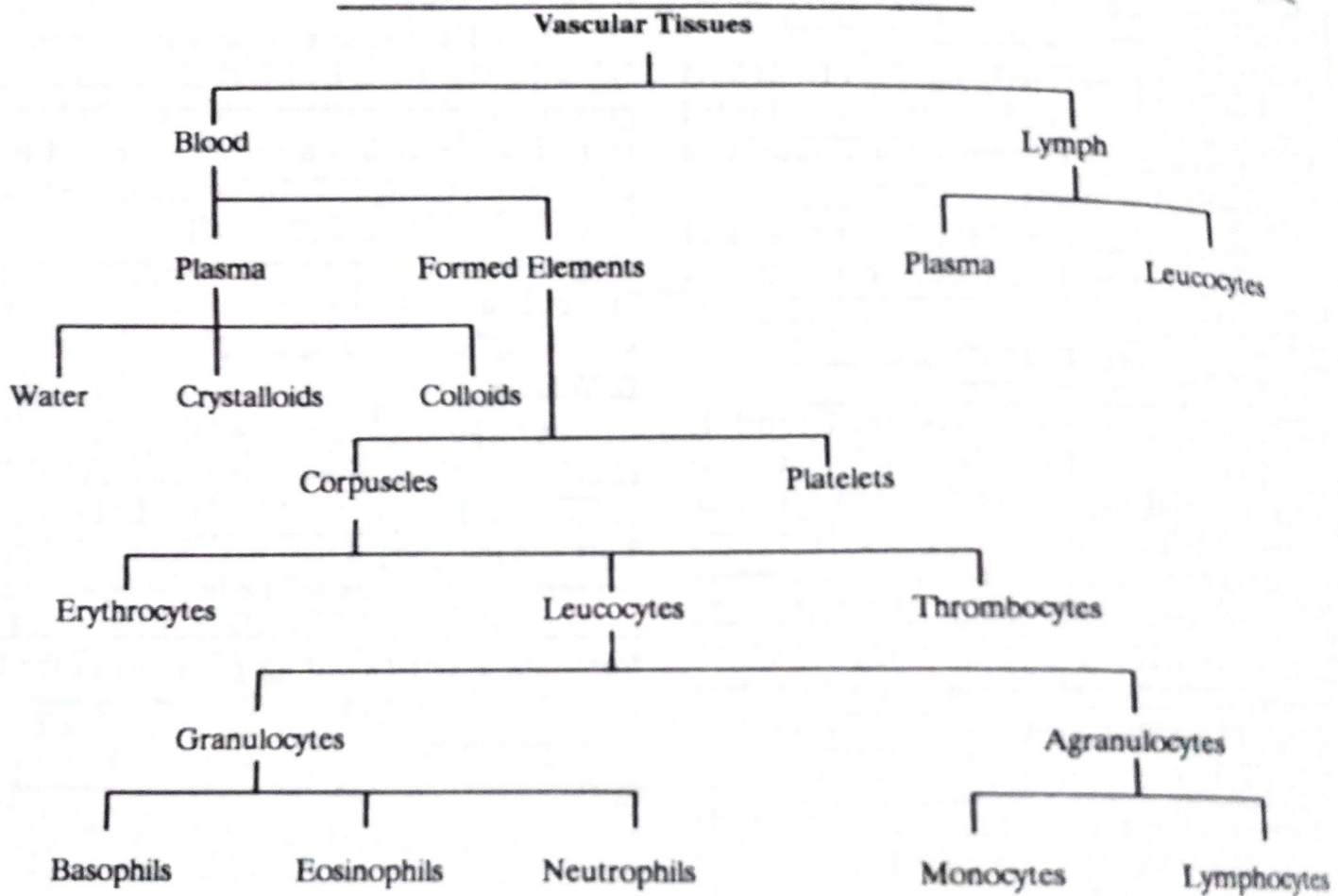


TABLE 6.5. Components of Blood Plasma and their Functions.

Components	Functions
<p>I. Having a Constant Concentration</p> <p>1. Water 90%</p> <p>2. Proteins 7 or 8%</p> <p>(i) Serum Albumen</p> <p>(ii) Serum Globulins :</p> <p>α-globulin</p> <p>β-globulin</p> <p>γ-globulin</p> <p>(iii) Prothrombin</p> <p>(iv) Fibrinogen</p> <p>(v) Enzymes</p> <p>3. Mineral ions 1%</p> <p>(Na^+, K^+, Ca^{2+}, Mg^{2+} H_2PO_4^-, HPO_4^{2-}, PO_4^{3-}, Cl^-, HCO_3^-, SO_4^{2-})</p>	<p>Source of H_2O for tissue cells, carries dissolved substances round the body, helps maintain blood pressure and blood volume.</p> <p>Source of proteins for tissue cells, act as buffers, provide osmotic pressure and viscosity, transport some material in combination with them, aid in blood clotting and defense of the body.</p> <p>Very abundant, binds plasma calcium</p> <p>Binds thyroxine and bilirubin</p> <p>Binds iron, cholesterol, and vitamins A, D and K</p> <p>Binds antigens, important in immunological reactions, generally called antibody, also binds histamine.</p> <p>Participates in blood clotting.</p> <p>Takes part in blood clotting.</p> <p>Play a role in metabolic activities.</p> <p>All collectively regulate osmotic pressure and pH of blood. Many have individual role too, e.g., Ca^{++} helps in blood clotting, muscle contraction and nerve impulse conduction.</p>
<p>II. Occurring in Varying Concentrations 1 or 2%</p> <p>1. Dissolved foods</p> <p>2. Dissolved wastes</p> <p>3. Dissolved gases</p> <p>4. Vitamins</p> <p>5. Hormones</p> <p>6. Cholesterol</p>	<p>All are being carried to and from the tissue, play their individual role in the tissue cells.</p>

... in smaller amounts. The remain...

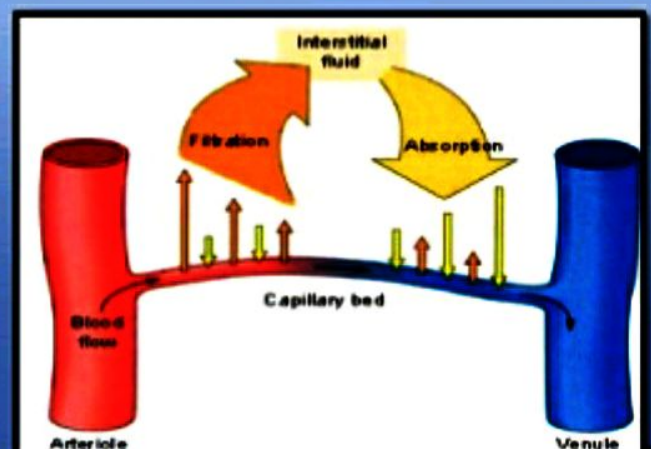
Functions of Plasma Proteins

1. *Helps in coagulation*

- Due to presence of fibrinogen, prothrombin and other clotting factors

2. *Helps to maintain colloidal osmotic pressure (COP) across capillary wall*

- COP across capillary walls helps to maintain the exchange of fluid at tissue level
- The rate of fluid exchange (ie filtration-absorption) at any point along a capillary depends upon a balance of forces called **Starling Forces**.



6. *Helps in maintaining acid-base balance in the body*

- Plasma proteins act as buffers
- Buffering capacity is $1/6^{\text{th}}$ of total buffering capacity of blood
- Amphoteric in nature : behave as both acids and bases depending on conditions

7. *Transport and Reservoir function*

- Plasma proteins form loose bond with hormones, drugs and metals to serve as reservoirs and from which they are released slowly at appropriate sites.

3. Helps in maintaining viscosity of blood

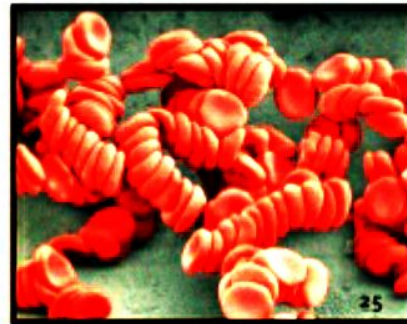
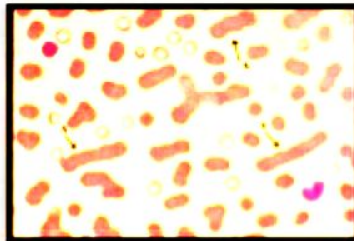
- Since 80% of total plasma concentration is due to albumin, and fibrinogen is present on traces, blood viscosity is maintained at low level.

4. Helps in maintaining systemic arterial blood pressure constant

- Plasma proteins maintain the blood pressure constant by maintaining the viscosity of blood.

5. Provides stability to blood

- Due to presence of globulin and fibrinogen
- If blood loses its stability, lead to **Rouleaux** formation



FUNCTIONS OF BLOOD

- **supplying oxygen to cells and tissues**
- **providing essential nutrients to cells, such as amino acids, fatty acids, and glucose**
- **removing waste materials, such as carbon dioxide, urea, and lactic acid**
- **protecting the body from infection and foreign bodies through the white blood cells**



- **transporting hormones from one part of the body to another, transmitting messages, and completing important processes**
- **regulating acidity (pH) levels and body temperature**

Another important function of the blood is its protective action against disease. White blood cells defend the body against infections, foreign materials, and abnormal cells.

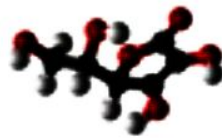
The platelets in blood enable the clotting, or coagulation, of blood. When bleeding occurs, the platelets group together to create a clot. The clot becomes a scab and stops the bleeding, as well as helping to protect the wound from infection.



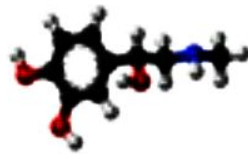
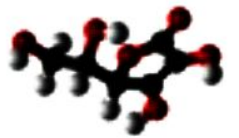


blood is responsible for carrying:

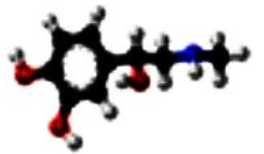
 **oxygen (O₂)**



**nutrients from the
digestive tract**



**hormones from
endocrine organs**



carbon dioxide (CO₂)





other functions of the bloodstream:



**regulates pH in
various tissues**

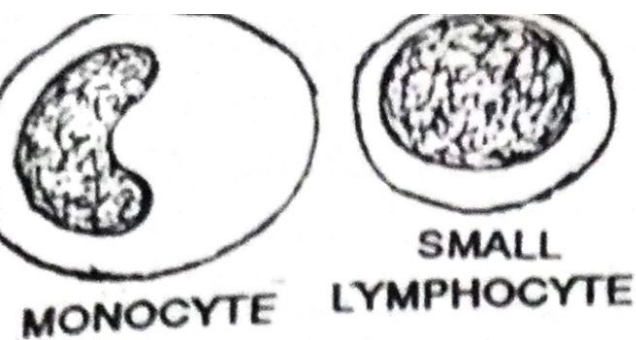


**maintains body
temperature**



prevents infection





es in red bone marrow.

platelet.

D. Functions

The blood plays a vital role in the body and is often called the "river of life." Each one of its constituents is important.

(a) **Plasma.** The plasma serves the following functions –

(i) **Transport of Food.** Food materials, such as glucose, amino acids, fatty acids and triglycerides ; vitamins and mineral salts are carried by the plasma from the alimentary canal directly or indirectly *via* lymph to the liver and thence to all the tissues of the body for growth, repair, storage and energy.

(ii) **Transport of Oxygen.** A small amount of oxygen is carried by plasma as its aqueous solution from the lungs to the tissues for oxidation of food.

(iii) **Transport of Carbon Dioxide.** Plasma collects CO_2 from the tissues and carries it to the lungs for elimination from the body.

(iv) **Transport of Waste Products.** Plasma carries nitrogenous wastes, such as urea, uric acid and creatinine, from the liver and other tissues where they are formed to the kidneys for removal in the urine.

(v) **Transport of Hormones.** The endocrine glands secrete their hormones directly into the blood, which carries them to their target organs.

(vi) **Transport of Metabolic Intermediates.** Plasma carries metabolic intermediates from one tissue to another for further metabolism. For example, lactic acid formed in muscles during anaerobic respiration is carried by plasma to the liver where it is partly oxidized and partly changed into glycogen.

(vii) **Supply of Raw Materials.** Plasma supplies raw materials to the glands for the preparation of their products.

(viii) **Regulation of Water Balance.** Plasma regulates the water balance of the body, as it supplies water to the tissues and receives the excess water formed in metabolic processes.

(ix) **Regulation of pH.** Plasma helps to regulate the pH of the body fluids. It contains buffer materials, such as proteins and mineral salts, which can neutralize the acids and bases entering the blood.

(x) **Regulation of Body Temperature.** In large animals with high metabolic rate, the plasma carries heat from the heat-producing tissues, such as muscles and glands, to others where no or a little heat is produced or to the body surface where it can be dissipated. This avoids over-heating of the internal organs.

(xi) **Moistening of Tissues.** Plasma keeps the tissues moist by leaking through the capillary walls as tissue fluid.

(xii) **Prevention of Blood Loss.** Prothrombin and fibrinogen proteins of the plasma help in blood clotting at the site of injury. This prevents blood loss.

(xiii) **Immunity.** Antibodies present in the plasma provide immunity against certain diseases.

(xiv) **Tissue fluid and Lymph Formation.** Plasma contributes to tissue fluid and lymph formation by filtering out through capillary walls.

(xv) **Transmission of Hydraulic Force.** This is an important but often overlooked function of the plasma. Hydraulic force is used in many processes such as locomotion in earthworm; breaking of exoskeleton during moulting in crustaceans; ultrafiltration in kidneys; movements of organs, e.g., penis, siphons in mussels, legs in spiders.

(xvi) **Transport of Phagocytic Leucocytes.** The plasma carries the phagocytic white corpuscles to the site of infection to dispose of the microbes.

(xvii) **Maintenance of Homeostasis.** The plasma keeps the internal environment suitable for the cells in regard to pH, ions, nutrients, etc.

(b) **Red Blood Corpuscles.** The red blood corpuscles have two functions –

(i) **Transport of Oxygen.** Erythrocytes carry oxygen bound to haemoglobin as oxyhaemoglobin from the lungs to the tissues for oxidation of food to release energy.

(ii) **Transport of Carbon Dioxide.** Erythrocytes carry a small amount of CO_2 as carbamino-haemoglobin from the tissues to the lungs for removal from the body.

(c) **White Blood Corpuscles.** The white blood corpuscles act as the soldiers, scavengers and builders of the body.

(i) **Soldiers.** Neutrophils and monocytes defend the body against the attacks of microorganisms. They collect at the site of infection and engulf the invaders. This action is called phagocytosis. Lymphocytes and eosinophils destroy toxins released by the microbes. The lymphocytes also provide immunity against many types of infections.

(ii) **Scavengers.** Neutrophils and monocytes also phagocytize the dead cells to clean the body.

(iii) **Builders.** Lymphocytes help in scar-formation after injury to heal the wounds. They also form collagen and elastin fibres. They may enter bone marrow and form erythrocytes and neutrophils.

(d) **Platelets/Spindle Cells.** The platelets/spindle cells play a role in blood clotting.

TABLE 6.6. Summary of Human Blood Corpuscles

FLUID	Function
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Function
