UNIT 10

BLOOD

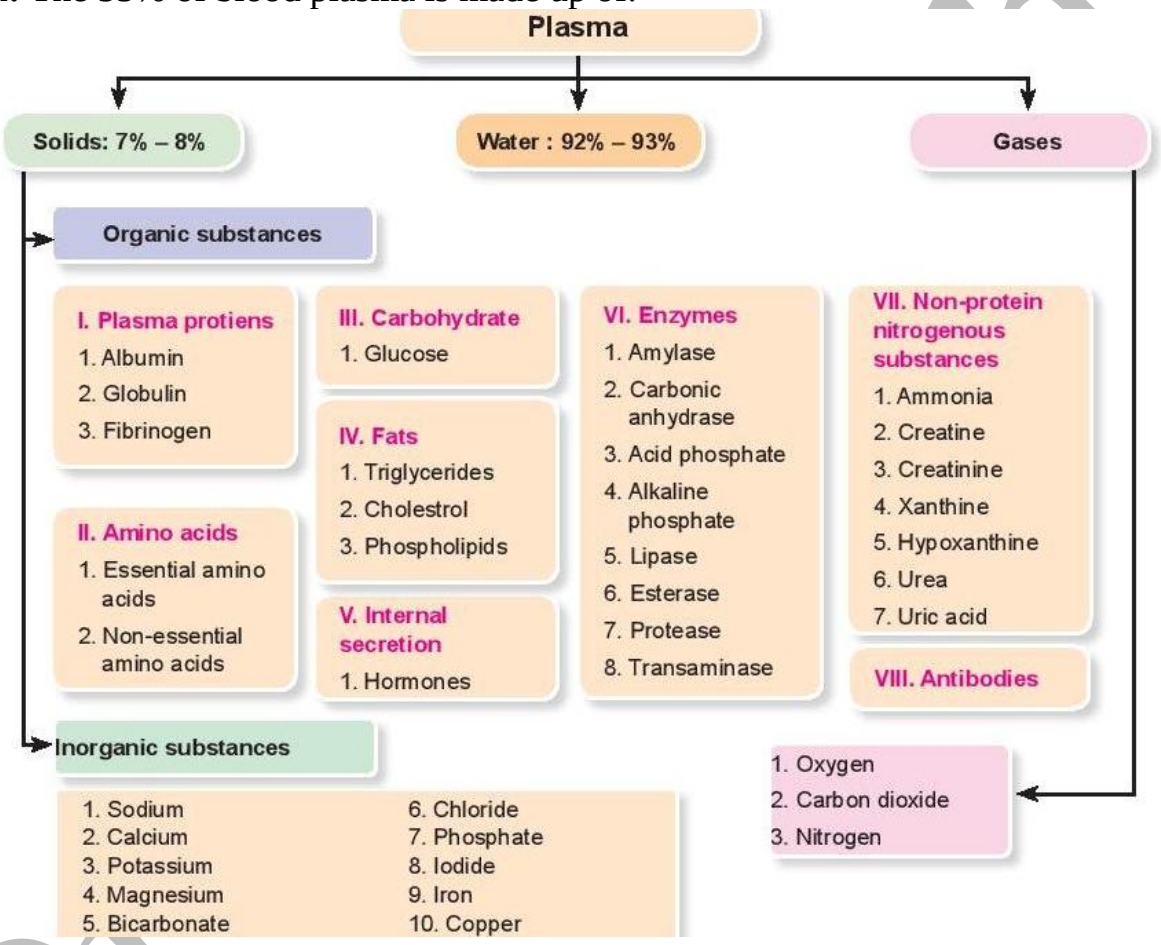
Blood is a fluid connective tissue, which circulates through the heart and blood vessels (arteries, veins and capillaries) carries nutrient materials and oxygen to body cell and removing waste products and carbon dioxide.

COMPOSITION OF BLOOD

Blood contains:

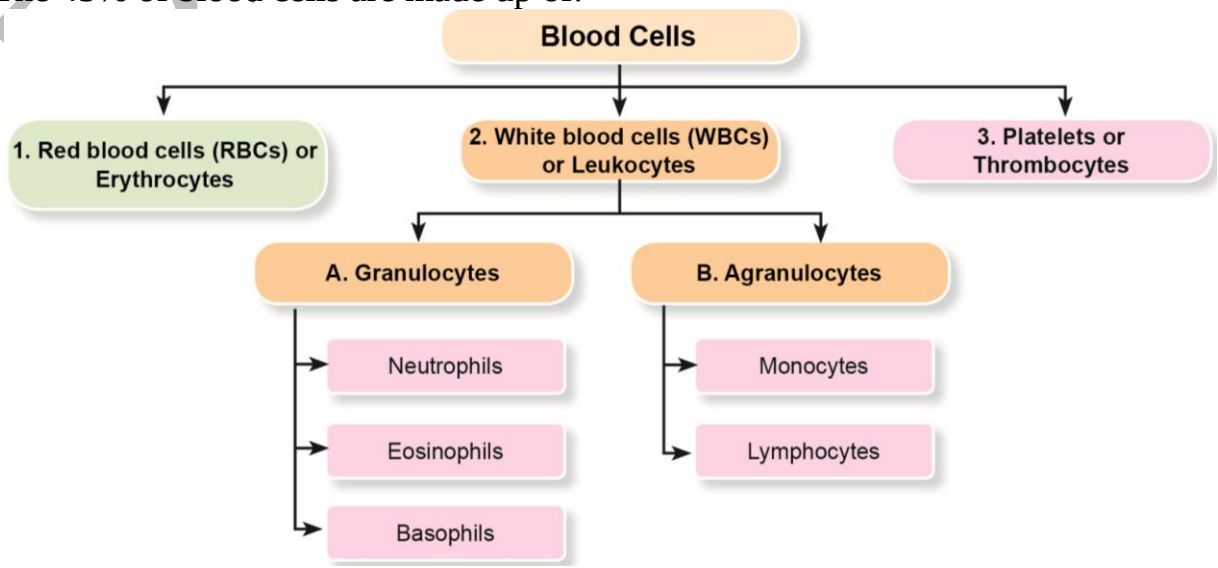
- Plasma : 55 %
- Blood cells : 45 %

1. **Plasma:** The 55% of blood plasma is made up of:



2. **Blood cells**

The 45% of blood cells are made up of:



FUNCTIONS OF BLOOD

1. **Nutritive function**: Blood transports nutritive substances like glucose, amino acids, lipids and vitamins from gastrointestinal tract to different parts of the body for growth and production of energy.
2. **Respiratory function**: Blood transports oxygen from alveoli of the lungs to different tissue and carbondioxide from the tissue to alveoli of lungs.
3. **Excretory function**: The waste products formed in the tissues during various metabolic activities are removed by blood and carried to the excretory organs like kidney, skin, liver, etc. for excretion.
4. **Storage function**: Blood serves as a storage site for water, proteins, glucose, sodium and potassium are released constantly when they are required by tissues.
5. **Regulation of water balance**: Blood helps in regulation of water content of the body by inter exchange with interstitial fluid.
6. **Regulation of acid-base balance**: Blood buffer (plasma proteins and haemoglobin) helps in the regulation of acid base balance in the body.
7. **Regulation of body temperature**: Blood helps in maintaining of body temperature by thermoregulatory mechanism (balance between heat loss and heat gain in the body).
8. **Transport of hormones and enzymes**: Hormones which are secreted by endocrine glands are released directly into the blood and transported to their target organs or tissues. Blood also transports enzymes.
9. **Defensive function:** The white blood cells plays important role in the defense of the body.

PLASMA PROTEIN

The protein which remains in plasma is known as plasma protein. The total amount of plasma proteins is 6 to 8gm/100ml of blood.

Types of plasma protein

a. Albumin: It is synthesized in the liver.
b. Globulin: It is synthesized in the lymphoid tissues.
c. Fibrinogen: It is synthesized in the liver.

Functions of plasma protein

1. It transports hormones, iron and other essential substances.
2. It exerts osmotic pressure and regulates blood volume.
3. It provides viscosity of blood (which helps in maintaining the blood pressure).
4. It develops body immunity.
5. It uniforms distribute of heat all over the body.
6. Fibrinogen is necessary for clotting.

RED BLOOD CELLS (RBCs)/ERYTHROCYTES

Red blood cells are the coloured and non-nucleated formed elements in the blood. These cells are red in colour due to the presence of colouring matter known as haemoglobin. It is also known as erythrocytes.

Normal count of red blood cells

- The average red blood cells count is 4 to 5.5 million per cubic millimeter of blood.
- In adult males**:** about 5 million per cubic millimeter of blood.
- In adult female: about 4.5million/cu mm of blood.

Functions of red blood cell

1. It transports oxygen from the lungs to the tissue.
2. It transports carbondioxide from the tissue to the lungs.
3. Haemoglobin in red blood cell also functions as a good buffer.

HAEMOGLOBIN

Haemoglobin is the colouring matter present in the red blood cells. It is a conjugated protein.

Types of haemoglobin

1. **Oxyhaemoglobin:** The combined form of haemoglobin and oxygen which is found in arterial blood and is the oxygen carried to the body tissues is known as oxyhaemoglobin.
2. **Carboxyhaemoglobin:** The inhaled carbon monoxide combines with haemoglobin binding more tightly than oxygen and rendering the haemoglobin incapable of transporting oxygen is known as carboxyhaemoglobin.

Normal range of haemoglobin

- The average hameoglobin contain in blood: about 14 to16 gm%
- In adult male: about 14 to 15gm%
- In adult females: about 13 to 14gm%

Functions of haemoglobin

1. It transports respiratory gases (oxygen and carbondioxide).
2. It helps in good buffer (maintenance of acid base balance).
3. It reserves iron and proteins.

WHITE BLOOD CELLS (WBC)/LEUKOCYTES

White blood cells are the colourless and nucleated formed elements in the blood. It is also known as leukocytes. The white blood cells plays role in immune system of the body.

Classification of white blood cells

Based on the presence or absence of granules in the cytoplasm, the leukocytes are classified into two groups:

1. **Granulocytes:** The presence of granules in the cytoplasm is known as granulocytes. The granulocytes cells are classified into three types:
   - Neutrophils
   - Eosinophils
   - Basophils
2. **Agranulocytes:** The absence of granules in the cytoplasm is known as agranulocytes. The agranulocytes cells are classified into two types:
   - Monocytes
   - Lymphocyte

Normal count/range of white blood cells

- The total WBCs count (TLC or TC): 4,000 to 11,000/cumm of blood.
- The deferential WBCs count (DLC or DC): given in the table.

White blood cells	Normal count (per cumm of blood).	Percentage (%)
1. Neutrophils	3,000 to 6,000	50 to 70
2. Eosinophils	150 to 450	2 to 4
3. Basophils	0 to 100	0 to 1
4. Monocytes	200 to 600	2 to 6
5. Lymphocytes	1500 to 2700	20 to 30

Life span of white blood cells

White blood cells	Life span
1. Neutrophils	2 to 5 days
2. Eosinophils	7 to 12 days
3. Basophils	12 to 15 days
4. Monocytes	2 to 5 days
5. Lymphocytes	½ to 1 days

Functions of white blood cells

1. It protects the body against the infection.

2. It repairs the injured tissues.
3. Basophils secrete an anticoagulant substance known as heparin.

PLATELETS/THROMBOCYTES

- Platelets are small colourless, non-nucleated and moderately refractive bodies. It is also known as thrombocytes.
- The normal range of platelets: 1.5 to 4 Lakh/cumm of blood.
- The life span of platelets: 7 to 14 days.

Functions of platelets

1. It is the essential part of blood coagulating mechanism.
2. It closes minute lesions in the walls of blood vessels.

HAEMATOPOIESIS

The formation and development of blood cells are known as haematopoiesis. The term ***Haem*** means blood and ***poiesis*** means synthesis. It is also kwon as haemopoiesis, haematogenesis and haemogenesis.

Site of haematopoiesis

- Fetus less than 2 month: Yolk sac.
- 2 to5 month: Liver and spleen.
- Adult life: Bone marrow.

Stages of haematopoiesis

The haematopoiesis is consists of:

- Erythropoiesis
- Leukopoiesis
- Thrombopoiesis

ERYTHROPOIESIS

The formation, maturation and development of red blood cells (erythrocyte) are known as erythropoiesis.

Stages of erythropoiesis

Bone marrow stem cells
↓
Pronormoblast
↓
Basophilic (Early) normoblast
↓
Polychromatic (Intermediate) normoblast
↓
Orthochromatic (Late) normoblast
↓
Reticulocyte
↓
Erythrocyte

Regulation of erythropoiesis: The process of development of red blood cells from bone marrow stem cells takes about 7 days. The vitamin B_{12} and folic acids are required for synthesis of red blood cells. They are absorbed in the intestine.

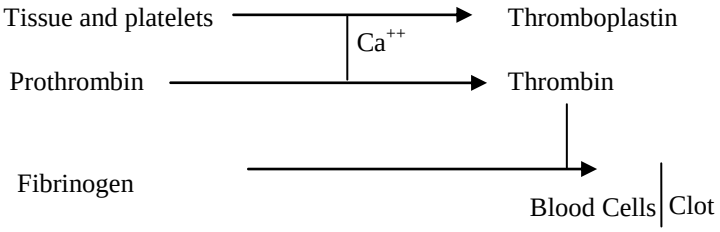
CLOTTING OF BLOOD (HAEMOSTASIS)

Haemostasis is a process that prevents excessive blood loss in the body. When a blood vessel is injured, the injury initiates a series of reactions, resulting in haemostasis. The more badly damaged the vessel wall, the faster coagulation begins, sometimes as quickly as 15 seconds after injury.

Mechanism of clotting

Clotting of blood occurs in the following stages:

- Thromboplastin is liberated from disintegrated tissues and damaged platelets.
- Thromboplastin converts prothrombin into thrombin .this occurs in presence of calcium ions.
- The insoluble fibrin forms threads. The formed elements of blood get entangled in this and form the clot.



Clotting factors

The coagulation of blood occurs through a series of reactions due to the activation of a group of substances. Those substances necessary for clotting are known as factors. Thirteen factors are identified these are:

FACTOR I	Fibrinogen
FACTOR II	Prothrombin
FACTOR III	Thromboplastin
FACTOR IV	Calcium
FACTOR V	Labile factor (Proaccelerin or accelerator globulin)
FACTOR VI	Pretense has not been proved
FACTOR VII	Stable factor
FACTOR VIII	Antihemophilic factor
FACTOR IX	Christmas factor
FACTOR X	Stuart-Prower factor
FACTOR XI	Plasma Thromboplastin antedent
FACTOR XII	Hegman factor (contact factor)
FACTOR XIII	Fibrin stabilizing factor (Fibrinase)

BLOOD GROUPS

Blood groups are determined by protein molecules present on the surface of red blood cells or cell membrane. The discovery of blood groups was done by the Austrian scientist ***Karl Landsteiner in 1901***.He was honored with Nobel prizes in 1930 for this discovery.

Types of blood group

- ABO system
- RH factors

1. **ABO system:** According to this system entire population is divided into four different blood groups. They are labeled according to type of agglutinogen present on red blood cell membrane.
   - Persons having "A" agglutinogen are called "A" group persons.
   - Persons having "B" agglutinogen are called "B" group persons.
   - Persons having "A" and "B" agglutinogen are celled "AB" group persons.
   - Persons having no agglutinogen called "O" persons.
2. **Rhesus factor (Rh factor)**: The antigens present on surface of RBC called Rhesus factor (Rh factor). The antigen presents on the surface of RBC that is called Rh-positive .If Rh antigen is not present on the surface of RBC that is called Rh-negative.

Procedure of blood grouping

- One drop of antiserum A is placed on one end of a glass slide and one drop of antiserum B on the other end.

- One drop of red blood cells suspension is mixed with each antiserum. The slide is slightly rocked for 2 minutes. The presence or absence of agglutination is observed by naked eyes or under microscope.
- Presence of clumping: Thick masses of red blood cells are seen.
- Absence of clumping: The mixture is clear with separate cells.

Results

- If agglutination occurs with antiserum A: The antiserum A contains alpha antibody. The agglutination occurs if the red cell contains A antigen. So, the blood group is A.
- If agglutination occurs with antiserum B: The antiserum B contains beta antibody. The agglutination occurs if the red cell contains B antigen. So, the blood group is B.
- If agglutination occurs with both antisera A and B: The red cell contains both A and B antigen to cause agglutination. And, the blood group is AB.
- If agglutination does not occurs either with antiserum A or antiserum B:- the agglutination does not occurs if the red blood cell does not contain any antigen, the blood group is O.

ERYTHROBLASTOSIS FOETALIS

Erythroblastosis fetalis is the hemolytic anaemia of the new born due to transmission of the antibody formed in the mother through placenta against the fetus red blood cells, associated with jaundice, enlargement of the liver and spleen and generalized edema.

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