

Editing file



Composition and Function of the Blood

Color index:

- Main Text
- **IMPORTANT**
- *Girls' slides only*
- *Boys' slides only*
- Extra Info
- Drs Notes



► Objectives:

- Describe the physical characteristics & composition of blood
- List the common functions of blood.
- Describe the composition of the plasma.
- Enumerate the plasma proteins and mention its functions
- Define the process of erythropoiesis, Discuss its sites and stages.
- Summarize the functions of red blood cells.
- Enumerate the factors affecting erythropoiesis.
- Describe the normal structure of Hemoglobin.

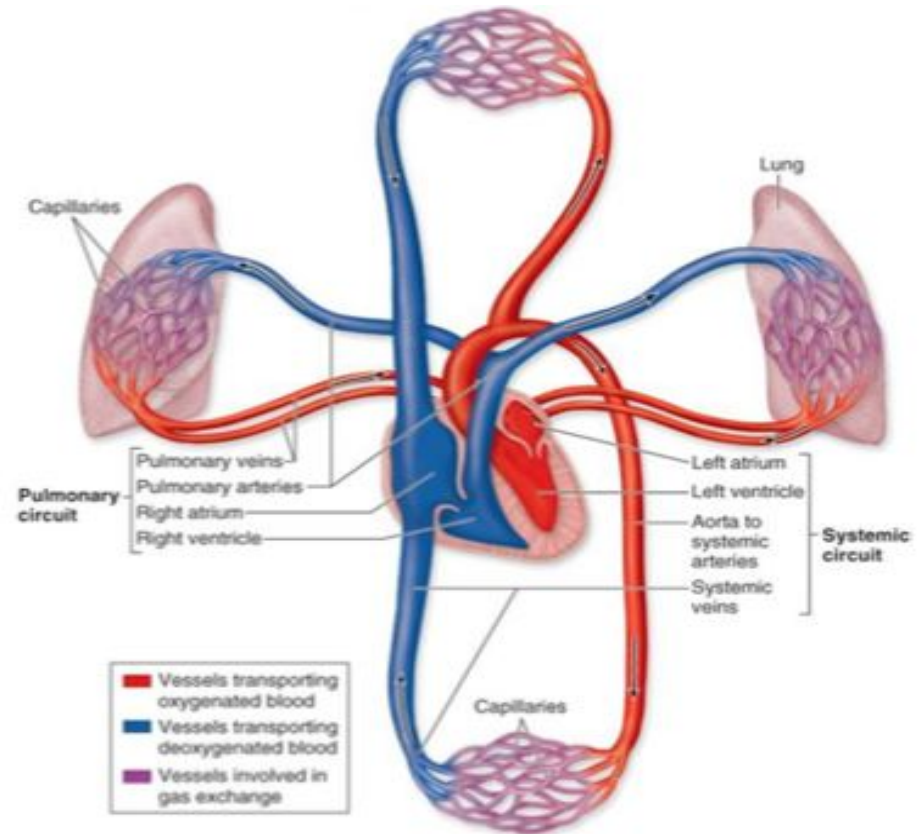


Major components of circulatory system:

■ Heart

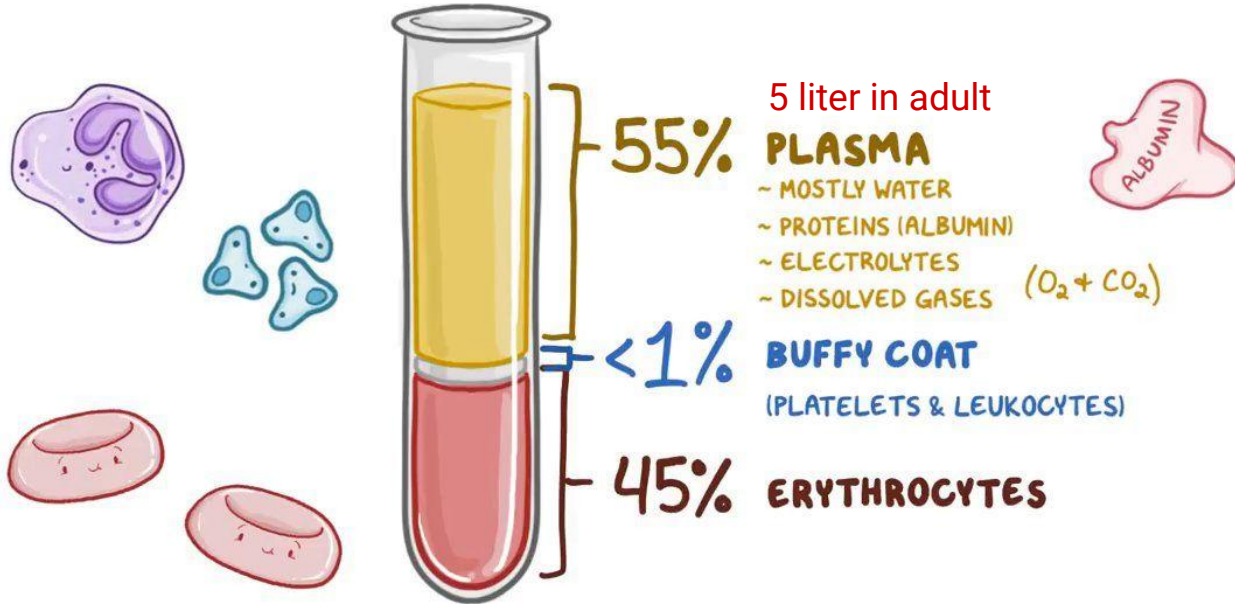
■ Blood vessels

■ Blood



Compositions of the Blood

BLOOD



These blood combustion numbers are in normal state these numbers could differ if in an abnormal state

Some physical characteristics of the Blood

Blood volume

- Blood makes up about 7 - 9 % of body weight.
- 5-6 Liters in male adult and 4-5 Liters in female adult.

Viscosity (Thickness and stickiness of blood)

- Blood is thicker than water (more viscous)
- Plasma at 37°C is about 1.8-times more viscous than water
- Whole blood viscosity (relative to water) = 4.5-5.5

pH

- Slightly alkaline: 7.4 (Neutral body pH)
- Ranges from 7.35 to 7.45

Color

- Bright red = O₂ rich
- Dull red = O₂ poor

Osmolarity

- Plasma osmolarity is about 300 mOsmol/L
- Plasma osmolarity is equal to the osmolarity of Normal Saline = 0.9% NaCl Solution. Hence, Normal Saline is an Isotonic solution

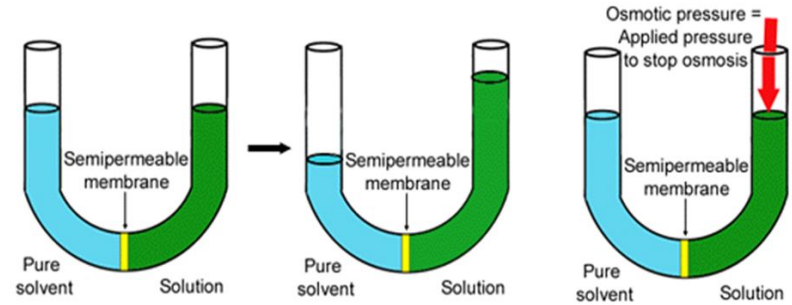


Osmotic pressure (oncotic)

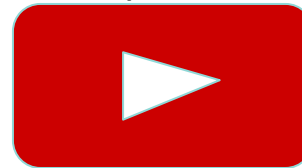
- Osmotic pressure is the pressure necessary to prevent net movement of water (in osmosis)
- osmotic pressure is the pressure developed by solutes dissolved in water working across a selectively permeable membrane.
- total plasma osmotic pressure is about 5540 mmHg.
- If the osmotic pressure is low this could lead to Edema which is accumulation of fluids in the interstitial space

Osmotic Pressure

The minimum pressure that stops the osmosis is equal to the osmotic pressure of the solution



Helpful video



Functions of the Blood

Transport

- Oxygen from the lungs and nutrients from the digestive tract
- Metabolic wastes from cells to the lungs and kidneys for elimination
- Hormones from endocrine glands to target organs

Homeostasis

- Appropriate body temperature by absorbing and distributing heat
- Normal pH in body tissues using **buffer systems**
- Adequate fluid volume in the circulatory system

Haemostasis

- Activating plasma proteins and platelets
- Initiating clot formation when a vessel is broken

Immunity

- Synthesizing and utilizing antibodies
- Activating WBCs to defend the body against foreign invaders

Composition of the Blood

- RBCs makes up 45% or we can name it hematocrit

◀ Red Blood Cells (**Erythrocytes**)

◀ White Blood Cells, or (**Leukocytes**)

◀ Platelet, or (**Thrombocytes**)

- Types of WBCs : **Boys slides**

Granular leukocytes :

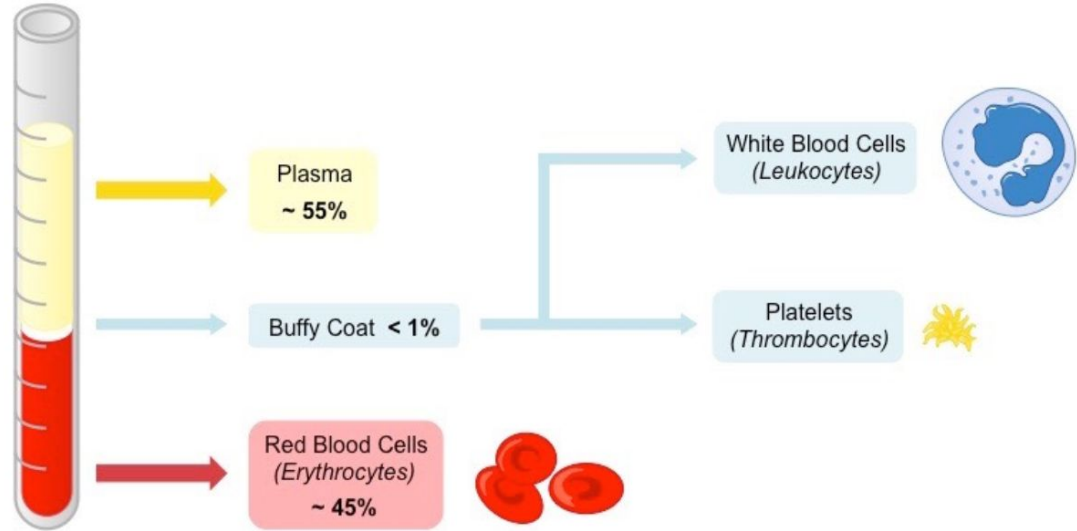
- 1- Neutrophils
- 2- Eosinophils
- 3- Basophils

Agranular leukocytes :

- 1- Lymphocytes
- 2- Monocytes

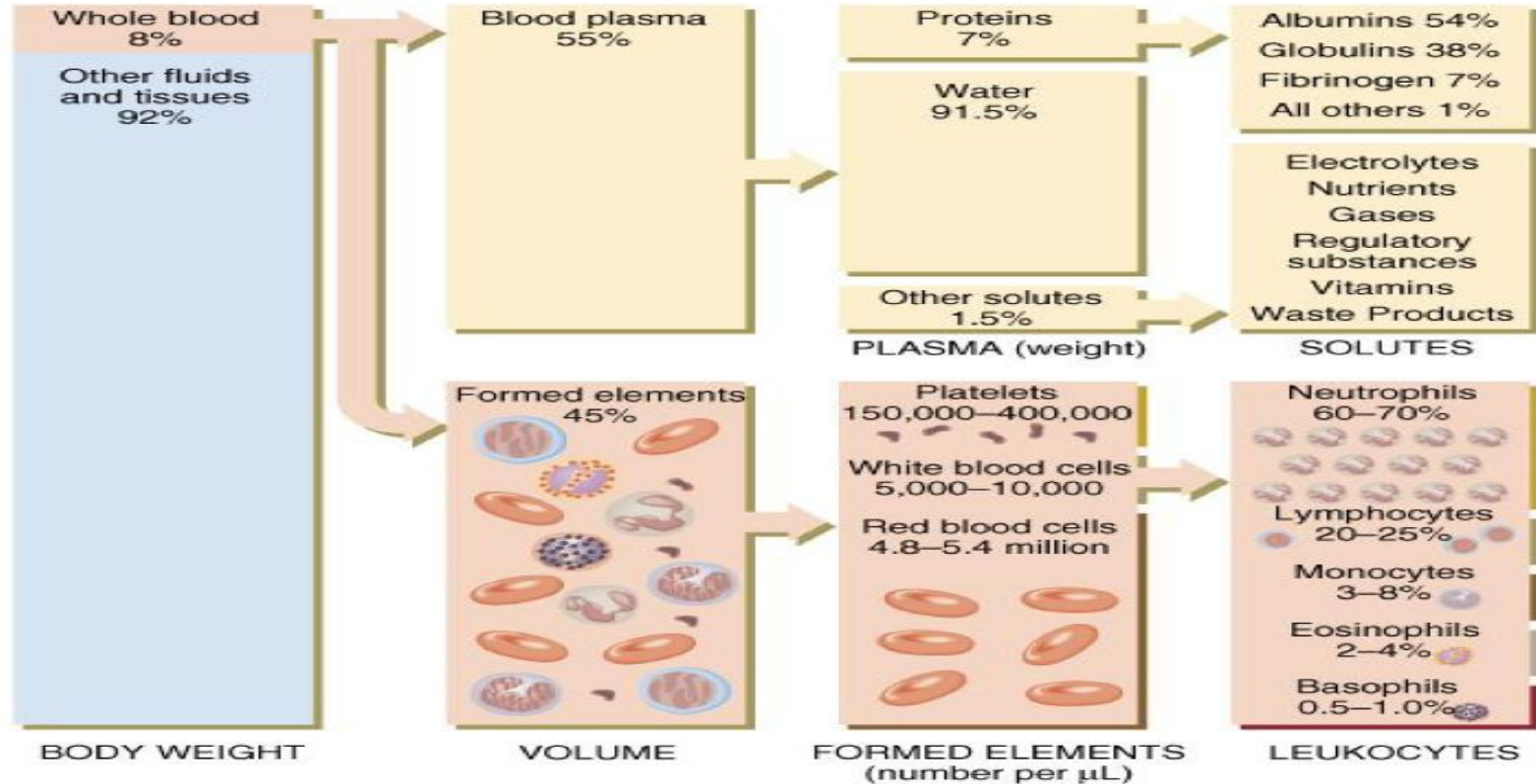
- Plasma

constituent of the ECF





Important



PLASMA

- Plasma = whole blood minus cells.
- Serum = plasma minus clotting proteins.
 - If whole blood is allowed to clot then the clot is being removed, the remaining fluid is SERUM.
 - Thus, serum does not contain coagulation factors.

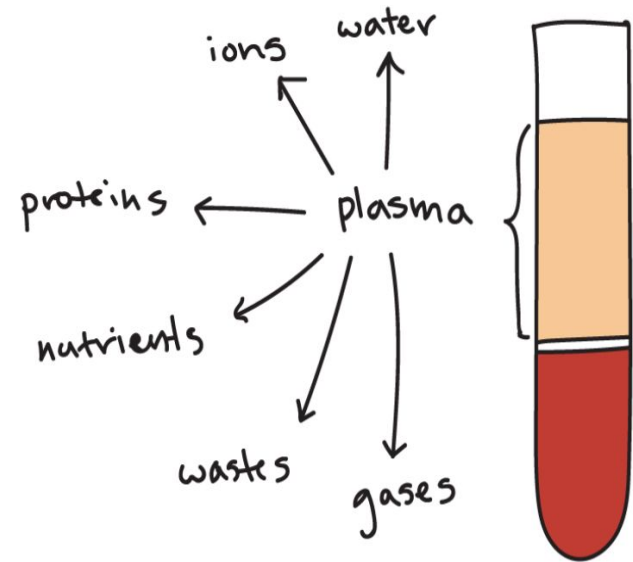


Serum = Plasma – Clotting Factors

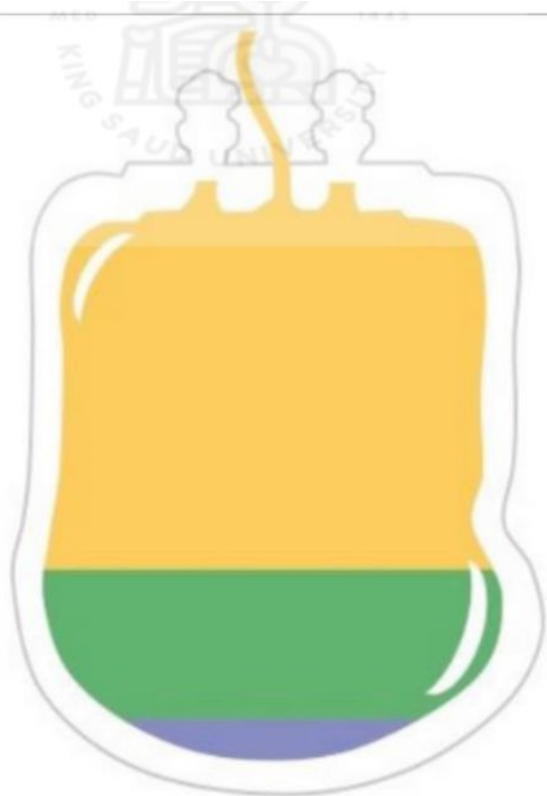
Constituents of plasma



- 90% water.
- 6-8% **plasma proteins**.
- 1% electrolytes (Na⁺, K⁺)
- 1-3% other solutes including:
 - Nutrients (e.g. glucose, amino acids, vitamins)
 - Hormones
 - Wastes
 - Blood gas



Plasma proteins



protein Major Types:

■ Albumin (60%)

Major component of osmotic pressure of plasma

■ Globulins (35%)

Antibodies (immunoglobulin) and transport proteins

■ Fibrinogens (4%)

Functions in blood clotting

■ Other (<1%)

Various roles (α -1-antitrypsin, coagulation factors, etc.)

Plasma proteins functions



- Generation of plasma colloid osmotic pressure (oncotic pressure)
(albumin)
*Albumin is the most abundant protein in plasma
- Buffering function of plasma proteins:
plasma proteins are responsible for 15% of the buffering capacity of the blood
(All types of plasma proteins)
- Nonspecific carriers
for various hormones (e.g., cortisol, thyroxin), other solutes (e.g. iron, copper), and drugs
(Albumin + α Globulins)
- Defence
(Gamma globulins are antibodies γ Globulins)
- Blood clotting
(Fibrinogen, prothrombin, β Globulins)

Functions of Globulins

*Alpha Globulin : Transport proteins

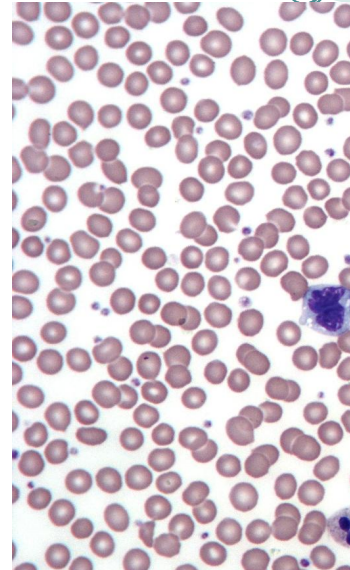
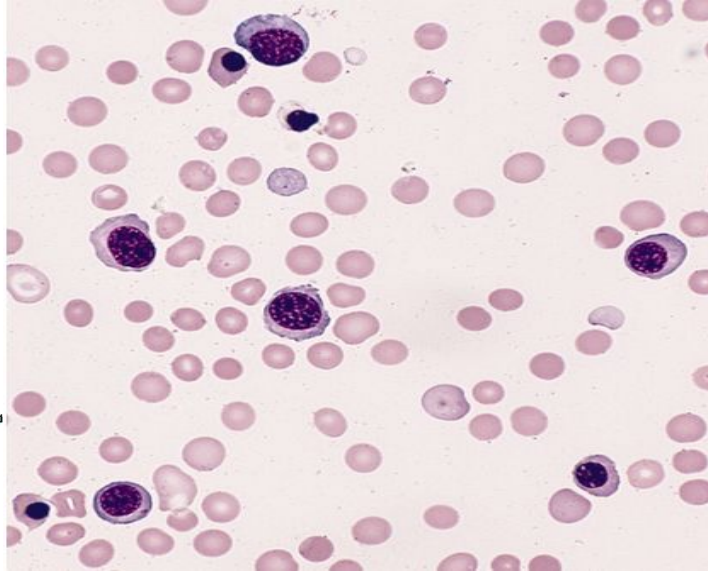
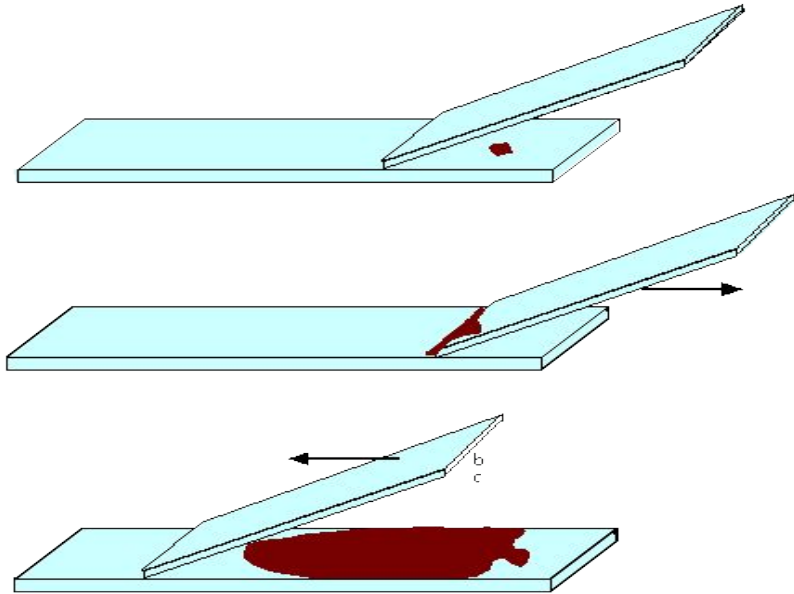
*Gamma Globulin :
Defensive
proteins=Antibodies=immunoglobulin

*Beta Globulin:Coagulation factors



NOTE: Important for SAQ

Blood Film (Blood Smear)



Formation of blood cells = Poiesis

- RBCs = Erythrocytes → Erythropoiesis
- WBCs = Leukocytes → Leukopoiesis
- Platelets = Thrombocytes → Thrombopoiesis

*Site: All occurs in the bone marrow



**Red blood cell
(erythrocyte)**



**White blood cell
(leucocyte)**



**Platelet
(thrombocyte)**



Red Blood Cells (RBCs)

Shape & Size:

- Flat Biconcave disc (due to the presence of the protein Spectrin in the cell membrane)
- Non-nucleated
- Thickness: 2 μ
- Diameter 7-8
- Flexible
- Average volume 90-95 μm^3
- **Number : 4-5 million**

Contains:

- Haemoglobin: (For Gas transport) Hb: 14-16 g/dl
- 2 - 3 DPG enzyme: For anaerobic glucose metabolism, controls the affinity for Oxygen binding
- Doesn't have : mitochondria, ribosomes, endoplasmic reticulum or Golgi apparatus
- In males 5,200,000 ($\pm 300,000$) / Cubic micron (μ^3). In females 4,700,000 ($\pm 300,000$) / Cubic micron (μ^3).



Function:

- □ O₂ transport
- □ CO₂ transport
- □ Buffer



Red Blood Cells (RBCs)

■ Production of RBC

In -utero:

- Early few weeks of embryo nucleated RBCs are formed in **yolk sac**.
- Middle trimester mainly in liver & spleen & lymph nodes.
- Last months RBCs are formed in bone marrow of all bones

After Birth:

- Bone marrow of flat bone continue to produce RBC into adult life. □
- Shaft of long bone stop to produce RBC at puberty while epiphysis continue..

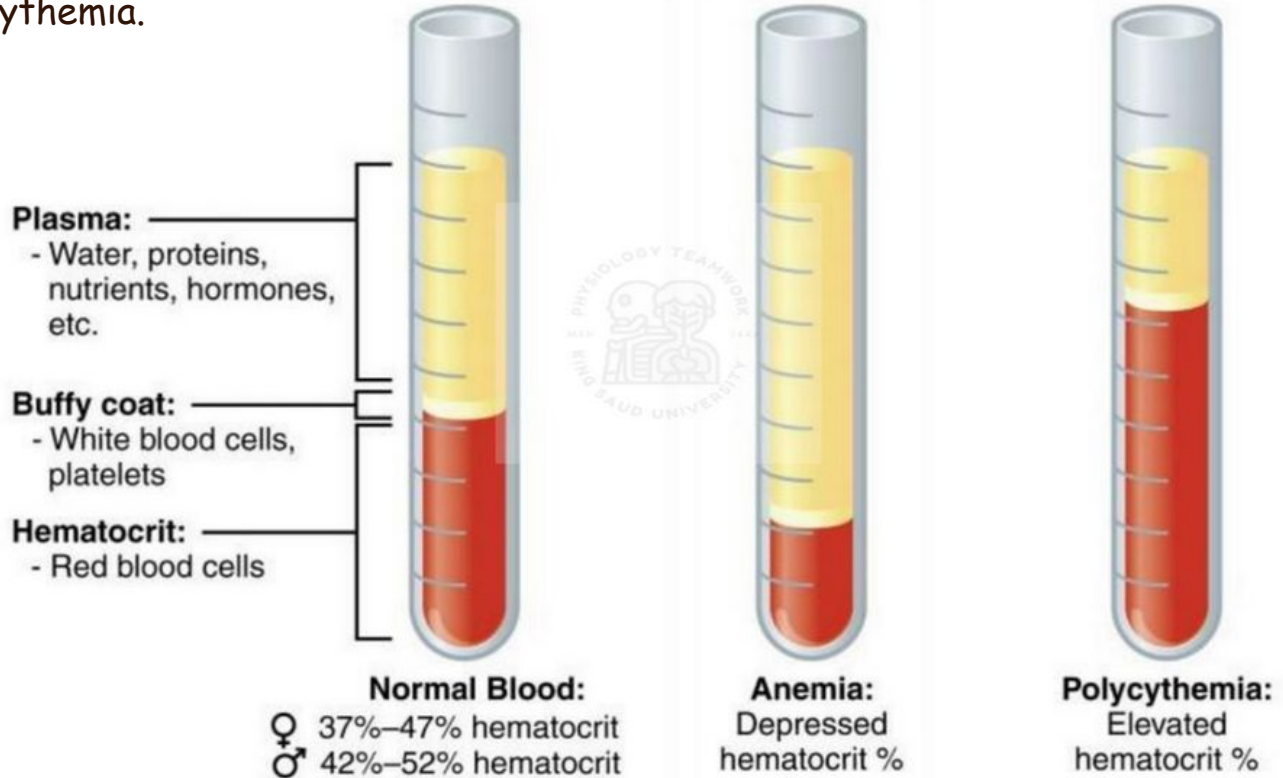




Hematocrit; Hct (PCV)

If decreased = Anemia

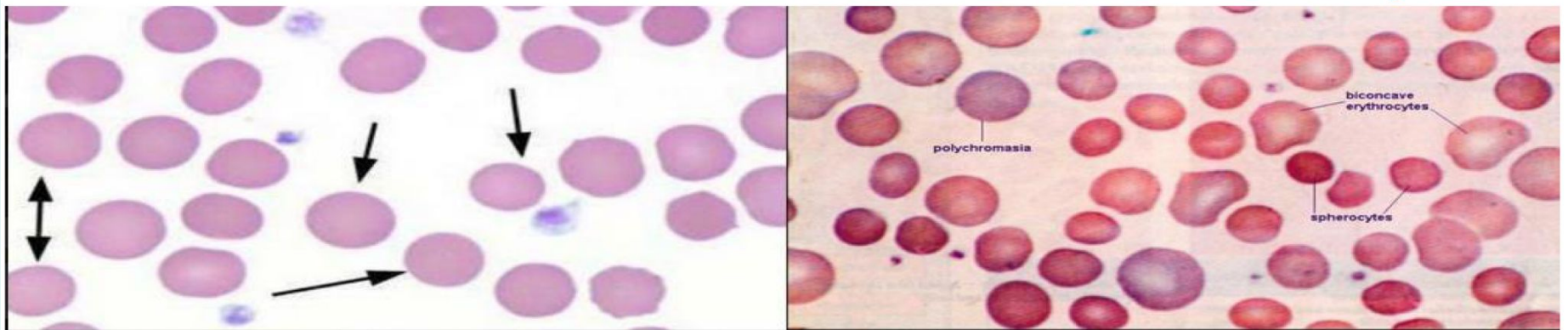
If increased = Polycythemia.



Clinical correlation

In boys slides only

- ◀ **Cause:** Congenital deficiency of the protein spectrin.
- ◀ **Manifestation:** Anemia + spherical RBCs instead of the normal biconcave shape.
- ◀ **On blood film:** Loss of central pallor. Maybe polychromasia.





MCQs

1- Blood makes up aboutof body weight.

A- 7%

B- 9%

C- 6%

D-5%

2- Agranular leukocyte:

A- monocytes

B- neutrophils

C- eosinophils

D- basophils

3- Which of the following statements is false?

A- The plasma proteins are responsible for 15% of the buffering capacity of the blood .

B- γ -Globulins are antibodies.

C- Most of the plasma proteins are Globulins.

D- Plasma proteins can function as a nonspecific carrier for various hormones, other solutes, and drugs.

6-D
5-B
4-A
3-C
2-A
1-A





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6-D
5-B
4-A
3-C
2-A
1-A





4- the most abundant protein in plasma ?

A- Albumin

B- α Globulins

C- β Globulins

D- Fibrinogen

5- plasma is mainly made of which of the following:

A-plasma protein

B-water

C- water

D- electrolytes

6- RBCs lack which of the following :

A- mitochondria

B- ribosomes

C- nucleus

D- all of above



SAQs

1- why is water reabsorbed back into the capillaries?

2-which class of globulins in the blood plasma used for defence?

Answers

1-due to osmotic pressure that caused by the concentration of plasma proteins.

2-gamma globulin



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Meshari Alharbi



Ziyad Bukhari



Hessah Alyousef



Samiyah Sulaiman



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