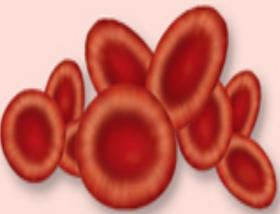


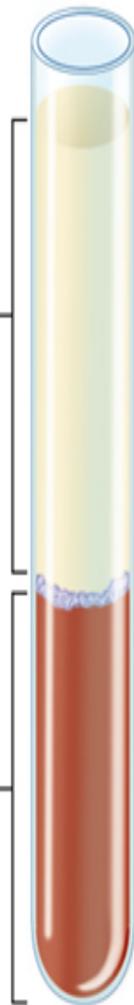
Biology

Blood

- Blood is a fluid connective tissue consisting of cells suspended in a liquid fibrous matrix. The cells are called **formed elements** and the liquid matrix is known as **plasma**. The formed elements consist of **erythrocytes** (red blood cells), **leukocytes** (white blood cells) and **platelets**.
- If blood is centrifuged, it divides into 3 portions:
 - (1) Plasma makes up roughly **55%** (upper layer).
 - (2) Packed RBCs make up roughly **45%** (lower layer).
 - (3) the buffy layer (containing WBCs and platelets) makes up **<1%** (middle layer).

Plasma		
Water 92% by weight	Proteins 7% by weight	Other solutes 1% by weight
	Albumins 58%	Electrolytes
	Globulins 37%	Nutrients
	Fibrinogen 4%	Respiratory gases
	Regulatory proteins 1%	Waste products

Erythrocytes
Erythrocytes 4.2–6.2 million per cubic mm




Buffy Coat	
Platelets 120–300 thousand per cubic mm	Leukocytes 5–10 thousand per cubic mm
	
	Lymphocytes 20–25%
	
	Neutrophils 60–70%
	
	Monocytes 3–8%
	
	Eosinophils 2–4%
	
	Basophils 0.5–1%

- The % of blood consisting of packed RBCs is known as the **hematocrit**.
- Blood's color ranges from scarlet (oxygen-rich) to dark red (oxygen poor).
- Its viscosity is **5x** that of water, due primarily to the presence of formed elements.
- Blood pH normally ranges from **7.35-7.45** (slightly alkaline).
- Blood temperature is typically **100°F**.
- Typical blood volume is **4-5 L for females** and **5-6 L for males**.

Blood functions:

- Blood has 3 main distribution functions:
- Blood has 3 main regulatory functions:
- Blood has 2 main protective functions:

Plasma:

- It is the straw-colour liquid part of blood. Blood plasma is about 55% of blood volume. 90% of plasma is water. Water acts as a solvent and suspending medium. Solutes dissolved in plasma include: plasma proteins, nutrients, electrolytes, respiratory gases, hormones and wastes.
- Albumin
- Alpha, beta & gamma globulins
- Fibrinogen

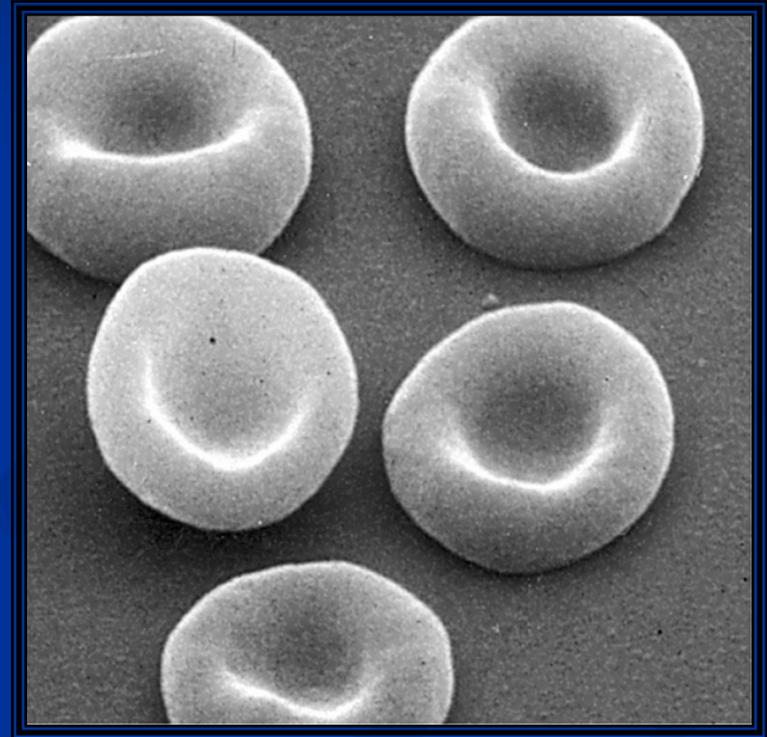
Blood cells:

The blood has 3 major formed elements:

- Erythrocytes (RBC):
- Leukocytes (WBC):
- Thrombocytes (platelets):

Erythrocytes:

- These are rounded biconcave disks, bright red in color due to the presence of hemoglobin.
- their biconcave shape will **maximize** their surface area/ volume ratio so facilitate the gaseous exchange.
- RBCs have **no nuclei** as they are lost during the process of formation.
- These cells are **highly flexible** (deformable) so they can pass through the irregular and smallest capillaries.

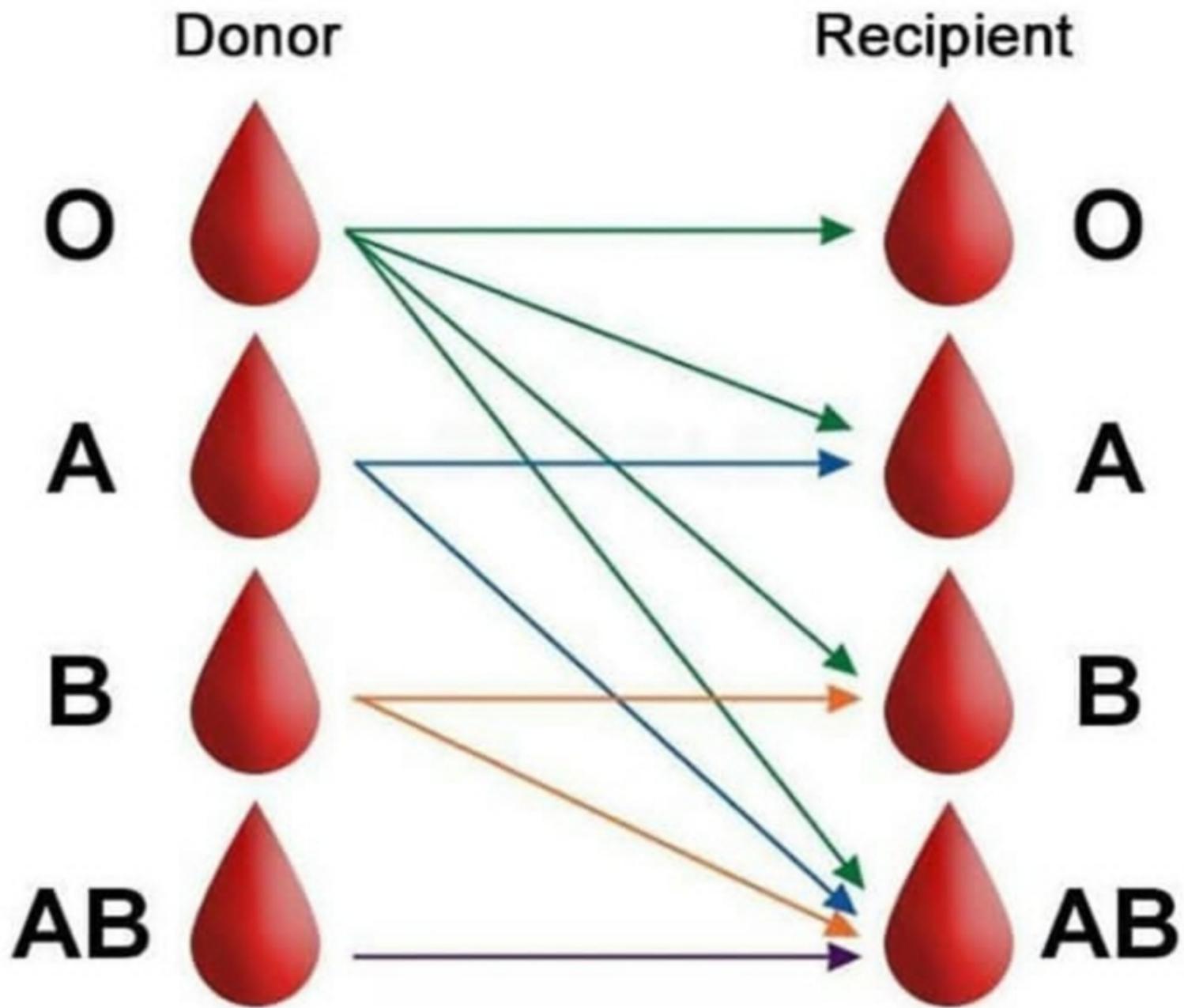


- RBC count in adult female is about 3.9-5.5 million/microliter, while in adult male it is about 4.1-6 million/microliter.
- RBCs are about 7.5 μm . in diameter, those RBCs with a diameter more than 9 μm . are called *Macrocytes*, while those with a diameter less than 6 μm . are called *Microcytes*.

- RBCs have a short life span of only 100-120 days in the circulation, with aging RBCs become less deformable until they cannot pass through the splenic microcirculation and so they will be removed by phagocytosis.
- Hemoglobin (iron containing protein) is contained in abundance within RBCs
 - Oxyhemoglobin
 - deoxyhemoglobin
 - carbaminohemoglobin

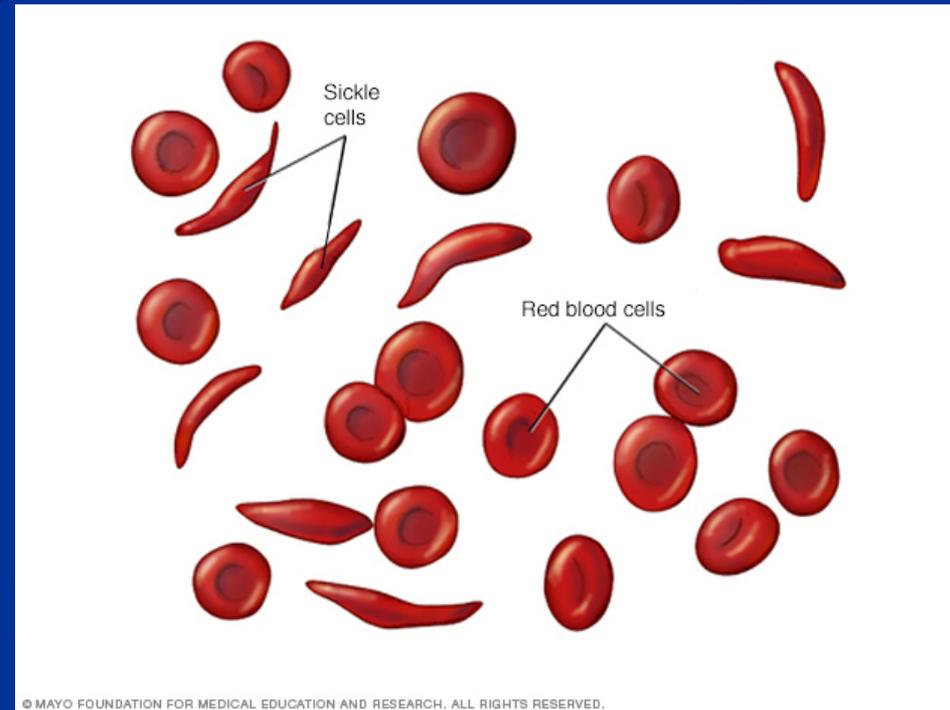
- The extracellular surface of the RBC plasmalemma have specific inherited antigens, and thus determine the blood group. The most notable of these are the A and B antigens, which determine the 4 blood groups, A, B, AB, and O.

■ Blood groups	Antigen present in the surface of RBC	Antibodies present in the plasma
■ A	Antigens A	b
■ B	Antigens B	a
■ AB	Antigens A and B	Neither antibodies a or b
■ O	Neither antigen A or B	Antibodies a and b

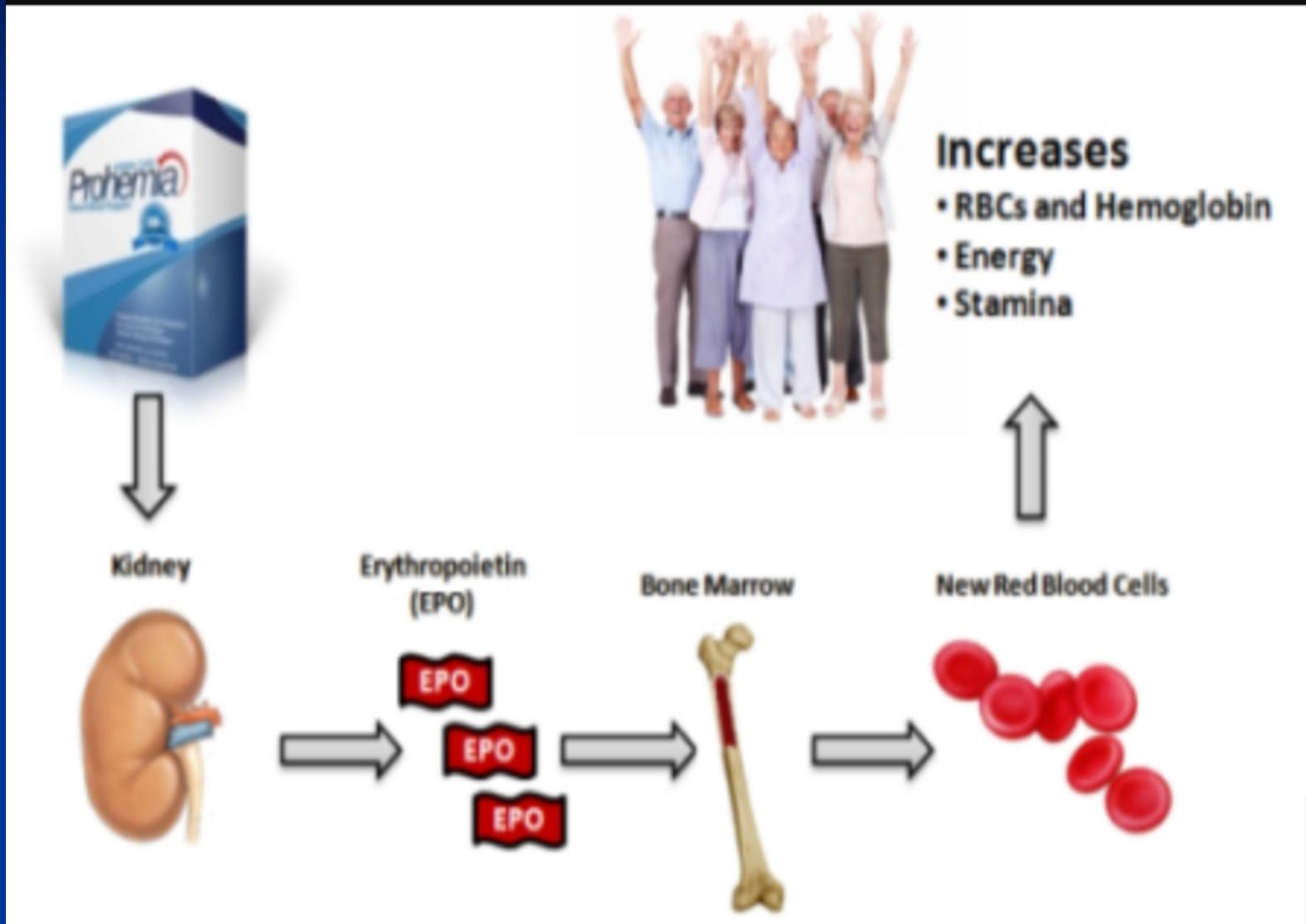


Disorders Involving Red Blood Cells

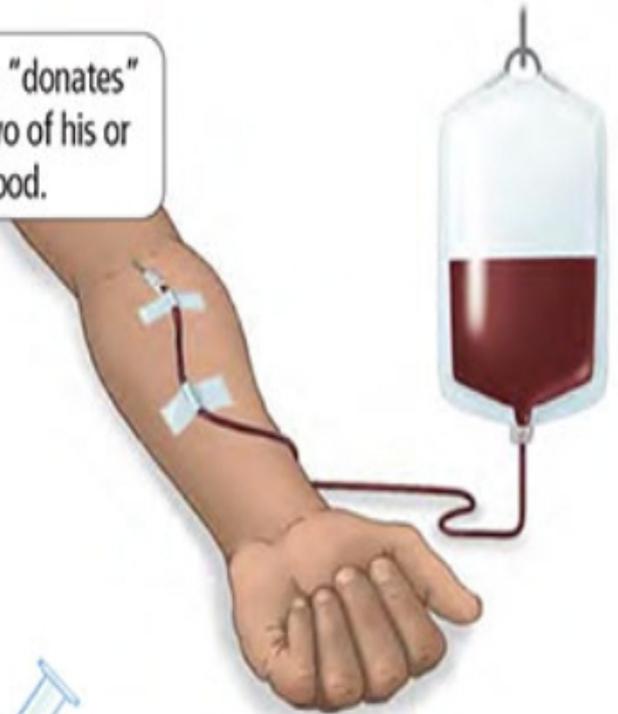
- **Anemia**
 - *Iron-deficiency anemia*
 - *pernicious anemia*
 - *Folic-acid-deficiency anemia*
- **Hemolysis**
- **Sickle-cell disease**



What is blood doping?



1 The athlete "donates" a pint or two of his or her own blood.



2 This blood is placed in a tube in a centrifuge, where it spins around at high speeds.



3 The red blood cells—which carry oxygen—are forced to the bottom of the tube.



4 The liquid part of the blood is drawn off from the top of the tube and re-injected into the athlete.



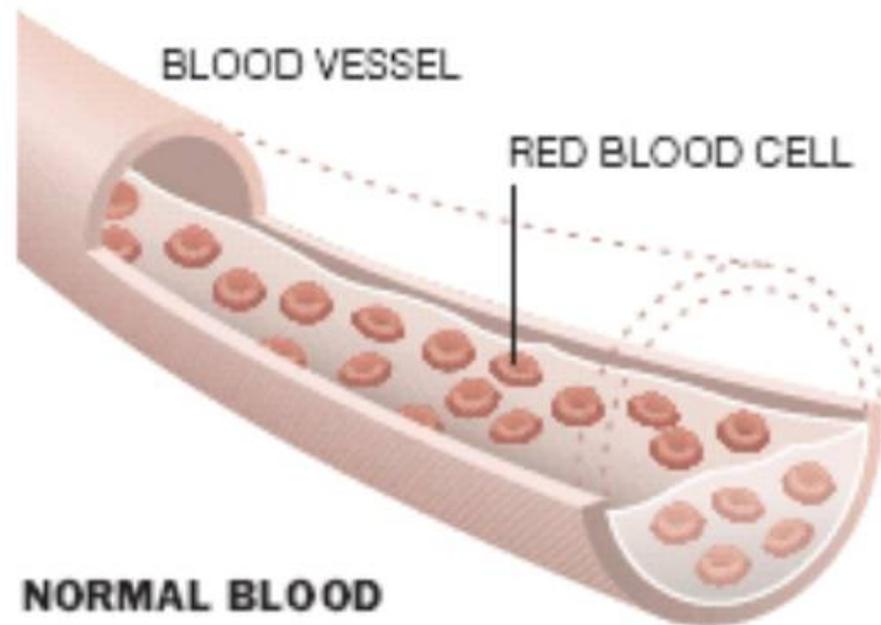
5 The red blood cells are stored (sometimes frozen).

6 A day or so before the competition, the stored red blood cells are re-injected into the athlete, enabling the blood to carry more oxygen.



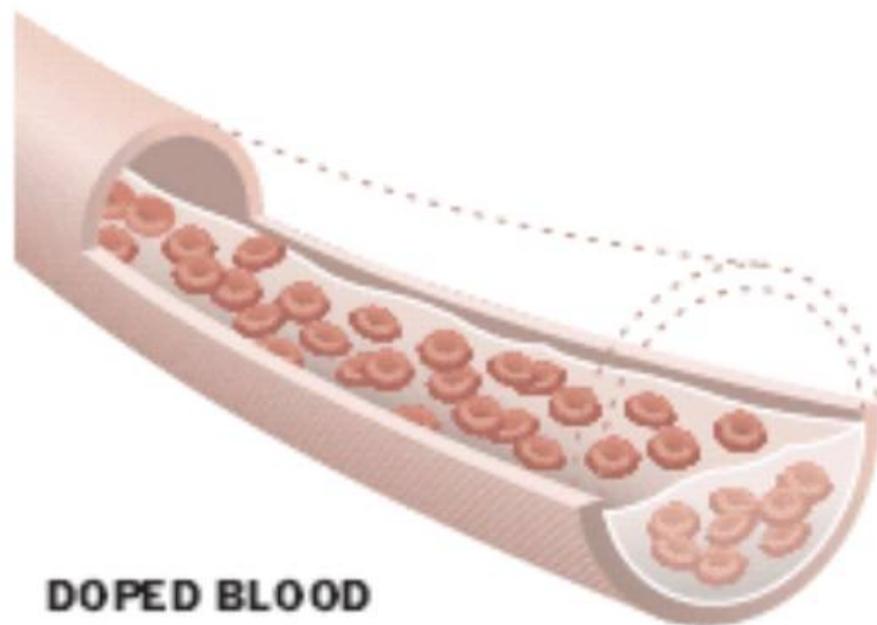
How Blood Doping Works

Elevated levels of red blood cells found in an athlete's bloodstream can be a sign of blood doping.



NORMAL BLOOD

The blood of a typical adult male is made up of 40 to 50 percent red blood cells, which carry oxygen to tissues. Typical levels for women are 35 to 45 percent.



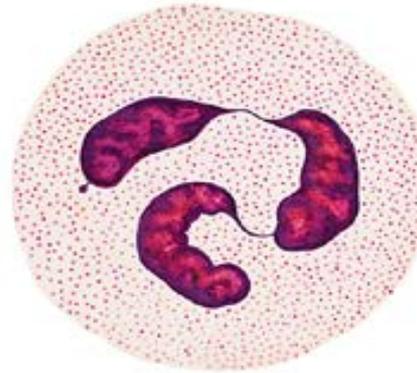
DOPED BLOOD

Red blood cells (from a donor or previously removed from the athlete) or the hormone erythropoietin (EPO) are injected. The increase in red cells allows muscles to work longer and harder without cramping.

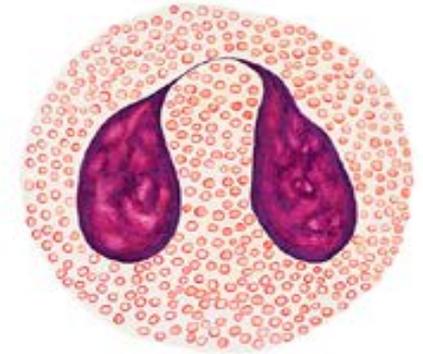
Leukocytes:

- Those are **spherical cells** that circulate in the blood until they migrate to the tissues.
- According to the presence or absence of granules in their cytoplasm & according to the shape of the nucleus, the **WBCs** are classified into two groups:
 - Granulocytes: (polymorphonuclear leukocytes)
 - Agranulocytes: (mononuclear leukocytes)

•The no. of leukocytes (WBC) is much smaller than that of RBCs, in fact in a normal adult there are only between (6000-10,000) WBCs per μL of blood.



Neutrophilic granulocyte



Eosinophilic granulocyte



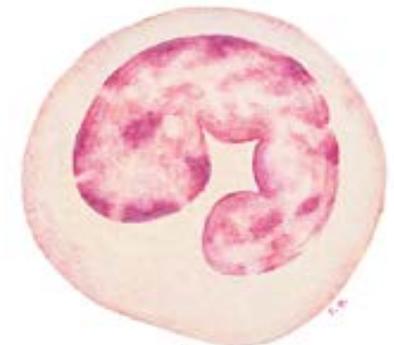
Basophilic granulocyte



Lymphocyte



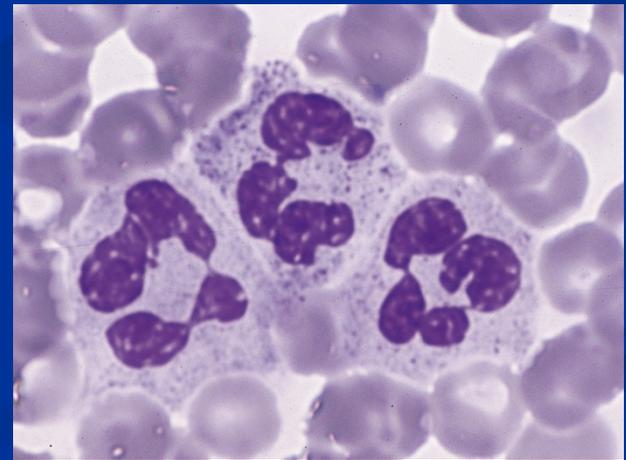
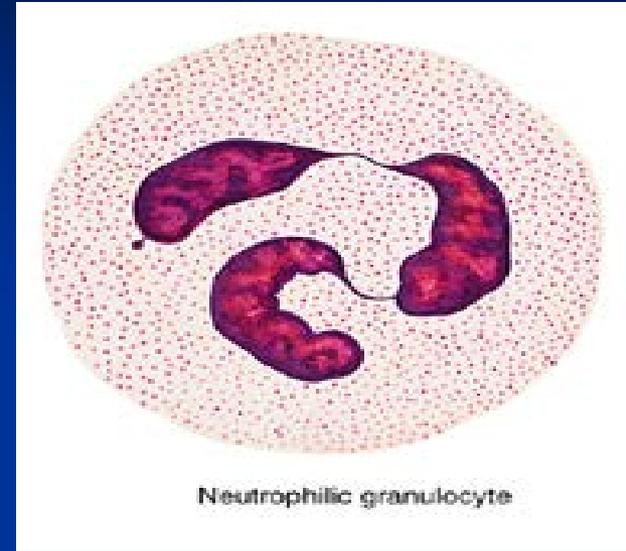
Monocyte



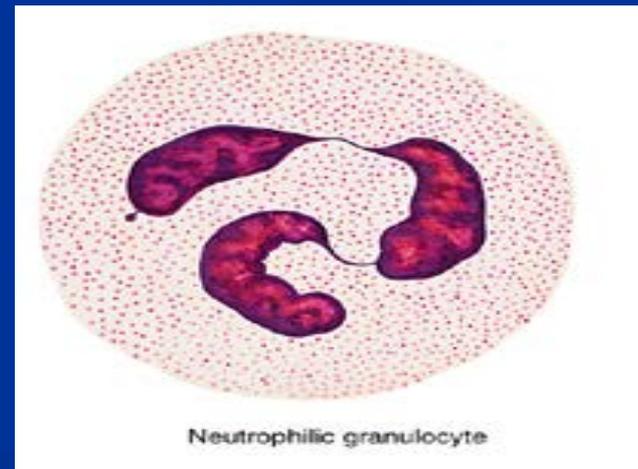
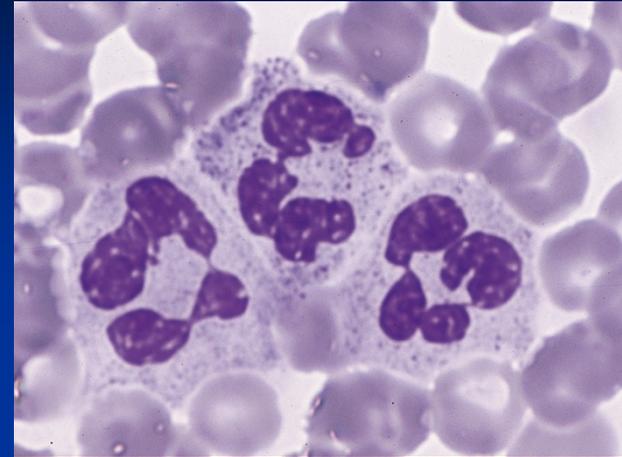
Monocyte

Neutrophils:

- Are called also polymorphonuclear leukocytes,
- they constitute about 60-70% of the circulating leukocytes,
- their nucleus consist of 2-5 lobes (usually 3) linked together by fine chromatine thread.

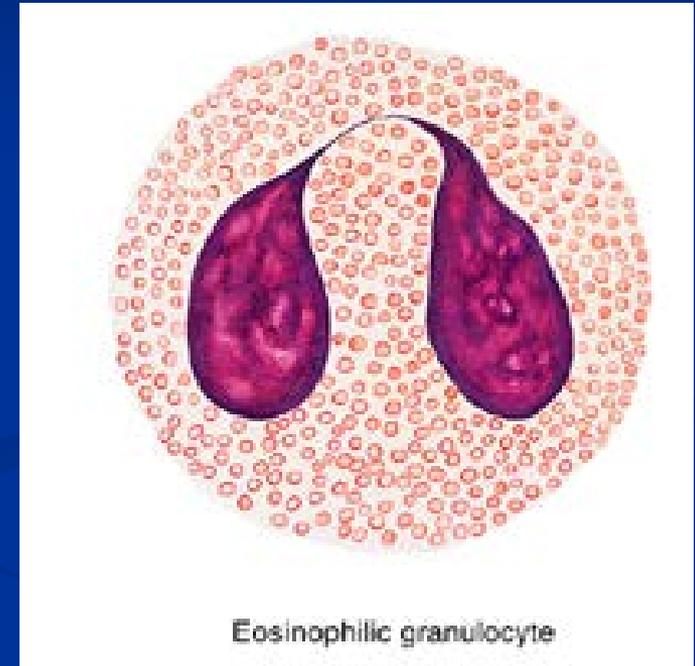


- These cells circulate in the blood in a **resting state** but with appropriate activation they leave the blood and enter the tissues where they become highly motile, phagocytic cells and their primary function is to ingest and destroy the invading organisms.
- Once neutrophils perform their function of killing microorganisms they die, resulting in the formation of **pus**, the accumulation of dead WBC with bacteria and tissue fluid.



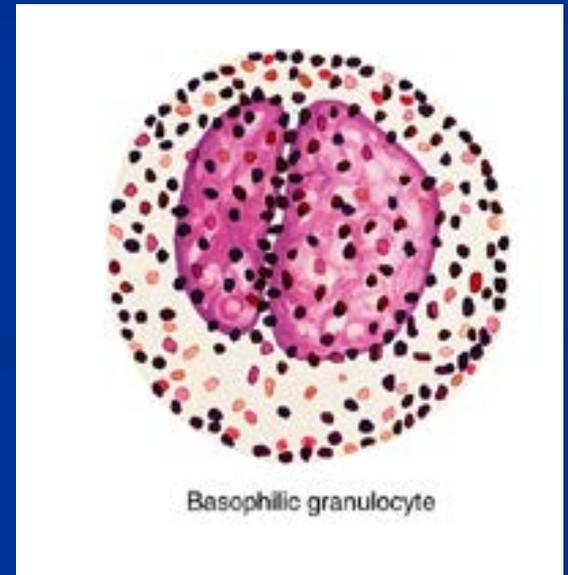
Eosinophils:

- they form only 2-4% of total WBC count.
- They have a characteristic bilobed nucleus.
- Their main feature is the presence of many large & elongated granules that are stained by eosin.
- Number of eosinophils increase greatly in many types of parasitic infestations & the protection against the parasitic disease is one of their major functions. They also increase in allergic states.



Basophils:

- Constitute less than 1% of the total WBC count,
- They have a cytoplasmic **granules** that are large and **intensely basophilic** they are irregular in size & shape contain **histamine** (vasodilator) and **heparin** (anticoagulant).
- Basophils might be the precursors of tissue mast cells with which they have many structural & functional similarities.



White blood cells concentrations [descending order]

“Never Let Monkeys Eat Bananas”

@medmonics

N: Neutrophils

[60-70%]

L: Lymphocyte

[20-30%]

M: Monocytes

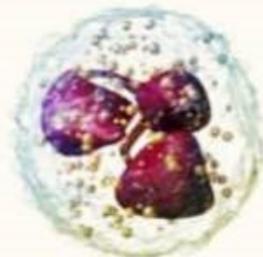
[3-8%]

E: Eosinophils

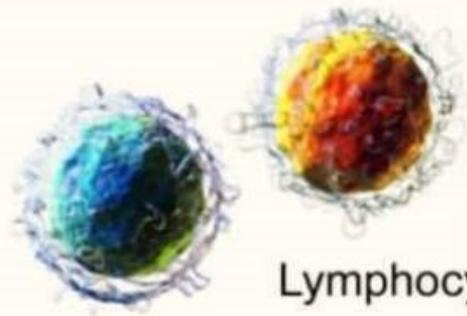
[2-4%]

B: Basophils

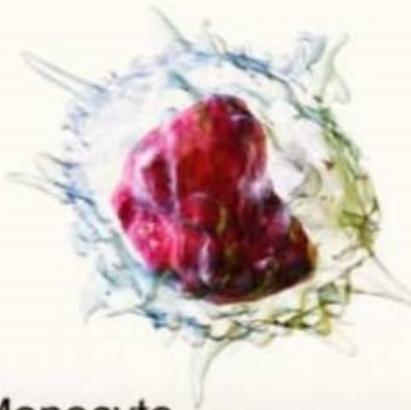
[< 1%]



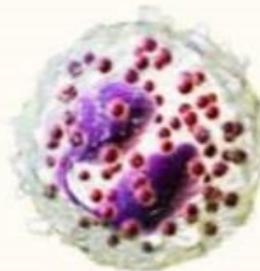
Neutrophil



Lymphocytes



Monocyte



Eosinophil



Basophil

Thank You & Good
Luck