المحاضرة رقم 1 المرحلة الثالثة/ علوم الحياة - مدرس المادة د.نوران جميل

علم الدم hematology

Hematology is a branch of medicine concerning the study of blood, the blood-forming organs, and blood diseases. **Blood** is a [body fluid](https://en.wikipedia.org/wiki/Body_fluid) in humans and other animals that delivers necessary substances such as [nutrients](https://en.wikipedia.org/wiki/Nutrient) and [oxygen](https://en.wikipedia.org/wiki/Oxygen) to the [cells](https://en.wikipedia.org/wiki/Cell_(biology)) and transports [metabolic waste](https://en.wikipedia.org/wiki/Metabolic_waste) products away from those same cells

**Characteristics of Blood**

When you think about blood, the first characteristic that probably comes to mind is its color. Blood that has just taken up oxygen in the lungs is bright red, and blood that has released oxygen in the tissues is a more dusky red. This is because hemoglobin is a pigment that changes color, depending upon the degree of oxygen saturation.

Blood is viscous and somewhat sticky to the touch. It has a viscosity approximately five times greater than water. Viscosity is a measure of a fluid’s thickness or resistance to flow, and is influenced by the presence of the plasma proteins and formed elements within the blood. The viscosity of blood has a dramatic impact on blood pressure and flow. Consider the difference in flow between water and honey. The more viscous honey would demonstrate a greater resistance to flow than the less viscous water. The same principle applies to blood.

The normal temperature of blood is slightly higher than normal body temperature—about 38 °C (or 100.4 °F), compared to 37 °C (or 98.6 °F) for an internal body temperature reading, although daily variations of 0.5 °C are normal. Although the surface of blood vessels is relatively smooth, as blood flows through them, it experiences some friction and resistance, especially as vessels age and lose their elasticity, thereby producing heat. This accounts for its slightly higher temperature.

The pH of blood averages about 7.4; however, it can range from 7.35 to 7.45 in a healthy person. Blood is therefore somewhat more basic (alkaline) on a chemical scale than pure water, which has a pH of 7.0. Blood contains numerous buffers that actually help to regulate pH.

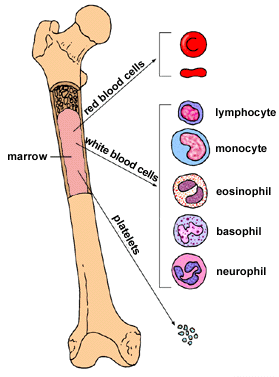
Blood constitutes approximately 8 percent of adult body weight. Adult males typically average about 5 to 6 liters of blood. Females average 4–5 liters. More than 90 percent of plasma is water.

**Blood performs many important functions within the body, including:**

* Supply of [oxygen](https://en.wikipedia.org/wiki/Oxygen) to tissues (bound to [hemoglobin](https://en.wikipedia.org/wiki/Hemoglobin), which is carried in red cells)
* Supply of nutrients such as [glucose](https://en.wikipedia.org/wiki/Glucose), [amino acids](https://en.wikipedia.org/wiki/Amino_acid), and [fatty acids](https://en.wikipedia.org/wiki/Fatty_acid) (dissolved in the blood or bound to [plasma proteins](https://en.wikipedia.org/wiki/Blood_proteins) (e.g., [blood lipids](https://en.wikipedia.org/wiki/Blood_lipid)))
* Removal of waste such as [carbon dioxide](https://en.wikipedia.org/wiki/Carbon_dioxide), [urea](https://en.wikipedia.org/wiki/Urea), and [lactic acid](https://en.wikipedia.org/wiki/Lactic_acid)
* Immunological functions, including circulation of [white blood cells](https://en.wikipedia.org/wiki/White_blood_cells), and detection of foreign material by [antibodies](https://en.wikipedia.org/wiki/Antibody)
* [Coagulation](https://en.wikipedia.org/wiki/Coagulation), the response to a broken blood vessel, the conversion of blood from a liquid to a semisolid gel to stop [bleeding](https://en.wikipedia.org/wiki/Bleeding)
* Messenger functions, including the transport of [hormones](https://en.wikipedia.org/wiki/Hormones) and the signaling of [tissue](https://en.wikipedia.org/wiki/Tissue_(biology)) damage
* Regulation of body [pH](https://en.wikipedia.org/wiki/PH)
* Regulation of core [body temperature](https://en.wikipedia.org/wiki/Body_temperature)

The cells

**a-Red blood cells**, or *erythrocytes*, **RBCs**, are relatively large microscopic cells without nuclei. These cells normally make up 40-50% of the total blood volume. They transport oxygen from the lungs to all of the living tissues of the body and carry away carbon dioxide. **Hemoglobin, Hb** is the gas transporting protein molecule that makes up 95% of a red cell. Each red cell has about 250 million iron-rich hemoglobin molecules. The number of RBCs varies, but the average is about 5 million cells per cubic centimeter (cm3). Although the numbers are important, it is the amount of hemoglobin in the blood at any time that really determines how well oxygen is transported.   
    
Developing RBCs divide many times and then begin synthesizing huge amounts of hemoglobin. Suddenly, when enough hemoglobin has been accumulated, the nucleus and most organelles are ejected and the cell collapses inward. Because they are *enucleate*, without a nucleus, the mature cells are unable to synthesize proteins, grow, or divide. As they age, RBCs become more rigid and begin to fragment in 100 to 120 days. Their remains are removed from the blood by phagocytes in the spleen and liver and their components recycled. 

**b-White blood cells**, or *leukocytes*, **WBCs** exist in variable numbers and types but make up a very small part of blood's volume - normally only about 1%. Some white cells (lymphocytes) provide a physiological defense against infection by seeking out microscopic parasites and destroying them. Their numbers increase when the body is under attack by bacteria, viruses, fungi, or other parasites. Some white cells (macrophages) are the blood's disposal units. They have the function of getting rid of old, unneeded blood cells as well as foreign matter (dust and bacteria). A total WBC count above 11,000 cells/cm3 is referred to as **leukocytosis**, and generally indicates a bacterial or viral infection. Individual white cells remain viable for only 18 to 36 hours.   
    
The several types of white blood cells are classified into two major groups, depending on whether or not they contain visible granules in their cytoplasm.   
  

**1-Granulocytes** are granule-containing WBCs: 

* + - **Neutrophils** have a multilobed nucleus and very fine granules. They are avid phagocytes at sites of acute infection.
    - **Eosinophils** have a blue-red nucleus and large brick-red granules. Their numbers increase rapidly during allergies.
    - **Basophils**, the rarest of all WBCs, contain large histamine-containing granules. Histamine is an inflammatory chemical that makes blood vessels leaky and attracts other WBCs to the inflammatory site.

**2-A granulocytes** do not have visible cytoplasmic granules: 

* + - **Lymphocytes** have a large dark purple nucleus that occupies most of the cell volume. Lymphocytes reside in lymphatic tissues and are the first immune response of the body.
    - **Monocytes** are the largest of WBCs. When they migrate into the tissues, they change into macrophages with an important role in fighting chronic infections.

**c-Platelets**, or *thrombocytes*, are cells that clot blood at the site of wounds. Platelets are not cells in the strict sense. They are fragments of multinucleated cells called **megakaryocytes**, which rupture, releasing thousands of "pieces" that quickly seal the leak in the blood vessel. There are more than a dozen types of platelets that need to interact in the blood clotting process. Individual platelets are about 1/3 the size of red cells. The normal platelet count in blood is about 300,000/cm3. Platelets have a lifespan of 7 to 10 days. 

**d-Plasma** is the relatively clear liquid medium which carries the red cells, white cells, and platelets. Most of our blood's volume is made up of plasma. About 95% of it consists of water that is as salty as the oceans. As the heart pumps blood to cells throughout the body, the plasma brings them nourishment and removes the waste products of metabolism. More than 90 percent of plasma is water. The remainder is mostly plasma proteins—mainly albumin, globulins, and fibrinogen—and other dissolved solutes such as glucose, lipids, electrolytes, and dissolved gases. Because of the formed elements and the plasma proteins and other solutes, blood is sticky and more viscous than water. It is also slightly alkaline, and its temperature is slightly higher than normal body temperature.

**e-Other Blood Components:**

* + Chemical substances, including; fat, carbohydrates, proteins, and hormones.
  + Gases, including; oxygen, carbon dioxide, and nitrogen.
* [Serum albumin](https://en.wikipedia.org/wiki/Serum_albumin)
* Blood-clotting factors (to facilitate [coagulation](https://en.wikipedia.org/wiki/Coagulation))
* Immunoglobulins ([antibodies](https://en.wikipedia.org/wiki/Antibody))
* [lipoprotein](https://en.wikipedia.org/wiki/Lipoprotein) particles
* Various other [proteins](https://en.wikipedia.org/wiki/Protein)
  + Various [electrolytes](https://en.wikipedia.org/wiki/Electrolyte) (mainly [sodium](https://en.wikipedia.org/wiki/Sodium) and [chloride](https://en.wikipedia.org/wiki/Chloride)
* The term **serum** refers to plasma from which the clotting proteins have been removed. Most of the proteins remaining are albumin and [immunoglobulins](https://en.wikipedia.org/wiki/Antibody).
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