Red blood cells

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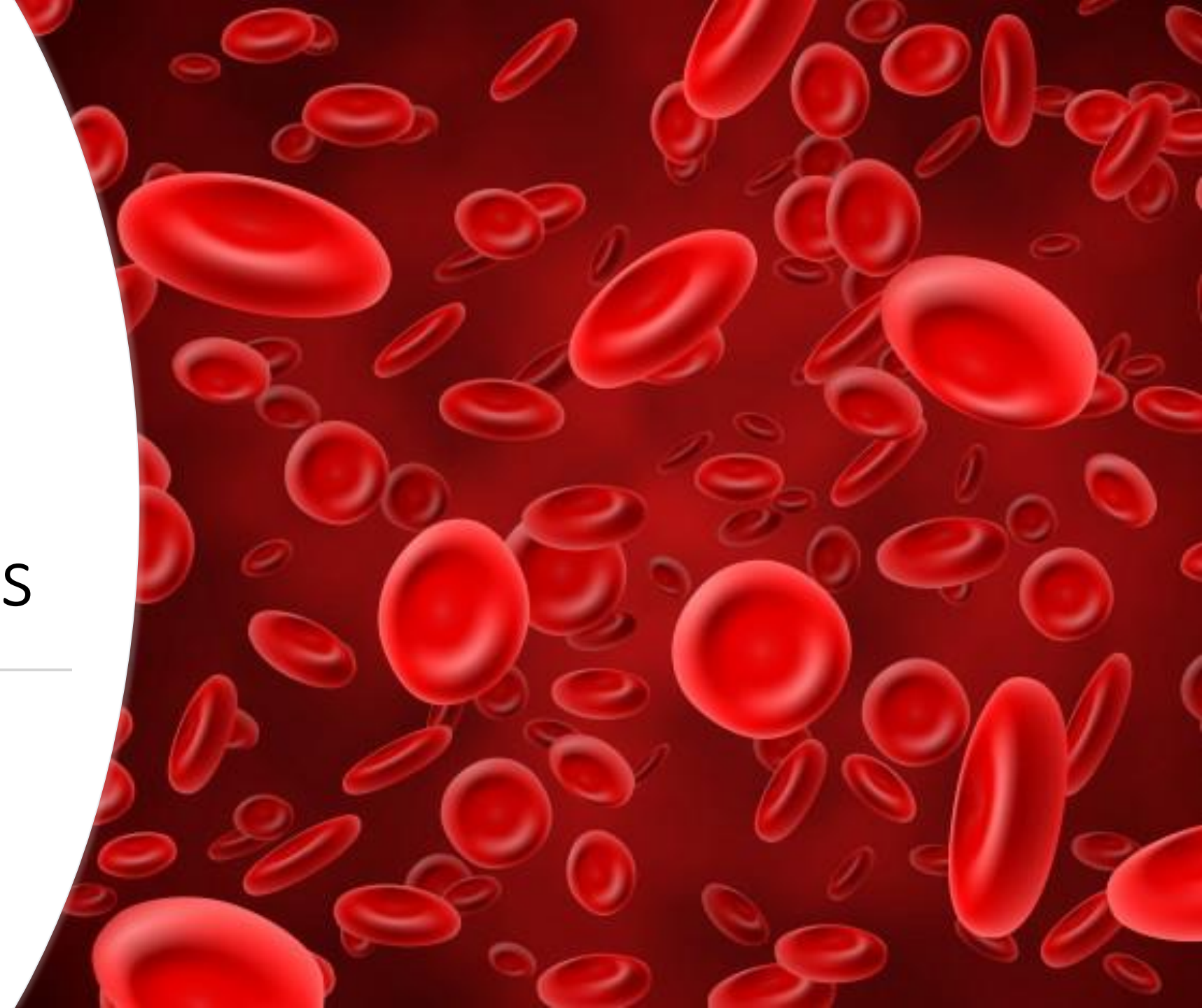


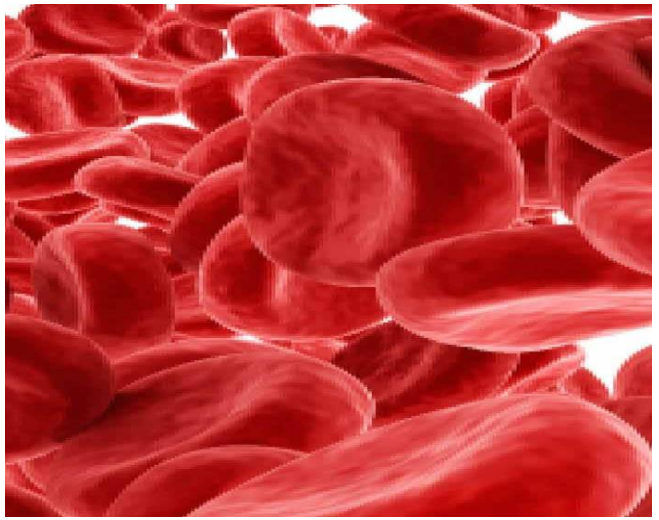
Learning objectives:

- Describe the structure, function, life span and normal count of Red Blood Cells.
- Define Haemopoiesis.
- Classify haematopoitic stem cells.
- Summarize the erythropoiesis sites during pre-natal and post-natal periods

Red blood cells (RBC's)

RBC is the predominant formed element

Occupy 40-45%of blood volume



RBC COUNT :

In normal man 5,200,000 ± 300,000 cells/mm^3

In normal woman 4,700,000 ± 300,000cells/mm^3

SIZE & SHAPE OF RBCS:

Circular,

non-nucleated,

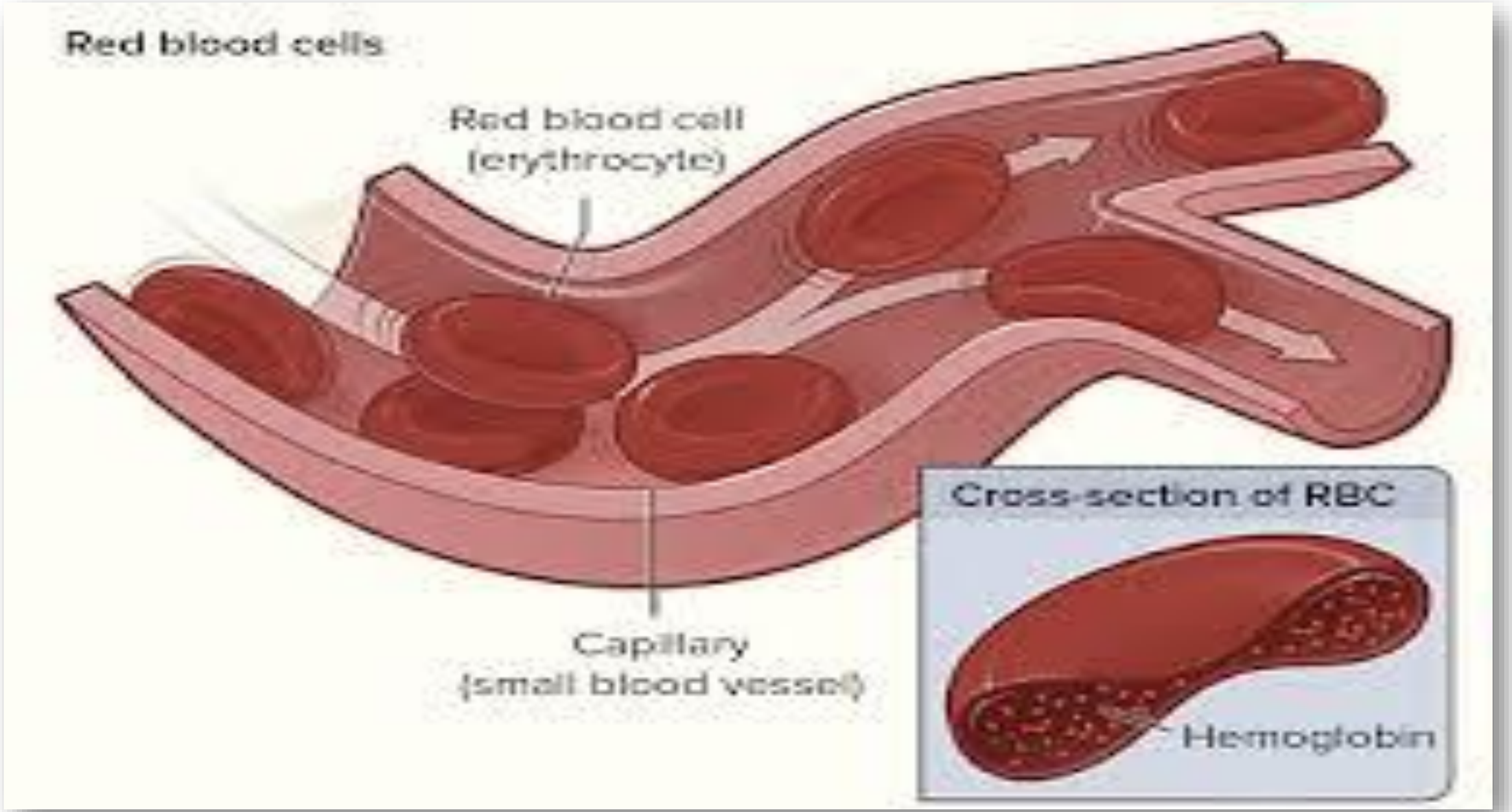
biconcave discs.

Mean diameter **7.8 µm**. Thickest at sides **2.5 µm**, thinner in center **1um** or less.

Life span:

120 days

- Why Biconcave shape ???


Red blood cells
Red blood cell
(erythrocyte)
Capillary
(small blood vessel)
Cross-section of RBC
Hemoglobin

SHAPE AND SIZE

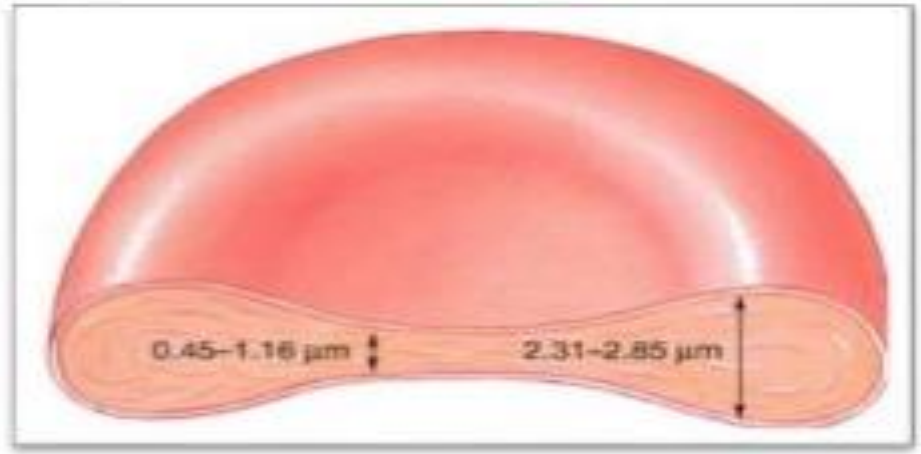
- Normally disk shaped & bi-concave.
- Central portion thinner and periphery thicker.

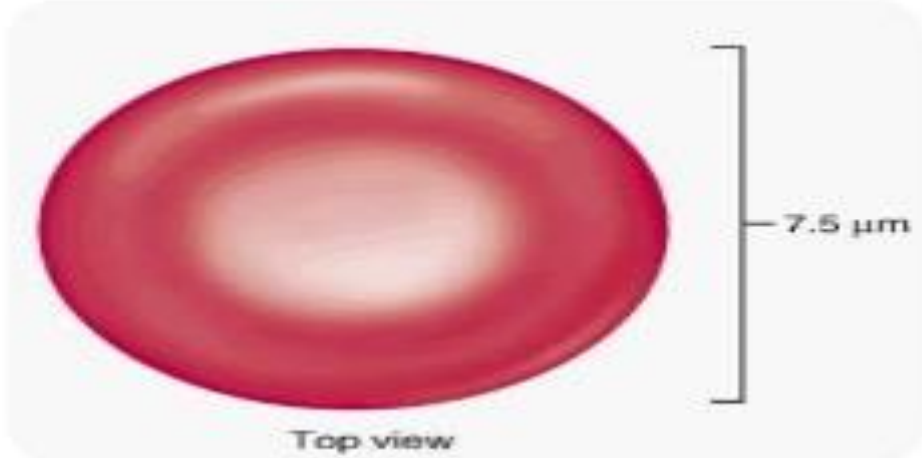
- Size: Diameter = 7.2μ (6.9-7.5 μ)

Thickness=

- At periphery=2.2 μ

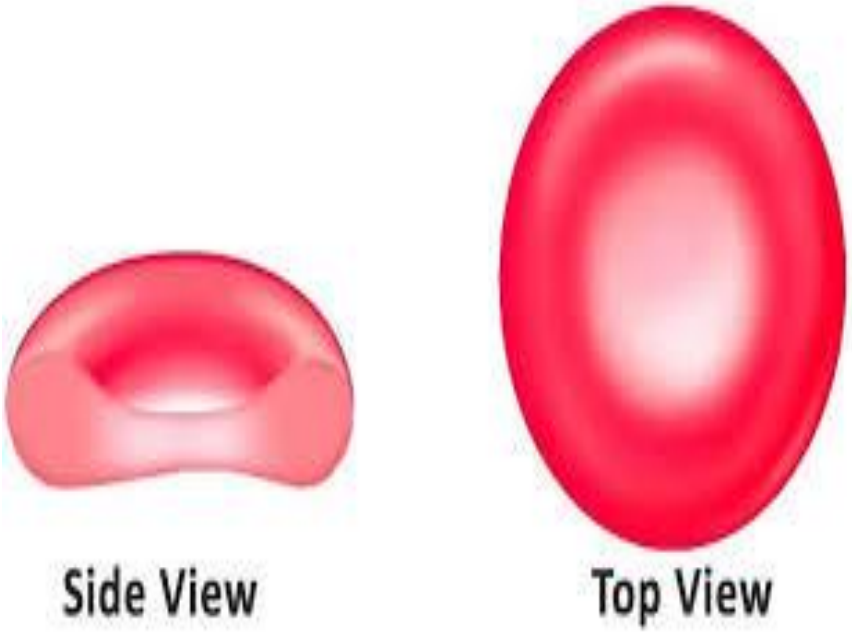
- At center = 1 μ





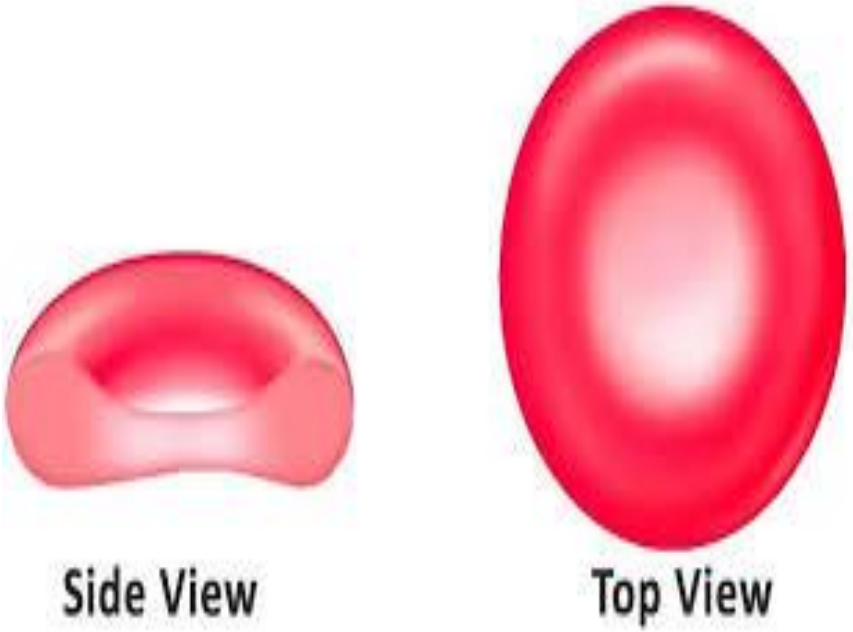
- **Bi-concave shape** increase the surface area greatly for the exchange of gases. Total surface area of all RBCs in human is 38000 sq. meters
- The **shape can be deformed** temporarily as it squeezes through capillaries 6 µm diameter.

This process is called diapedisis.



Unique shape of RBC contributes in 2 ways to perform their main function of O2 transport.

- Biconcave shape provides greater surface area for O2 diffusion across membrane.
- The thin inner center enables O2 to diffuse rapidly between exterior and innermost regions of the cell.



Organelles of RBC’s

Does not contain

- Nucleus
- Mitochondria
- Endoplasmic reticulum
- Golgi apparatus
- Ribosomes.

Why???

Lack of Nucleus and Organelles

- To maximize its Hemoglobin content

A single RBC is stuffed with more then 250 million hemoglobin molecules, excluding almost everything else.

So each RBC can carry more then 1 billion O2 molecules.

Red blood cell

Each red blood cell contains several hundred thousand hemoglobin molecules which transport oxygen

Hemoglobin molecule

Heme

O_2

O_2

Oxygen binds to heme on the hemoglobin molecule

Enzymes in RBC’s

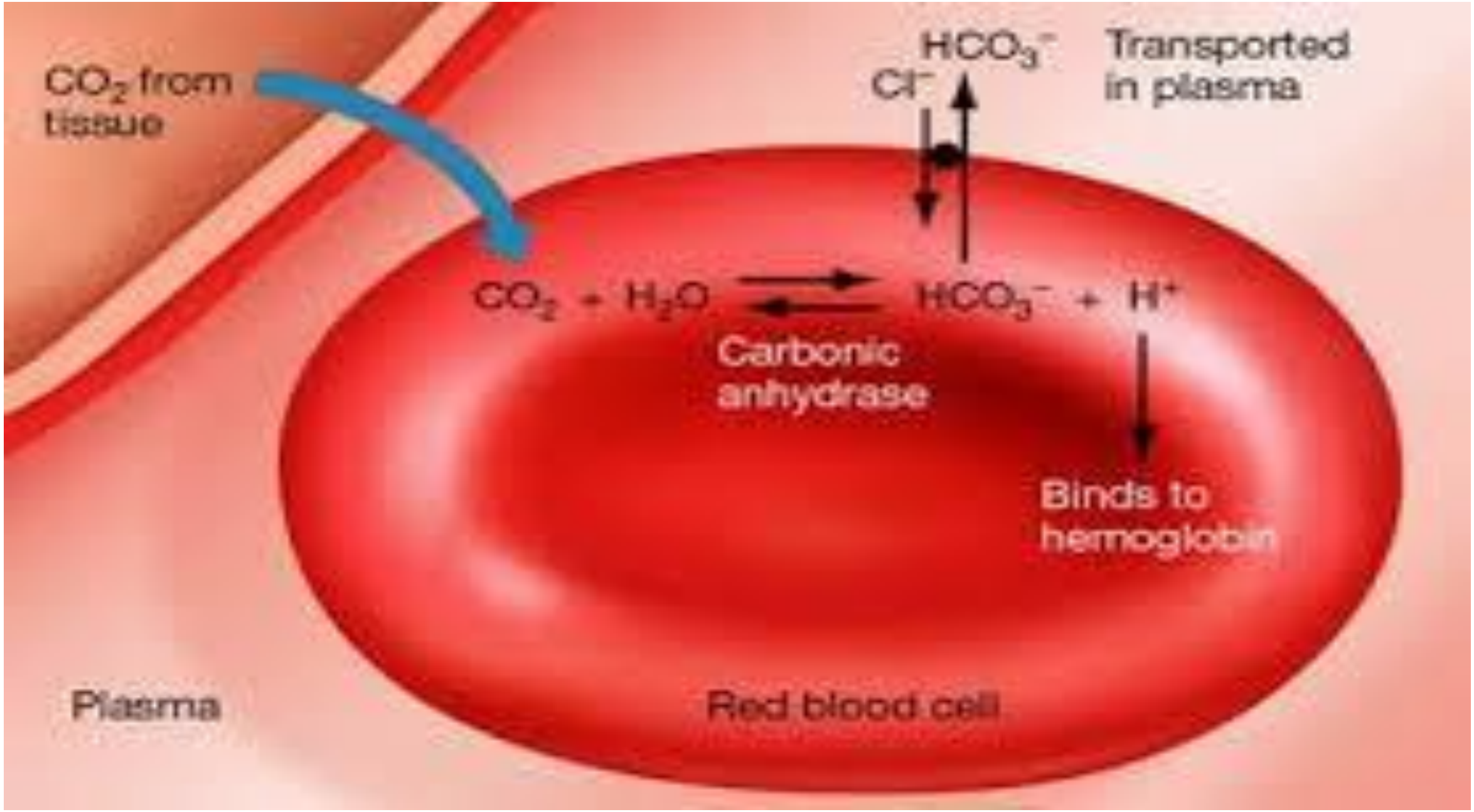
Mature RBCs contain two types of enzymes:

1) Glycolytic enzymes:

- Essential for generating energy.
- Maintain ionic concentration of cell.
- Carry oxygen but cannot use it.
- Rely on glycolysis for ATP formation.

2) Carbonic anhydrase:

- Catalyzes conversion of CO_2 in HCO_3 ions which is main transport form of CO_2 in blood.


CO_2 from tissue
HCO_3^-
Cl^-
Transported in plasma
$CO_2 + H_2O$
$HCO_3^- + H^+$
Carbonic anhydrase
Binds to hemoglobin
Plasma
Red blood cell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CONGRATULATIONS

Hematopoiesis

- Hematopoiesis is a term describing the formation and development of blood cells.
  - Cells of the blood are constantly being lost or destroyed. Thus, to maintain homeostasis, the system must have the capacity for self renewal. This system involves:

Hematopoiesis……. Cont.

- Proliferation of progeny stem cells
- Differentiation and maturation of the stem cells into the functional cellular elements.
- In normal adults, the proliferation, differentiation, and maturation of the hematopoietic cells (RBCs, WBCs, and platelets) is limited to the bone marrow and the widespread lymphatic system and only mature cells are released into the peripheral blood

- Hematopoiesis in the bone marrow is called medullary hematopoiesis
- Hematopoiesis in areas other then the bone marrow is called extramedullary hematopoiesis
  - Extramedullary hematopoiesis may occur in fetal hematopoietic tissue (liver and spleen) of an adult when the bone marrow cannot meet the physiologic needs of the tissues. This can lead to hepatomegaly and/or splenomegaly

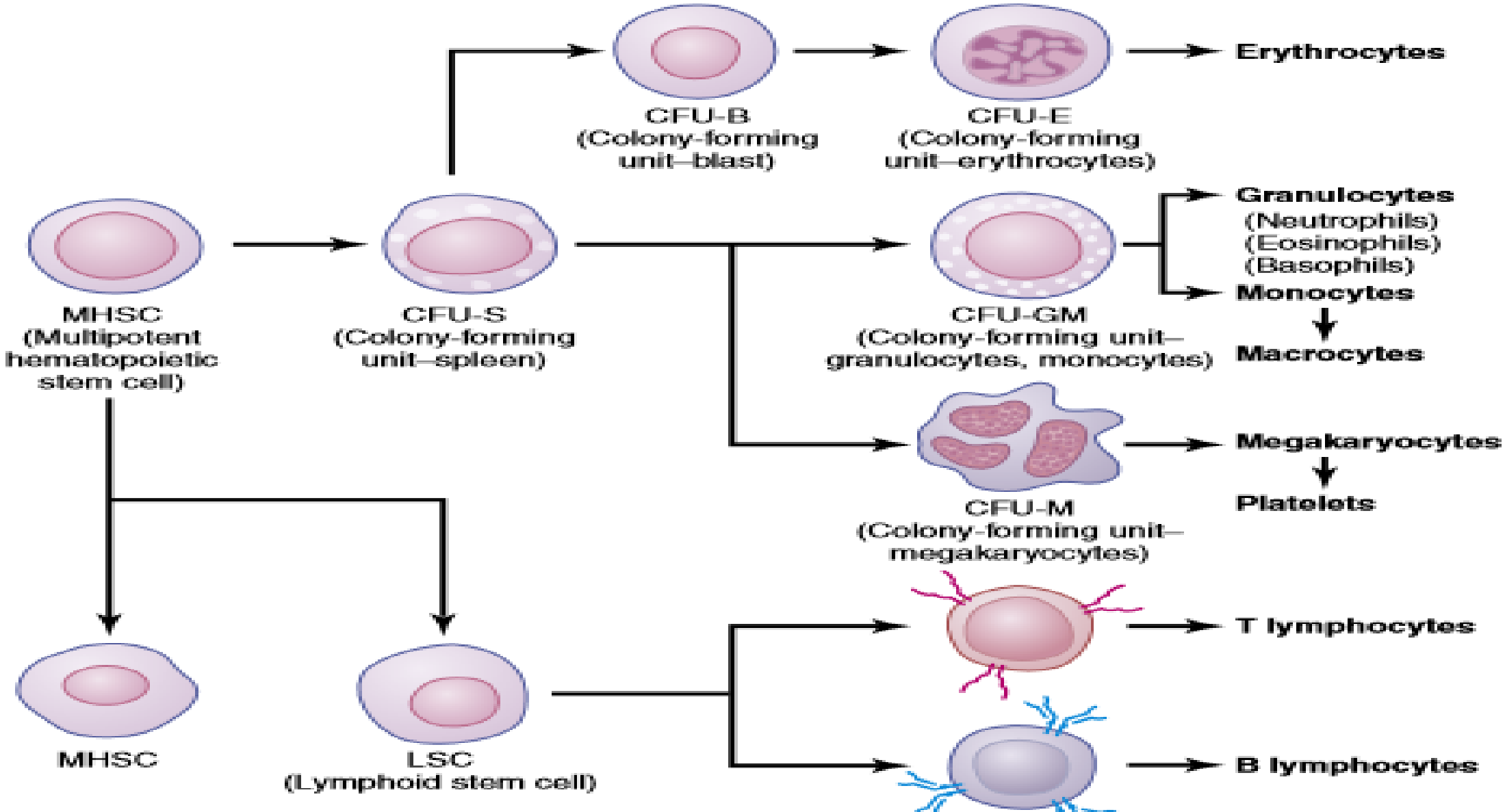
Hematopoiesis: (Greek word)

is the process through which the body manufactures blood cells.

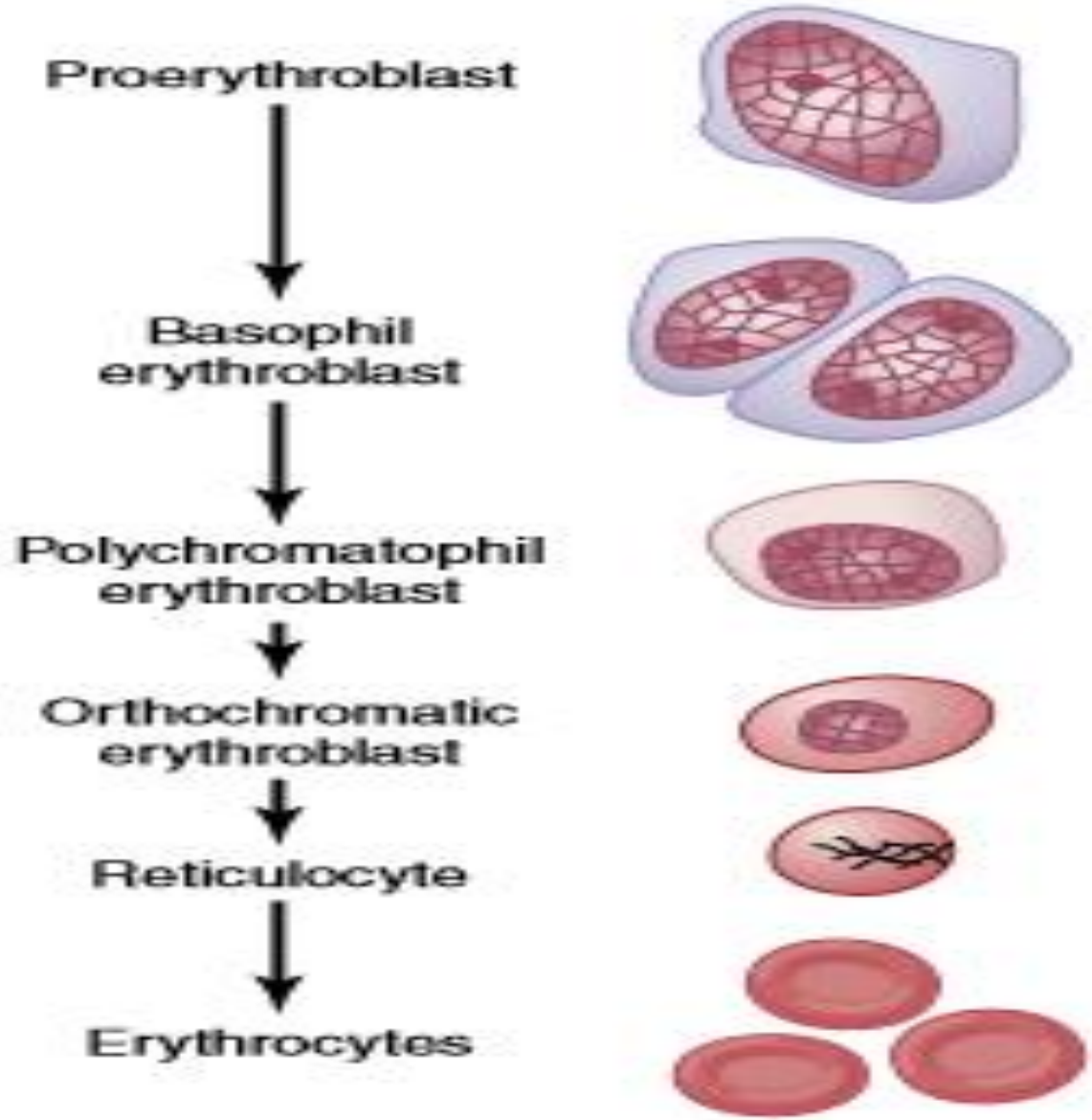
Hemopoiesis: (English word)

Both are used interchangeably…

Formation of multiple blood cells from the hematopoietic cells in the Bone marrow



Genesis of RBCs

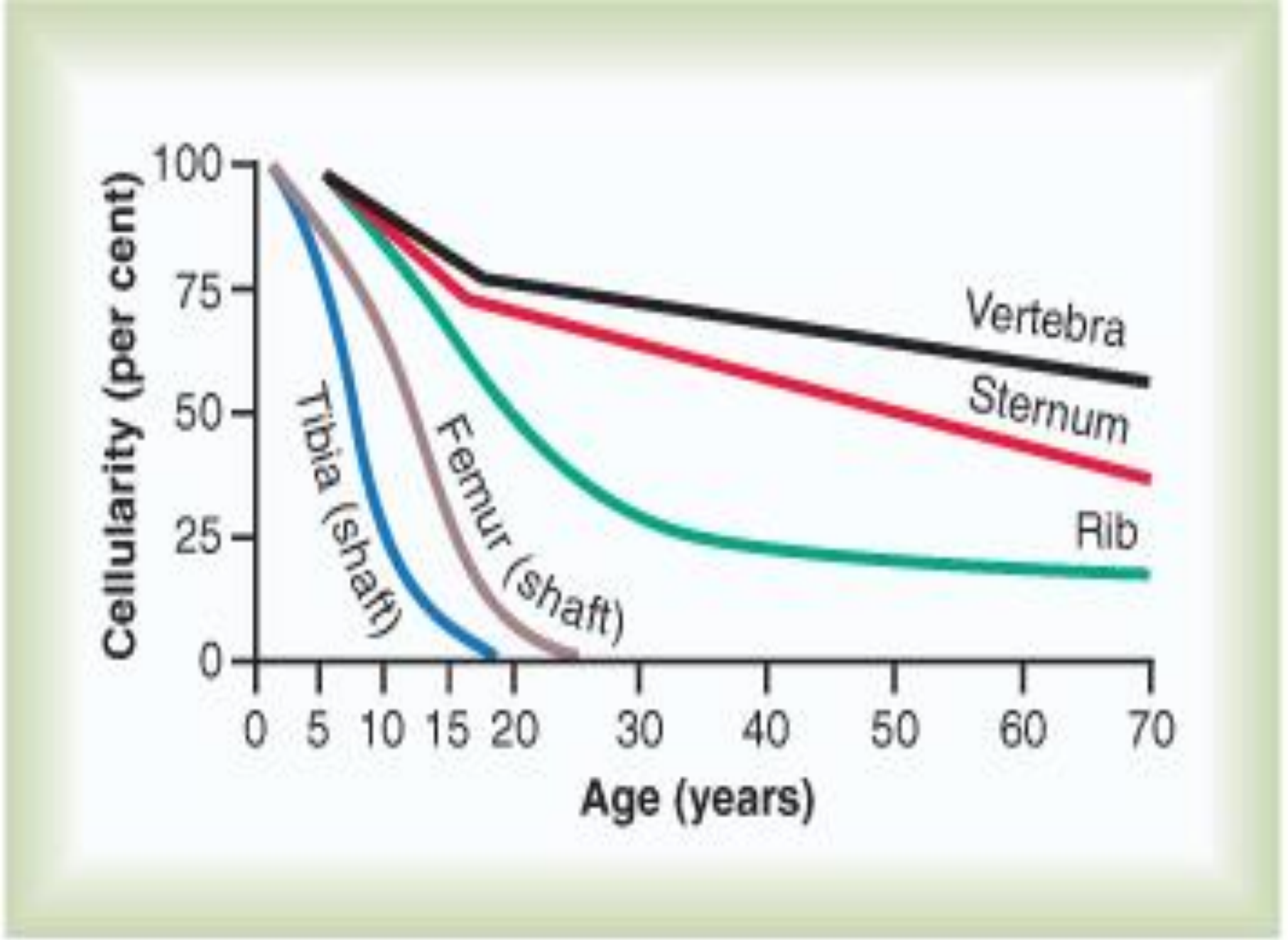


Terms used in genesis of blood cells:

- **Pluripotential hematopoietic stem cells:** from which all the cells of circulating blood are derived.
- **Committed stem cells:** Intermediate stage of cell, which are committed to become a particular line od cell, example, RBC, WBC, Platelet.
- **Colony-forming-unit-Erythrocytes, CFU-E :** committed stem cells that produce Erythrocytes (RBC's)
- **Colony-forming –unit-granulocytes, monocytes, CFU-GM:** That produces granulocytes, monocytes.
- **Colony-forming-unit-megakaryocytes, CFU-M:** That produces megakaryocytes (platelets)

Sites of Hemopoiesis

Early weeks of embryonic life	Primitive nucleated RBC's are produced in the yolk sac.
Middle trimester of gestation	Liver (main organ) reasonable number also formed in spleen and lymph nodes.
Last month of gestation & after birth	Exclusively in the bone marrow. Bone marrow of all bones produces RBC's until a person is 5 years old. Marrow of most bones becomes fatty & except proximal portion of Humerus and tibia, do not produce RBC's after age 20. Beyond this most RBC's continue to be produced in the marrow of membranous bones.



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