

جامعة الانبار

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قسم : الصيدلة

اسم المادة باللغة العربية: بايولوجيا الانسان

اسم المدة باللغة الإنكليزية: **Human Biology**

المرحلة: الاولى

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عنوان المحاضرة باللغة العربية: الدم

عنوان المحاضرة باللغة الإنكليزية: **Blood**

محتوى المحاضرة:

Lec # : Blood

COMPOSITION AND FUNCTION OF THE BLOOD

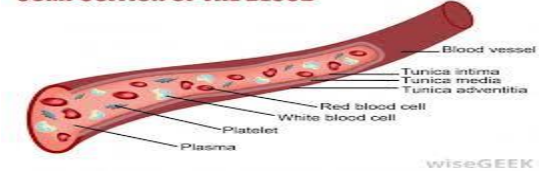
What is the blood???

1. Introduction

1.1 Blood and Blood Cells:

Blood is three to four times more viscous than water. Most blood cells form in red bone marrow. Types of blood cells are **red** blood cells and **white** blood cells. Cellular fragments of blood are **platelets**. Formed elements of blood are the cells and platelets.

COMPOSITION OF THE BLOOD



1.2 Blood Volume and Composition:

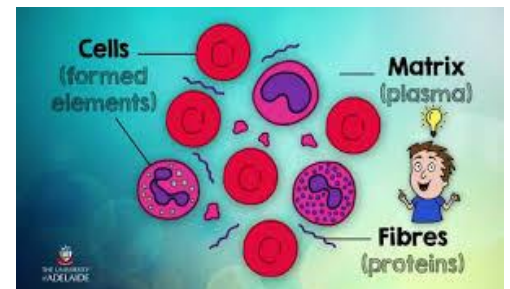
Blood volume varies with body size, changes in fluid and electrolyte concentrations, and the amount of adipose tissue. Blood volume is about 8% of body weight. An average-size adult has 5 liters of blood. Hematocrit is the percentage of blood cells in a blood sample. A blood sample is usually 45 % cells and 55 % plasma. **Plasma** is a mixture of water, amino acids, proteins, carbohydrates, lipids, vitamins, hormone, electrolytes, and cellular wastes. Less than 1% of formed elements of blood are white blood cells and platelets and 99% are red blood cells.

1.3 The Origin of Blood Cells:

Blood cells originate in **red bone marrow** from **hemopoietic stem cells**. A stem cell can differentiate into any number of specialized cell types. Colony-stimulating factors (C-SF) are growth factors that stimulate stem cells to produce certain cell types. **Thrombopoietin** stimulates the production of **megakaryocytes**.

FUNCTIONS of blood:

1. Transports oxygen and nutrients to cells
2. Removes carbon dioxide and wastes from cells
3. Immunity (protects from disease)
4. Temperature regulation (cold, constricts; hot, dilates)



5. Helps prevent loss of blood by clotting
6. Transports hormones

COMPONENTS OF CIRCULATORY SYSTEM

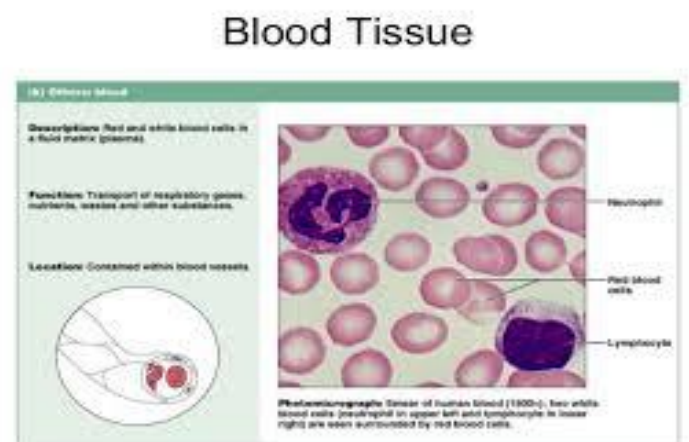
1. Blood
2. Heart
3. Blood vessels (arteries, capillaries, veins)
4. Lymph and lymph vessels

1. BLOOD:

Blood is not an epithelial tissue, and it's not loose or dense connective tissue; it's classified as a "special connective tissue". You have about 5 liters of blood, but that is only half of the body fluid. The other half includes fluid around each cell, and joint fluids, etc.

Blood consists of the following:

- A. Plasma
- B. Red blood cells
- C. White blood cells
- D. Platelets



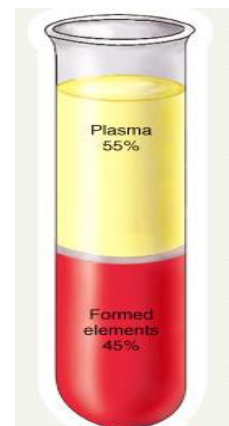
A. PLASMA

Plasma is what the blood cells float around in. If you spin a blood sample in a test tube, the red blood cells sink to the bottom, and you'll see the yellow plasma on top. Some people who need blood just need the packed RBCs, others need the plasma, and some need whole blood, which is both plasma and RBCs. The plasma also carries around the platelets and some white blood cells.

PLASMA CONTENTS

1. Water (90%)
2. Dissolved substances (10%)
 - a. **Proteins**
 - i. Antibodies
 - ii. Clotting factors
 - iii. Lipoproteins (move fats through blood: HDL, LDL)
 - b. **Nutrients**
 - i. Glucose (main energy source)
 - ii. Amino Acids (builds proteins)
 - c. **Wastes** (urea)
 - d. **Gases** (O₂, CO₂, Nitrogen)
 - e. **Electrolytes** = ions (Na⁺, K⁺, Cl⁻, Ca⁺⁺).

Plasma (Blood plasma)



A. RED BLOOD CELLS (ERYTHROCYTES):

These are small red biconcave discs. They are among the smallest cells in the body. There are about 5 million of them in each of us. Their structure is simple; like a doughnut with the hole not fully cut out.

- a. They have **no** nucleus
- b. Filled with a red pigment called **hemoglobin, which carries O₂ throughout the body.** Oxygenated Hb is bright red, deoxy Hb is dull red. Blood in the veins only looks blue because you are seeing the dull red color through a yellow fat layer in the skin and subdermal tissue.
- c. Average life span is **120 days.** They are made in the red bone marrow, and **the old ones are destroyed in the spleen and liver,** and Hb is recycled. During your lifetime, about 250 billion of these cells are destroyed, and 250 billion are made.

Biological Events in Red Blood Cells

Characteristics of Red Blood Cells

Red blood cells are also called **erythrocytes**. Red blood cells are biconcave in shape. The biconcave shape of red blood cells allows them to have an increased surface area for the transport of gases. Hemoglobin is an oxygen carrying protein in red blood cells. Each red blood cell is about one-third hemoglobin by volume. **Oxyhemoglobin** is hemoglobin combined with oxygen. **Deoxyhemoglobin** is hemoglobin that has released oxygen. Red blood cells extrude their nuclei as they mature.

Because red blood cells **lack** mitochondria they must produce **ATP** through **glycolysis**. As red blood cells age, they become rigid and are more likely to be damaged and removed by enzymes in the liver and spleen.

[Red Blood Cell Production and Its Control](#)

Erythropoiesis is red blood cell production. Initially, red blood cell formation occurs in the **yolk sac**, **liver** and **spleen**. After an infant is born, red blood cells are produced almost exclusively in the **red bone marrow**. Stem cells in red bone marrow give rise to **erythroblasts** that give rise to **erythrocytes**. Reticulocytes are immature red blood cells that still contain endoplasmic reticulum. The average life span of a red blood cell is 120 days. **Erythropoietin** controls red blood cell production and is released primarily from the **kidneys**. When oxygen levels fall, **erythropoietin** is released and red blood cell production increases.

[Dietary Factors Affecting Red Blood Cell Production](#)

Two vitamins needed for red blood cell production are **vitamin B₁₂** and **follic acid**. Two B-complex vitamins are needed for DNA synthesis. Intrinsic factor is needed for the absorption of vitamin B₁₂. Iron is required for hemoglobin production. Anemia is a reduction in the oxygen-carrying capacity of the blood.

Destruction of Red Blood Cells:

Damaged red blood cells rupture as they pass through the spleen or liver.

In the liver and spleen, macrophages destroy worn out red blood cells.

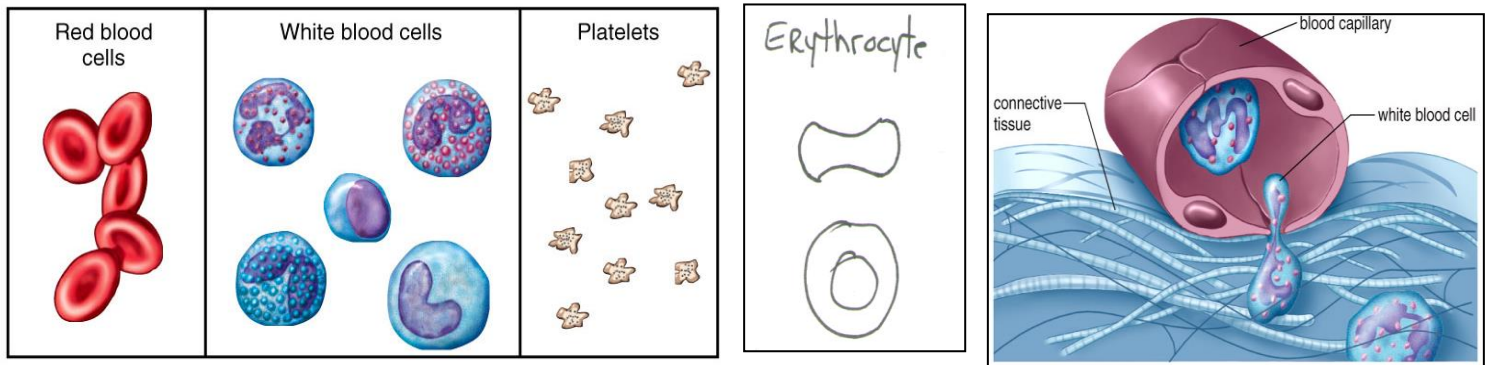
Hemoglobin molecules are **broken** down into **globin** and **heme** groups.

Heme decomposes into **iron** and **biliverdin**. Ferritin is an iron-protein complex that stores iron in the liver. Biliverdin is converted to bilirubin.

Bilirubin and biliverdin are excreted in bile.

B. WHITE BLOOD CELLS (LEUKOCYTES)

There are different kinds; **all fight infection**. They seep out of the blood vessels whenever they sense bacteria nearby or migrate to the site of infection.



Types of White Blood Cells:

White blood cells are also called **leukocytes**. White blood cells function to protect against diseases. Two mediators that stimulate white blood cell production are **interleukins** and **C-SFs**. Granulocytes have granules in their **cytoplasm**. Examples of granulocytes are **neutrophils**, **basophils**, and **eosinophils**. Agranulocytes **lack** cytoplasmic granules. Examples of agranulocytes are **monocytes** and **lymphocytes**. Functions of WBCs, **Diapedesis** are the movement of a WBC out of the blood stream into surrounding tissues. Amoeboid motion is a form of self-propulsion used by WBCs outside the blood stream to move. The most mobile and active phagocytic leukocytes are neutrophils and monocytes.

Types of Granulocytes Cells:

Neutrophils: Neutrophil granules appear light **purple** in an acid/base stain. Neutrophils have nuclei that are **lobed**. Neutrophils phagocytize

bacteria, fungi, and some viruses. Neutrophils account for about 54%-62% of white blood cells in a blood sample.

Eosinophils: Eosinophil granules stain **red** in an acid stain. The nucleus of an eosinophil is usually **bilobed**. Eosinophils moderate **allergic** reactions and defend against parasitic worm infestations. Eosinophils make up 1% - 3% of the total number of circulating white blood cells.

Basophils: Basophil granules stain **blue** in a basic stain. Basophils migrate to damaged tissues where they release **histamine** and **heparin**.

Heparin functions to prevent blood clots. Histamine promotes inflammation. Basophils usually account for less than 1% of leukocytes.

Types of Agranulocytes Cells:

Monocytes: The **largest** of the white blood cells are monocytes. The nuclei of monocytes are spherical, kidney shaped or oval. Monocytes can leave the blood stream to become **macrophages**. Monocytes usually make up 3% - 9% of white blood cells in a blood sample.

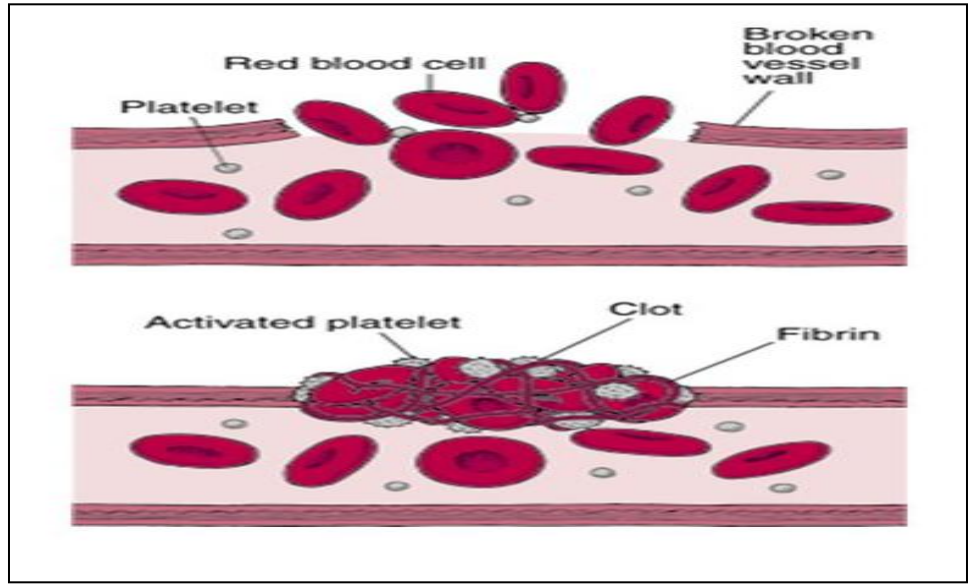
Lymphocytes: A typical lymphocyte contains a large, spherical nucleus surrounded by a thin rim of cytoplasm. The major types of lymphocytes are **T cells** and **B cells**. T cells attack microorganisms, tumor cells, and transplanted cells. B cells produce antibodies. Lymphocytes account for about 25% - 33% of the circulating white blood cells.

White Blood Cell Counts:

A white blood cell count is normally between 5,000 -10,000 cells per mm^3 of blood. **Leukocytosis** is an increased WBC count and is often caused by acute infections. **Leukopenia** is a decreased WBC count and is often caused by influenza, mumps, measles, chicken pox, or AIDS. A differential white blood cell count lists percentages of the types of leukocytes in a blood sample. The number of neutrophils increases during bacterial infections, and eosinophils increase during parasitic worm infections.

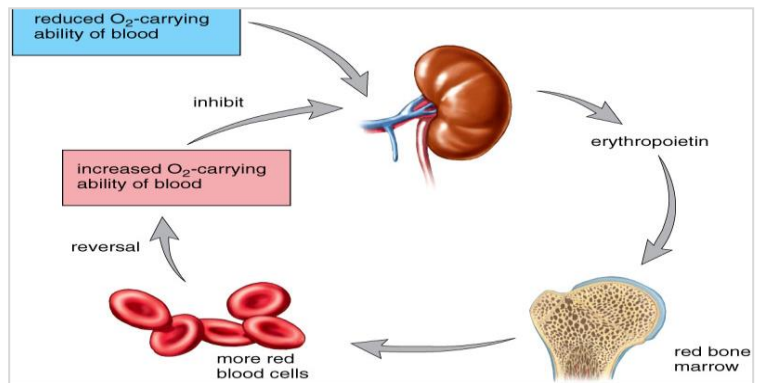
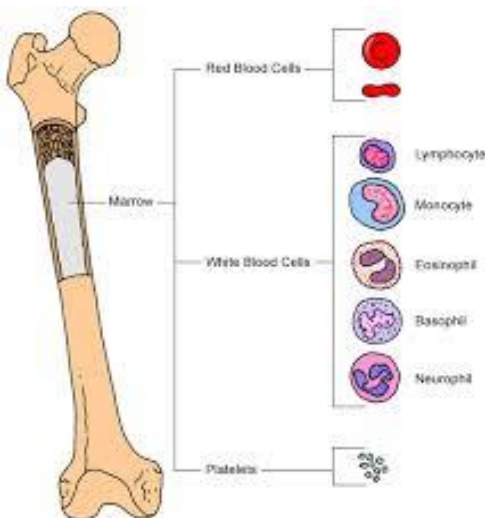
C. PLATELETS

When a platelet encounters a broken blood vessel it releases a substance that clots blood. **Platelets are responsible for clot formation.** Platelets are also called **thrombocytes**. **Platelets** are bits of cell broken off larger cells. Platelets arise from cells called **megakaryocytes**. A normal platelet count is normally between 150,000 - 400,000 platelets per mm^3 of blood. Platelets help repair damaged blood vessels by sticking to broken surfaces. Platelets release **serotonin** that contracts smooth muscles in the vessels walls, reducing blood flow. Platelets produce tiny **fibrinogen fibres** to form a net. This net traps other blood cells to form a **blood** clot.



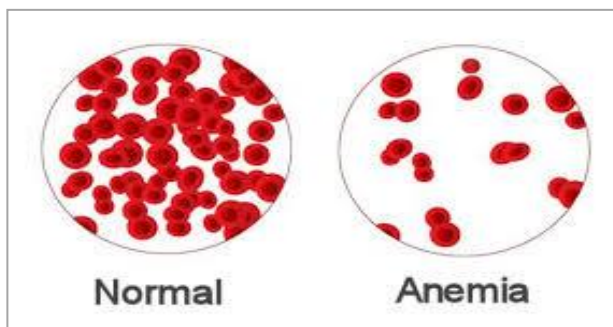
BONE MARROW:

Most blood cells mature in **the red bone marrow**. When they are mature, they are released into the bloodstream. When they are old, they are destroyed in the spleen.



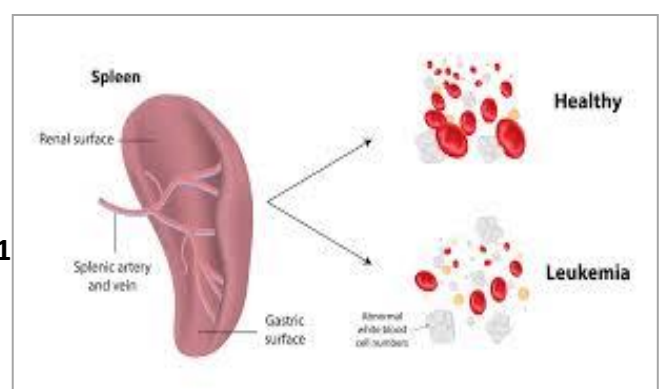
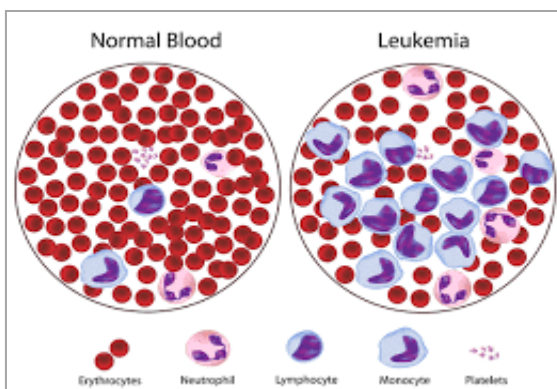
ANEMIA: If the body makes too few erythrocytes.

- a. Causes of anemia include lack of iron, lack of hemoglobin, hemorrhage, lack of vitamin B12 (needed for cell division).
- b. Characteristic sign of anemia: pale skin and fatigue with pale



eye conjunctiva.

LEUKEMIA: Cancer of the blood is called leukemia. It actually only involves the white blood cells. Something goes wrong in one stem cell, and it starts making huge amounts of clones of itself which don't work right and not



enough normal white blood cells are made. Therefore, the body cannot fight infection. There are many types of leukemias.

BLOOD TYPING: The ABO SYSTEM

Blood typing is the technique for determining which specific protein type is present on RBCs.

Only certain types of blood transfusions are safe because the outer membranes of the red blood cells carry certain types of proteins that another person's body will think is a foreign body and reject it.

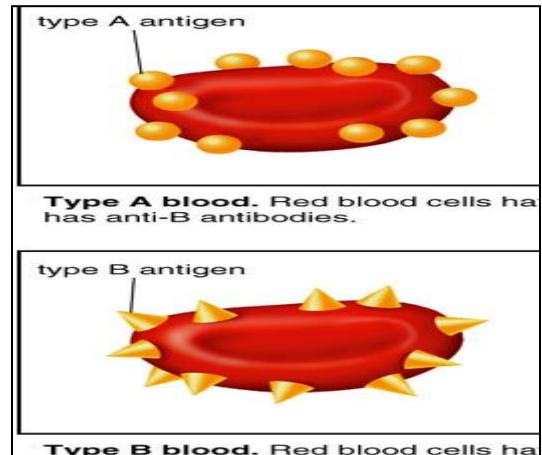
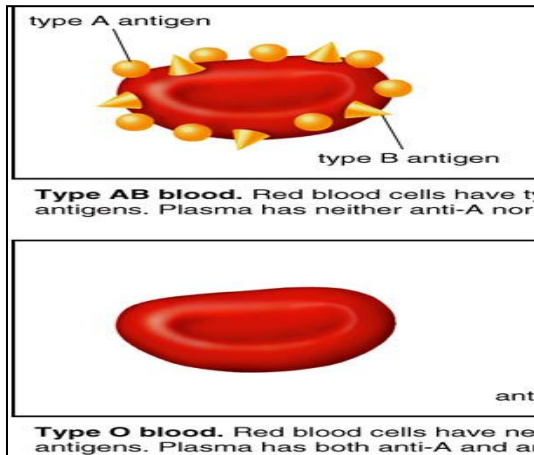
These proteins are called antigens (something that causes an allergic reaction). There are two types of blood antigens: Type A and Type B.

A person with **Type A antigens** on their blood cells have **Type A blood**.

A person with **Type B antigens** have **Type B blood**.

A person with both types has type **AB blood**.

A person with neither antigen has **type O blood**.



If a person with type A blood gets a transfusion of type B antigens (from Type B or Type AB, the donated blood will clump in masses (coagulation), and the person will die.

The same is true for a type B person getting type A or AB blood.

Type O blood is called the universal donor, because there are no antigens, so that blood can be donated to anyone. Type AB blood is considered the universal acceptor, because they can use any other type of blood. This blood type is fairly rare.

RH FACTOR

There is another term that follows the blood type. The term is “positive” or “negative”. This refers to the presence of another type of protein, called the Rh factor. A person with type B blood and has the Rh factor is called A-positive. A person with type B blood and no Rh factor is called B-negative.

The reason this is so important is that if an Rh- mother has an Rh+ fetus in her womb (from an Rh+ father), her antibodies will attack the red blood cells of the fetus because her body detects the Rh protein on the baby's red blood cells and thinks they are foreign objects. This is called Hemolytic Disease of the Newborn (HDN).

This can be prevented if the doctor knows the mother is Rh- and the father is Rh+, because that means the baby has a 50% chance of being Rh+ like the father. Therefore, anytime a mother is Rh-, they will ask if the father is Rh-. If so, they will give her an injection of a medicine that will prevent her immune system from attacking the baby.

