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Blood Physiology

Blood is a viscous fluid which is pumped by the heart through a closed system of blood vessels.

The normal total circulating blood volume is about 8% of the body weight (5600 ml in a 70 kg man). About 55% of this volume is plasma.

• Blood Components:

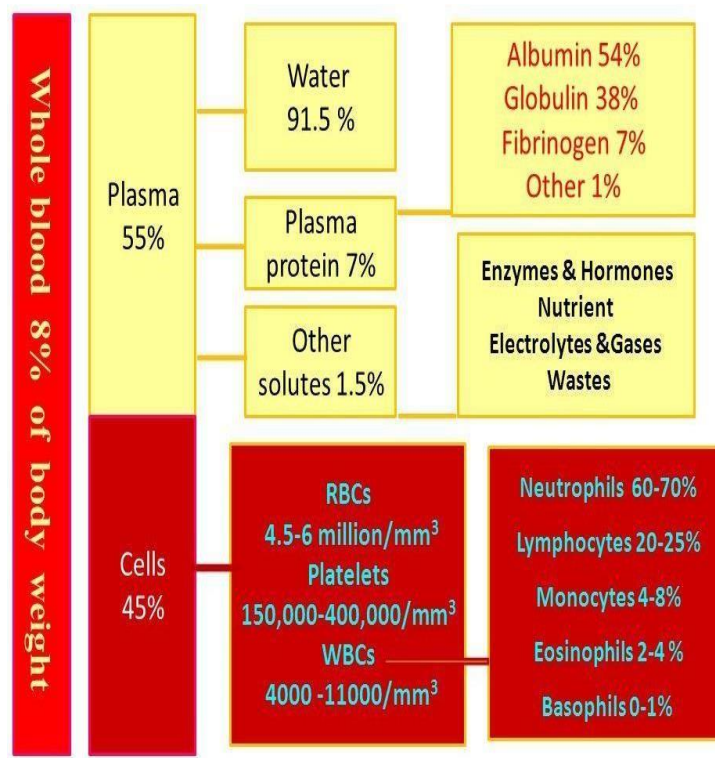


Figure 1: blood components

1-plasma:

Plasma is a part of the extracellular fluid of the body. The normal plasma volume is about 5% of the body weight (3500 ml in a 70-kg man).

Plasma consists of an aqueous solution of proteins (albumin, globulins, fibrinogen), electrolytes, and small organic molecules.

2-Red blood cells (RBCs) (erythrocytes): are non-nucleated, biconcave discs.

The red cell membrane is flexible and exhibits a remarkable deformability; the RBC being able to change its shape as it passes through narrow capillaries and then return, undistorted, to its original biconcave shape.

The biconcave shape of the RBC, which provides a high surface to volume ratio, allows for maximum surface area (which facilitates gas transport) and greatest deformability.

The average normal RBC count:

adult male: 5,200,000 $\pm$ 300,000/ microliter of blood.

adult female: 4,700,000 $\pm$ 300,000 / microliter of blood.

At birth, the average RBC count is about 5,700,000 per microliter.

Each RBC has a mean diameter of about 7.8 micrometers and a thickness of 2.5 micrometers at the thickest point and 1 micrometer or less in the center.

The main constituent of the RBC is hemoglobin.

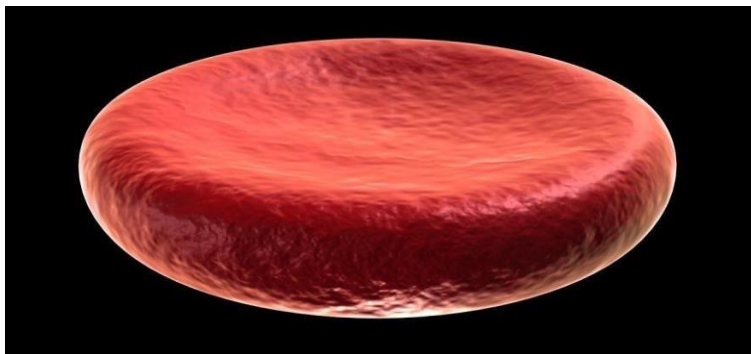


Image 1: red blood cell

2- White blood cells (WBCs) (leukocytes):

- granular leukocytes
 - neutrophils
 - eosinophils

- basophils
- agranular leukocytes
 - lymphocytes = T cells, B cells, and natural killer cells
 - monocytes

There are normally between 4000 and 11,000 white blood cells per microliter of blood, and ranging from 7 and 21 micrometers in diameter, they make up approximately 1% of blood in a healthy adult.

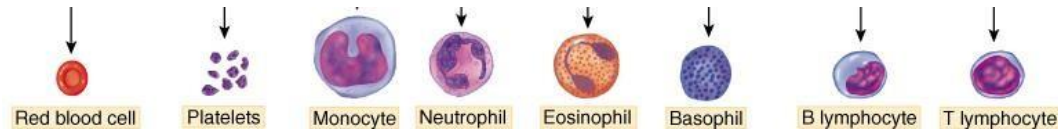


Image 2: blood cells

3- Platelet (thrombocyte) : the smallest of the formed elements in blood, a disk-shaped, non-nucleated blood element with a fragile membrane, formed in the red bone marrow by fragmentation of megakaryocytes.

Platelets tend to adhere to uneven or damaged surfaces, and there are normally between 150,000-400,000/ μl .

• Hemopoiesis:

Formation of blood cells (hemopoiesis) occurs at different anatomical sites during development from embryonic to adult life.

In the early few weeks of embryonic life blood cells are produced in the yolk sac.

Later (after the third month of pregnancy) they are formed mainly in the liver and in the lymph nodes and the spleen.

During the latter part of fetal life and after birth, blood cells are produced by the bone marrow of all bones.

By the age of 20 the active red marrow of long bones (except for the upper humerus and femur) has become inactive, yellow, and fatty, and produce no more blood cells.

Beyond 20 years blood cells are normally formed in the marrow of flat or membranous bones (such as the vertebrae, sternum, ribs, and pelvis) and the proximal ends of humerus and femur. Even in these bones, the marrow becomes less productive as age increases.

In the bone marrow, there are **multipotent uncommitted stem cells** from which all the cells in the circulating blood are derived.

The lymph nodes, spleen, and liver help regulate the production, destruction, and differentiation (developing a specific function) of cells.

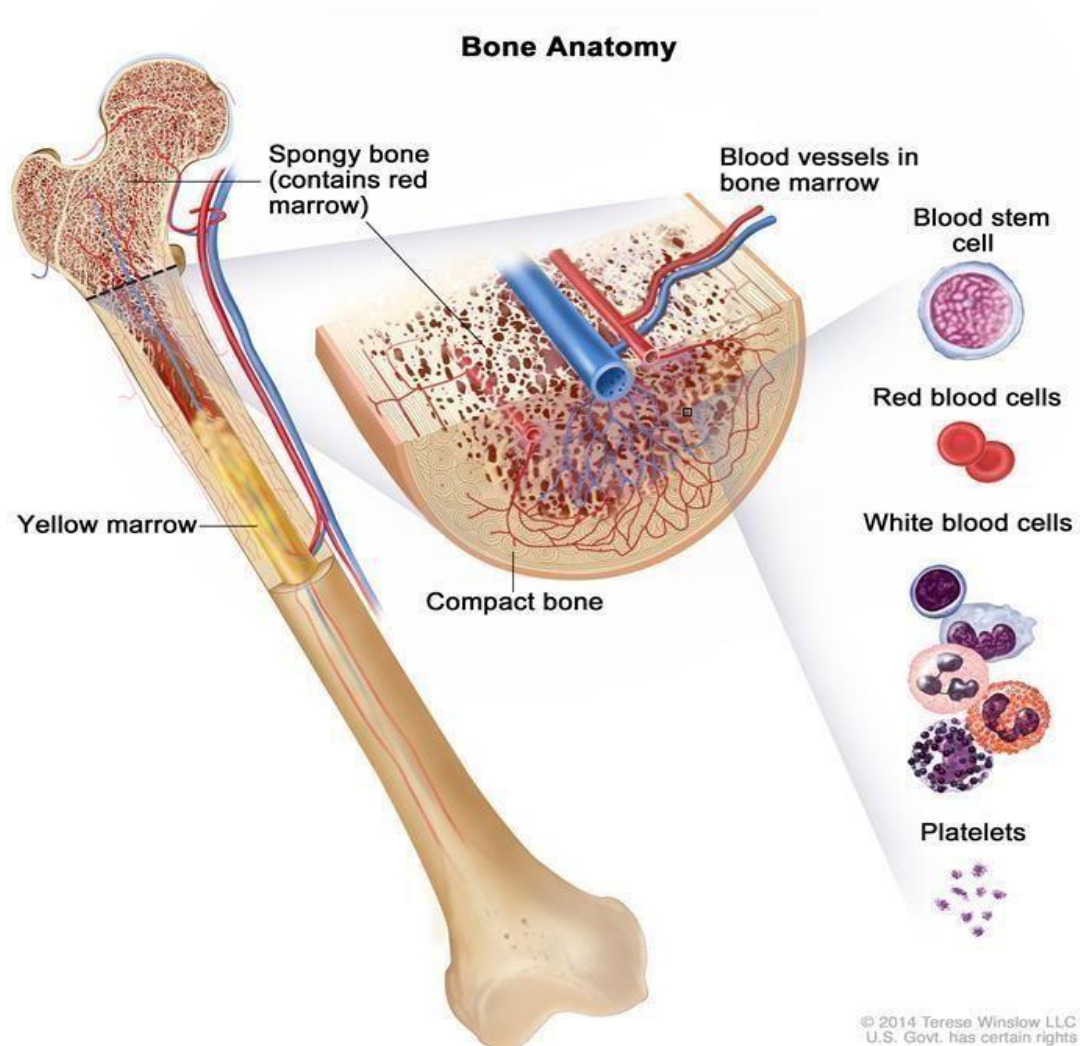


Image 3: bone marrow and blood cells

Practical part:

blood smear

- A blood smear is a blood test that gives information about the number and shape of blood cells. It is often done as part of or along with a complete blood count (CBC).
- **Other names:** Peripheral smear; Complete blood count – peripheral (CBC – peripheral).

The smear provides this information:

- The number and kinds of white blood cells (differential, or percentage of each type of cell).
- The number and kinds of abnormally shaped blood cells.
- A rough estimate of white blood cell and platelet count.

Collection of blood

There are two ways of collecting of blood samples:

a- From vein:

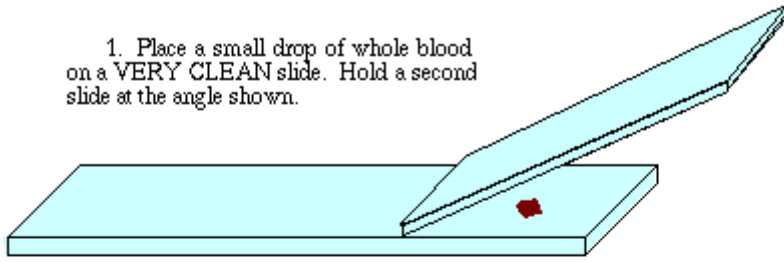
the most site which is used for collecting of blood in adult from antecubital fossa (medial cubital vein).

b- From capillary: is preferred for tests that need few drops of blood .

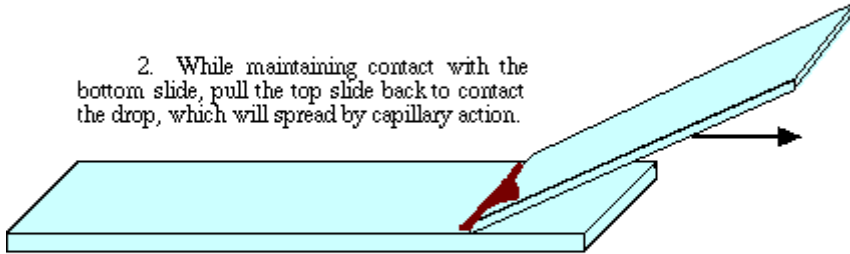
blood can be taken from

- palmer surfaces of the tip of the finger.
- Lobe of the ear.
- In infants from the planter surface of the heel or the big toe.

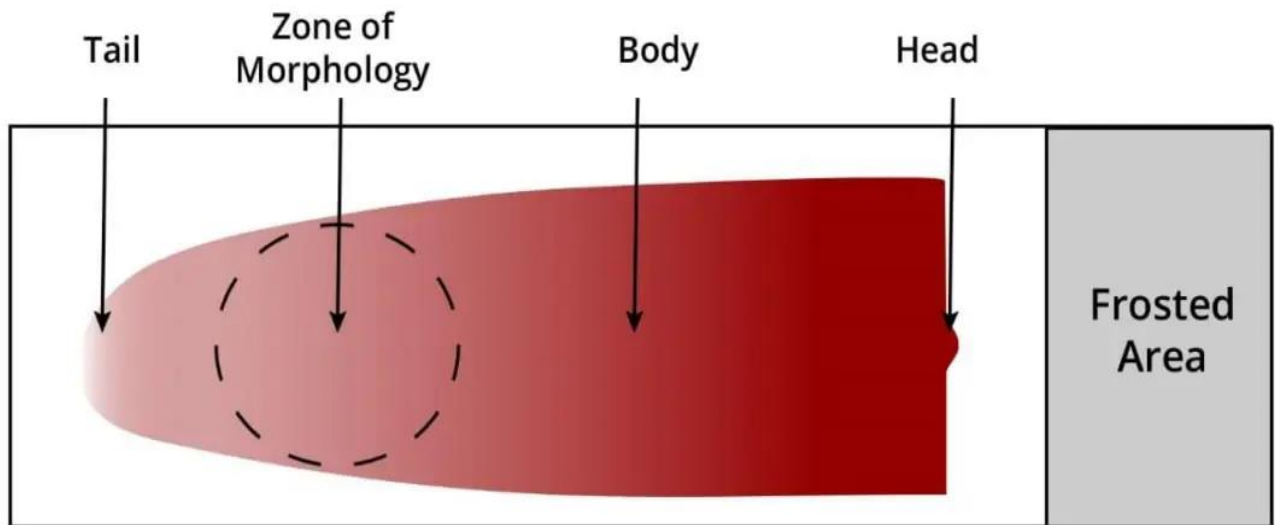
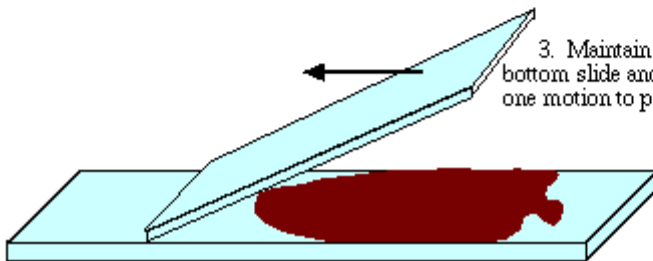
1. Place a small drop of whole blood on a VERY CLEAN slide. Hold a second slide at the angle shown.



2. While maintaining contact with the bottom slide, pull the top slide back to contact the drop, which will spread by capillary action.



3. Maintain firm contact with the bottom slide and push the top slide in one motion to produce the smear.



blood smear