

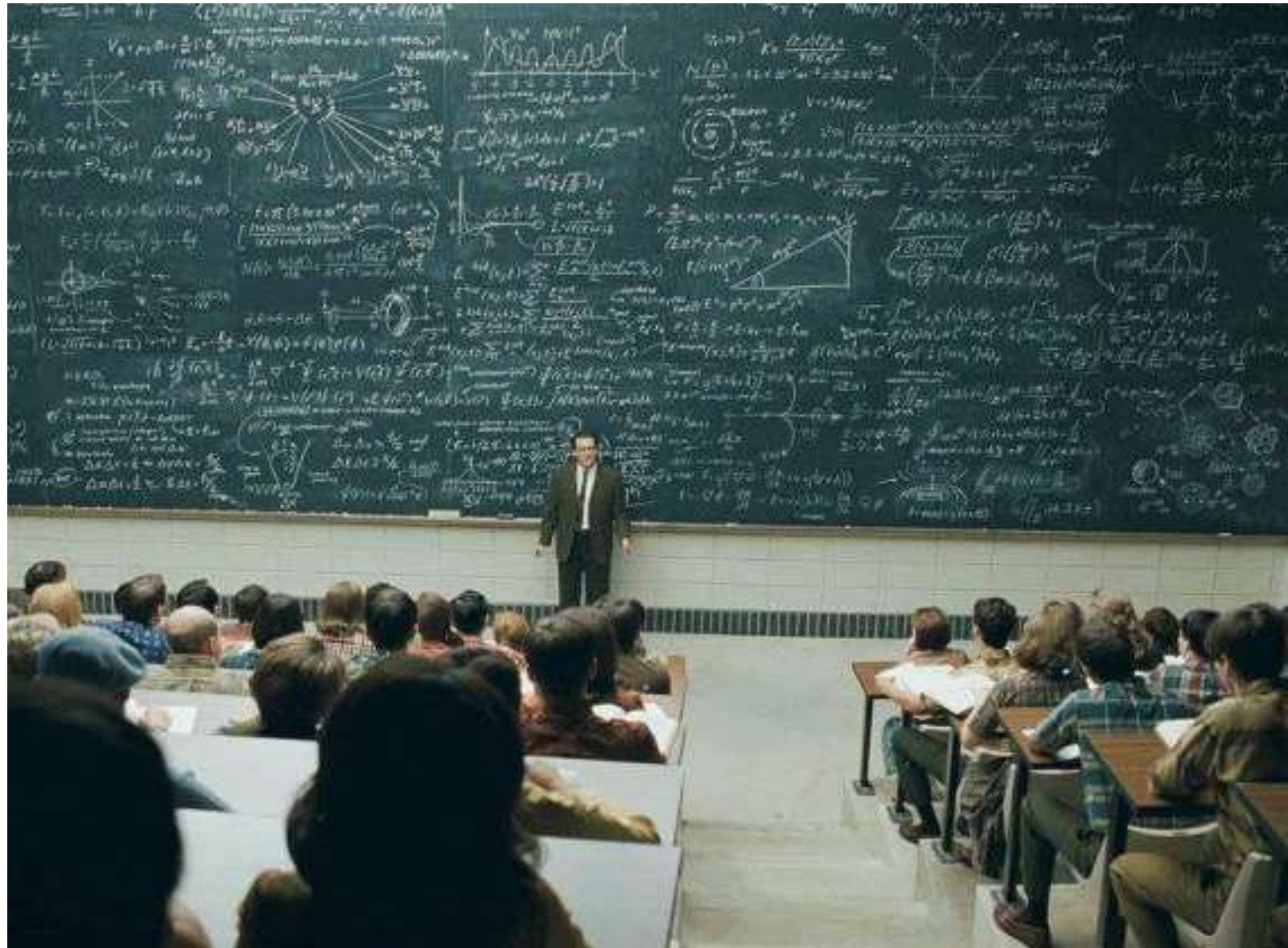
Hemopoiesis

The topic is sooooo easy

The following is the Summary of the lecture on the board

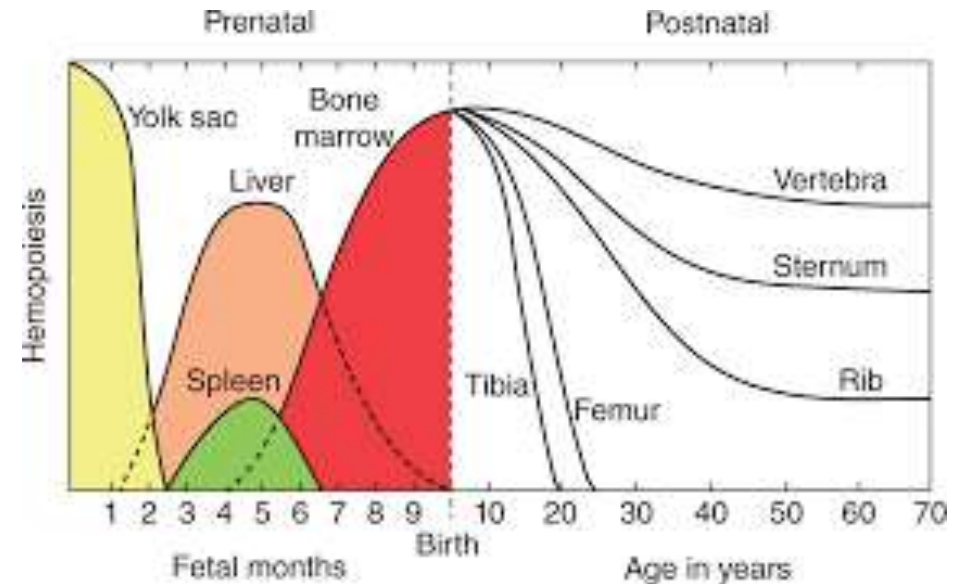
JUST CONCENTRATE

Otherwise, you will not understand it



Hemopoiesis

- Because of the short life span of blood cells, they must be replaced by stem cells found in HEMATOPOEITIC ORGANS
- In early development, blood cells arise from the mesoderm in the **yolk sac**
- Later, the **liver** and **spleen** take over
- Late in pregnancy, **bone marrow** takes over and becomes the main source of blood elements

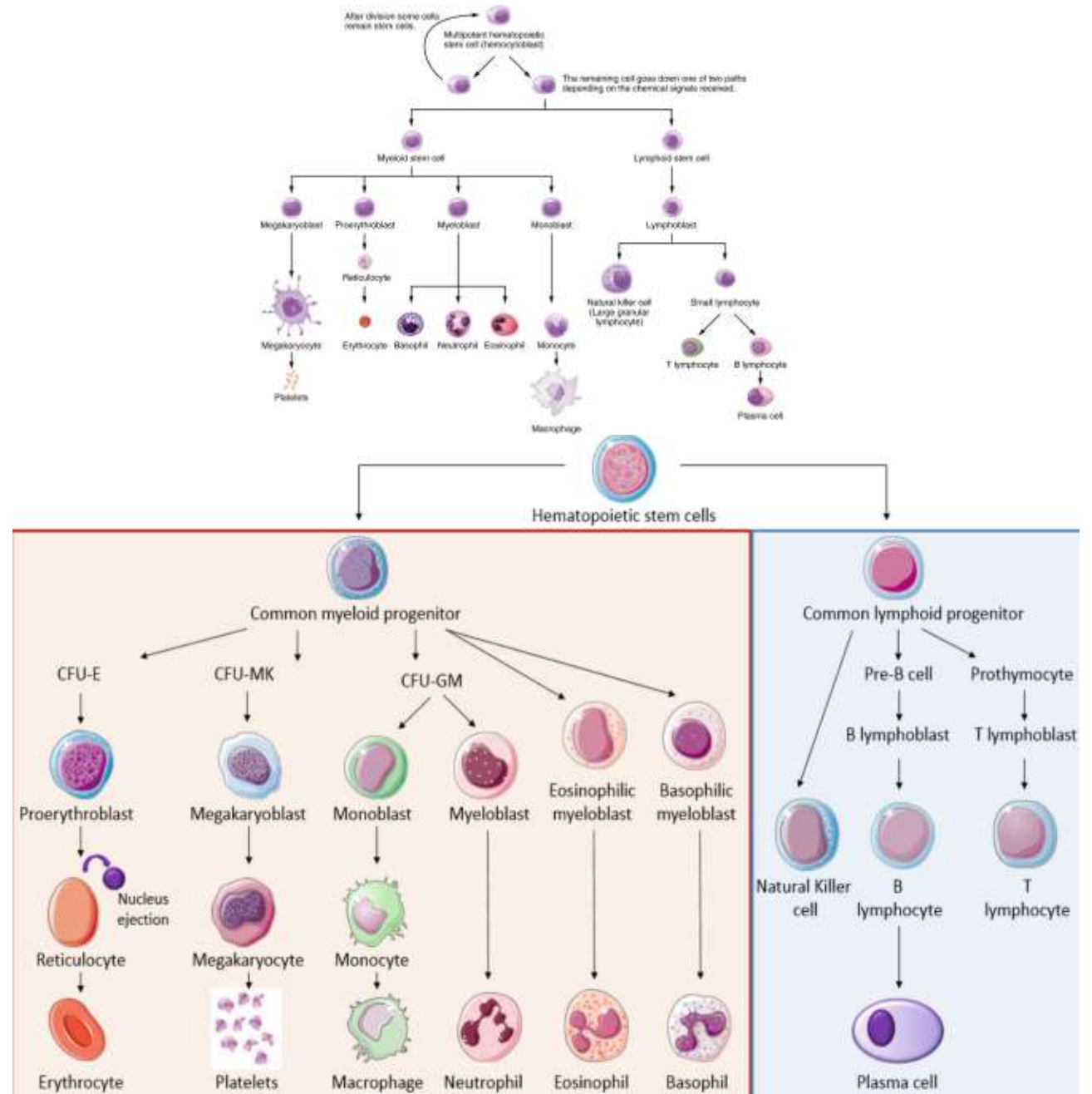


Stem Cells

- They are **pluripotent** cells
- Capable of asymmetrical division and self-renewal
- Some daughter cells become irreversibly differentiated cells
- Other cells remain as stem cells
- Pluripotent cells proliferate and form two cell lineages:

Myeloid cells

Lymphoid cells



Stem Cells

- Stem cells give rise to daughter cells with restricted potentials called **Progenitor Cells**

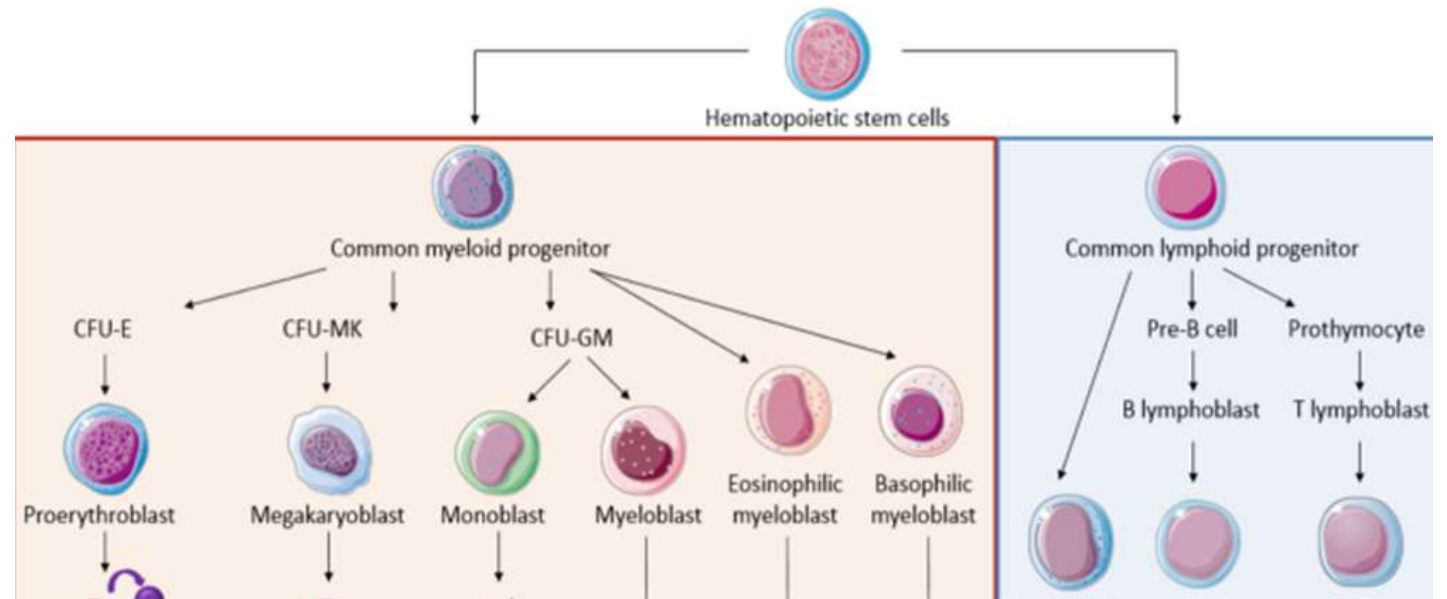
- Four groups are formed:

CFU-E

CFU-meg

CFU-GM

CFU-L



- All these progenitor cells in (CFUs) produce Precursor (**Blast Cells**)
- They have morphological characteristics
- They differentiate into the **mature cells**

Bone Marrow

- Bone marrow is found in medullary canals of long bones and cavities of cancellous bone
- Yellow bone marrow
- Red bone marrow

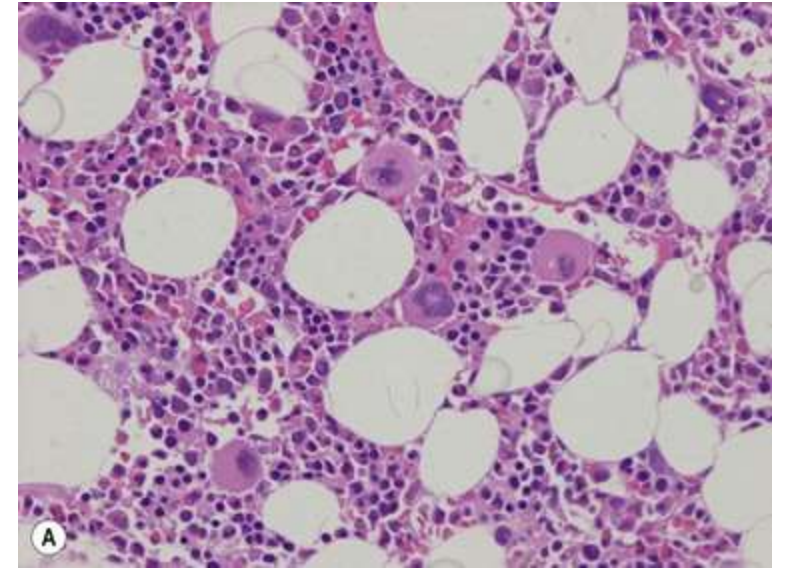
Stroma made of **reticular cells** and **fibers**

Hematopoietic cords or islands of cells

Sinusoidal capillaries

Matrix:

Collagen type I, Proteoglycan, Fibronectin, macrophages
and Laminin binds to integrins



Changes during Erythropoiesis

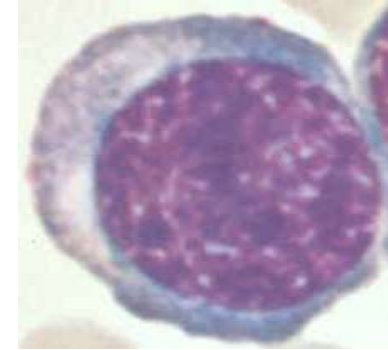
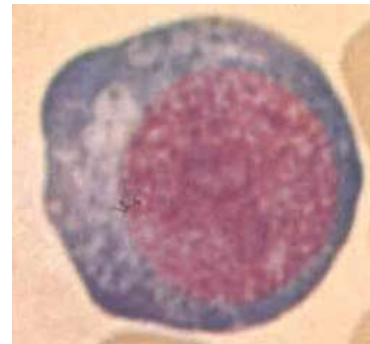
The following are the changes that occur in the blast cell until RB formation:

- Cell **decreases** in size
- Nucleus **decreases** in size
- Decrease **basophilia**
- Increase **acidophilia**
- **Condensation** and then **expulsion** of the nucleus
- Cell organelles gradually **disappear**

Maturation of Erythrocytes

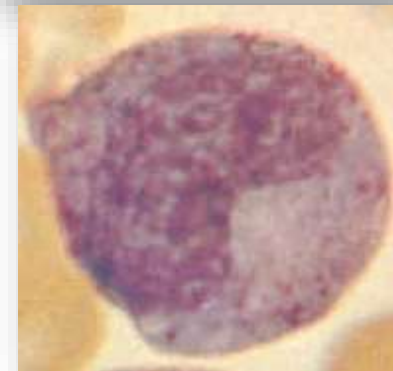
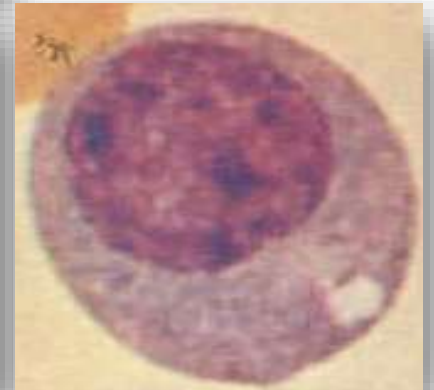
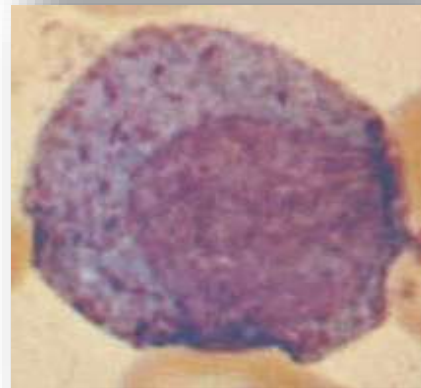
Maturation of erythrocyte pass through the following stages :

- Proerythroblast
- Basophilic erythroblast
- Polychromatic erythroblast
- Normoblast
- Reticulocyte
- Mature erythrocyte



Changes during Granulopoiesis

- Myeloblast: first recognizable stage
- Promyelocyte
- Myelocyte
- Metamyelocyte
- Band cell
- Mature cell



Neutrophils

Vast majority of granulocytes are neutrophils

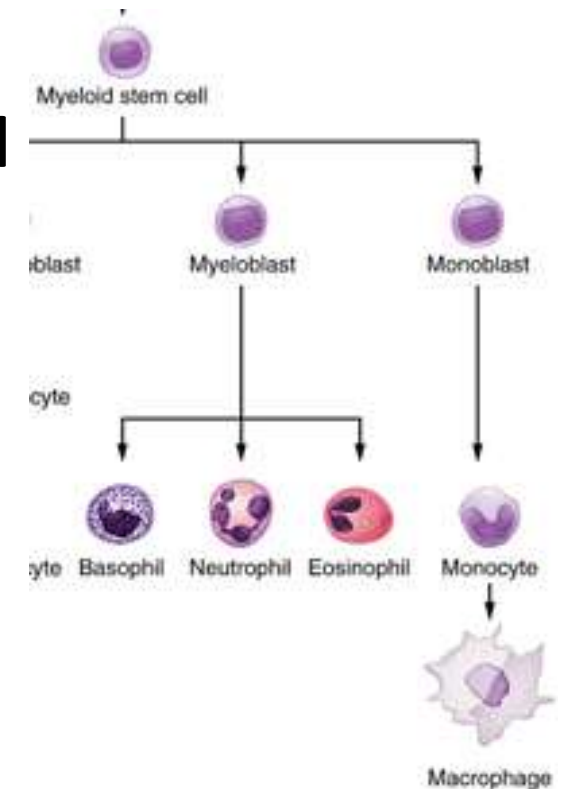
Developing and mature neutrophils are found in:

- Granulopoietic component in bone marrow
- Stored as mature neutrophil in bone marrow
- Circulating neutrophils
- Marginating neutrophils adhering to the endothelium of venules and small veins

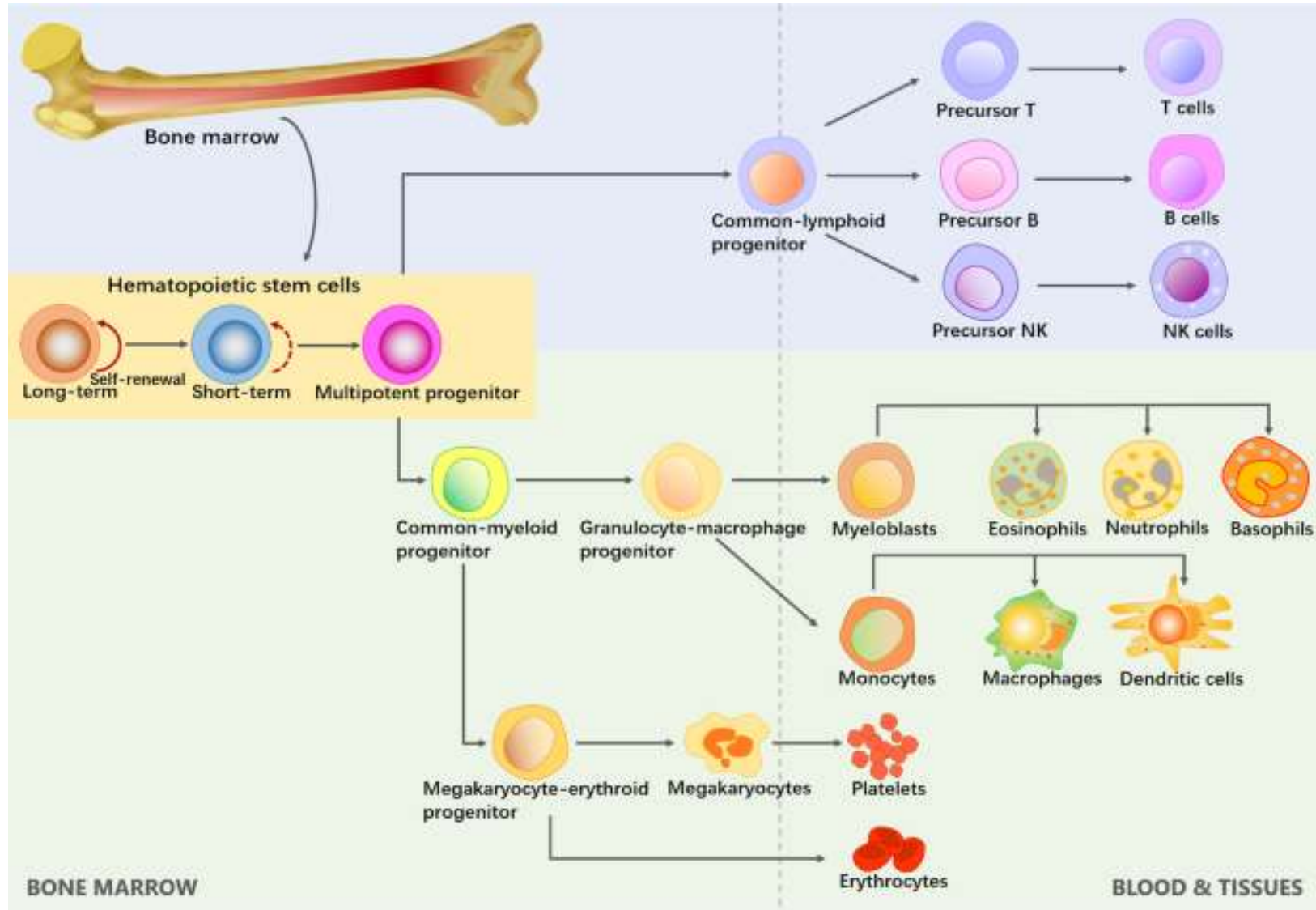
Diapedesis: neutrophils move to the connective tissue

Monocyte Maturation

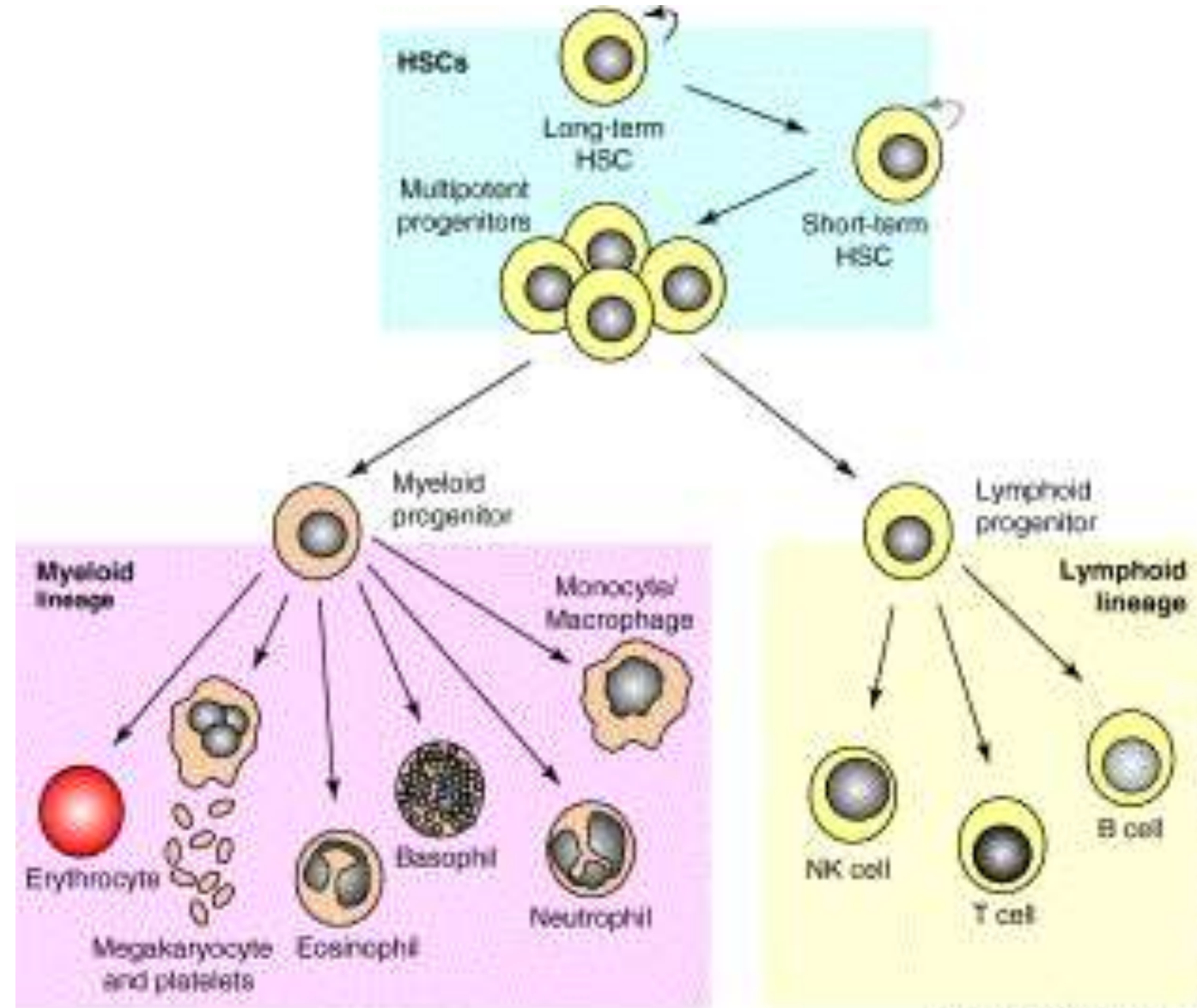
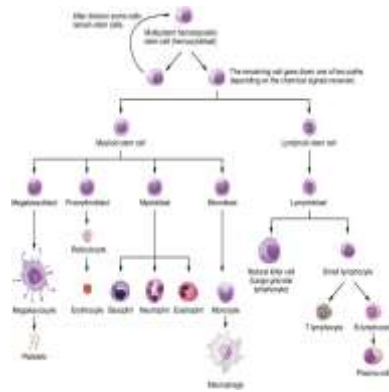
- **Monoblast** is the first recognizable cell in monocyte lineage
- It is more like myeloblast
- Promonocyte with basophilic cytoplasm and indented nucleus. It has lacy chromatin and few nucleoli
- It divides twice before it differentiates into monocyte
- It is characterized by abundant RER and Golgi with **azurophilic granules**
- They leave to the circulation for few hours and then to connective tissue to become **Macrophage**



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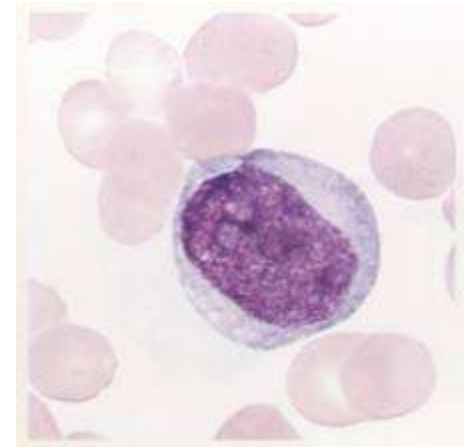
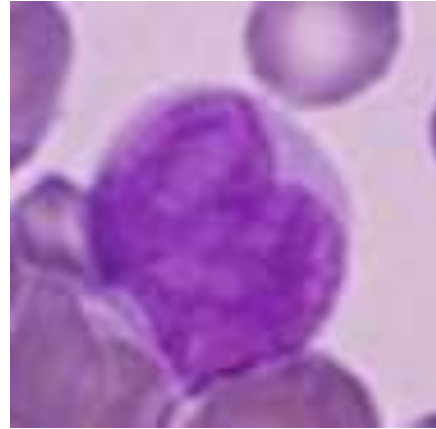
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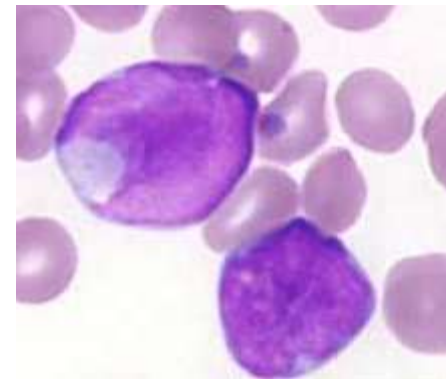
Lymphocyte Formation

- **Lymphoblast** is the first recognizable cell in the lymphocyte series
- They have few nucleoli and less dense chromatin
- It is capable of dividing 2-3 times
- It differentiates into **prolymphocyte**
- It is smaller in size with dense chromatin and invisible nucleoli
- None of these cells carry any surface antigens
- In bone marrow and thymus, they synthesize surface receptors and become B and T lymphocytes

- **Monoblast**

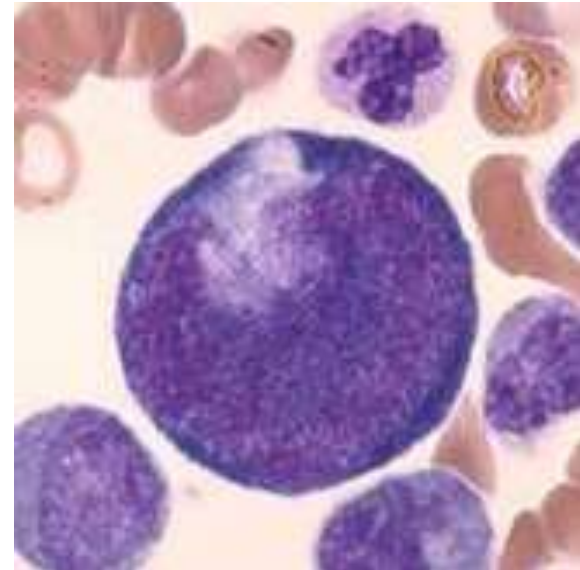


- **Lymphoblast**



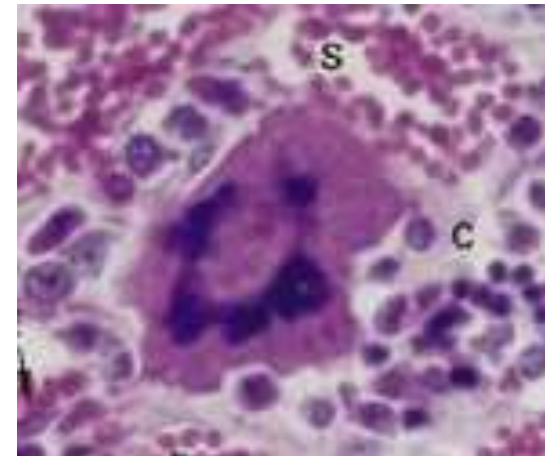
Platelet Formation

- **Megakaryoblast** in bone marrow is large 25-50 μm in diameter with an ovoid to kidney-shaped nucleus with numerous small nucleoli
- This cell goes endomitosis several times resulting in a highly polyploid nucleus.
- It has homogeneous and intense basophilic cytoplasm
- It differentiates into **Megakaryocyte**, which is three times larger than the ancestor cell

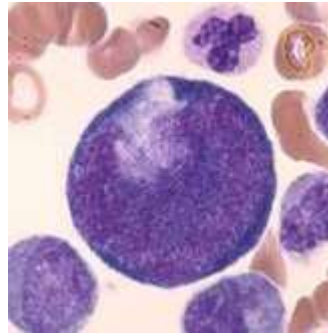


Megakaryocyte

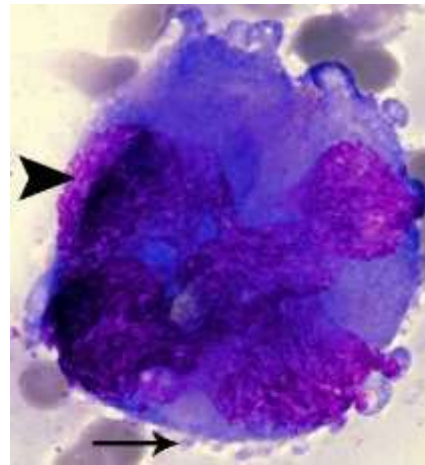
- It has coarse chromatin, a multilobulated nucleus, and invisible nucleoli
- They show all organelles involved in protein synthesis
- They form **proplatelets** (long cytoplasmic processes)
- The elongation of **proplatelets** depends on the sliding microtubules
- Platelets are pinched off from the end of the **proplatelet**
- The remnant of megakaryocytes show apoptosis and removed by macrophages



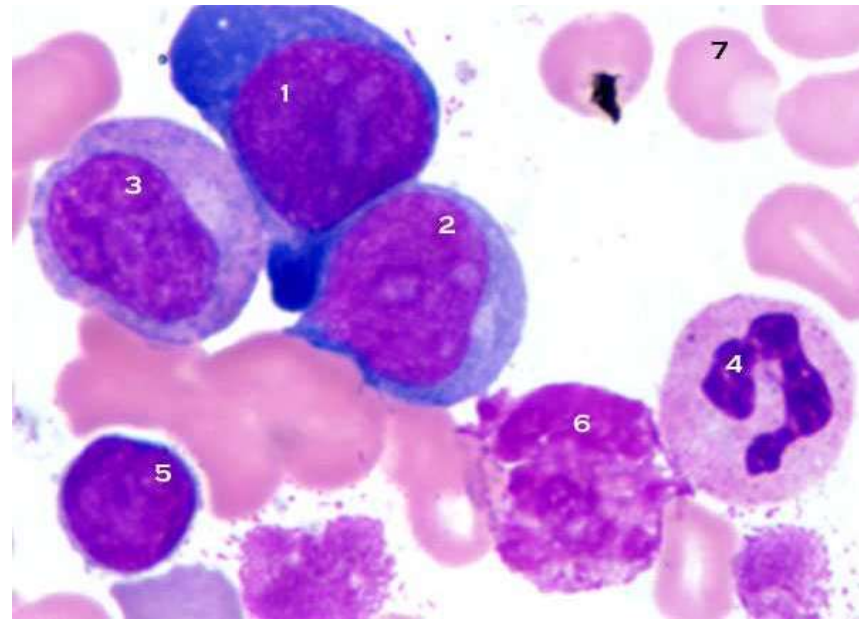
- **Megakaryoblast**



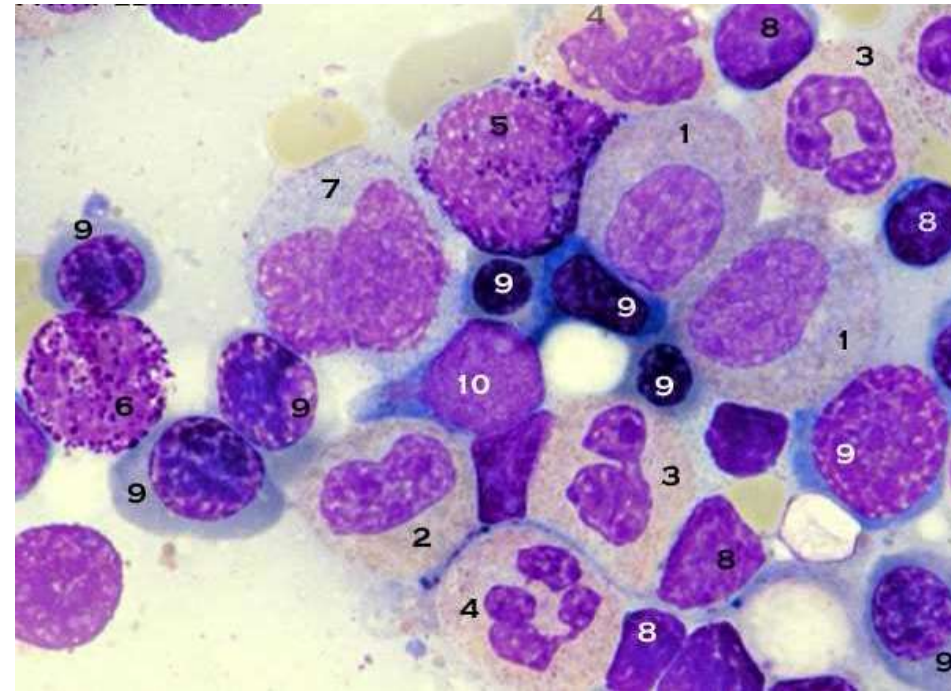
- **Megakaryocyte**



1. **Proerthroblast: More basophilic cytoplasm, nucleoli long curved comma shaped**
2. **Myeloblast: less basophilic cytoplasm, round nucleoli**
3. **Myelocyte**



1. Myelocyte
2. Metamyelocyte
3. Band
4. Mature neutrophil
5. Basophilic myelocyte
6. Basophil
7. Monocyte



NORMAL BONE MARROW

1 = Proerythroblast

2 = Basophilic erythroblast

3 = Polychromatic erythroblast

4 = Promyelocyte

5 = Myelocyte

6 = Early band neutrophil

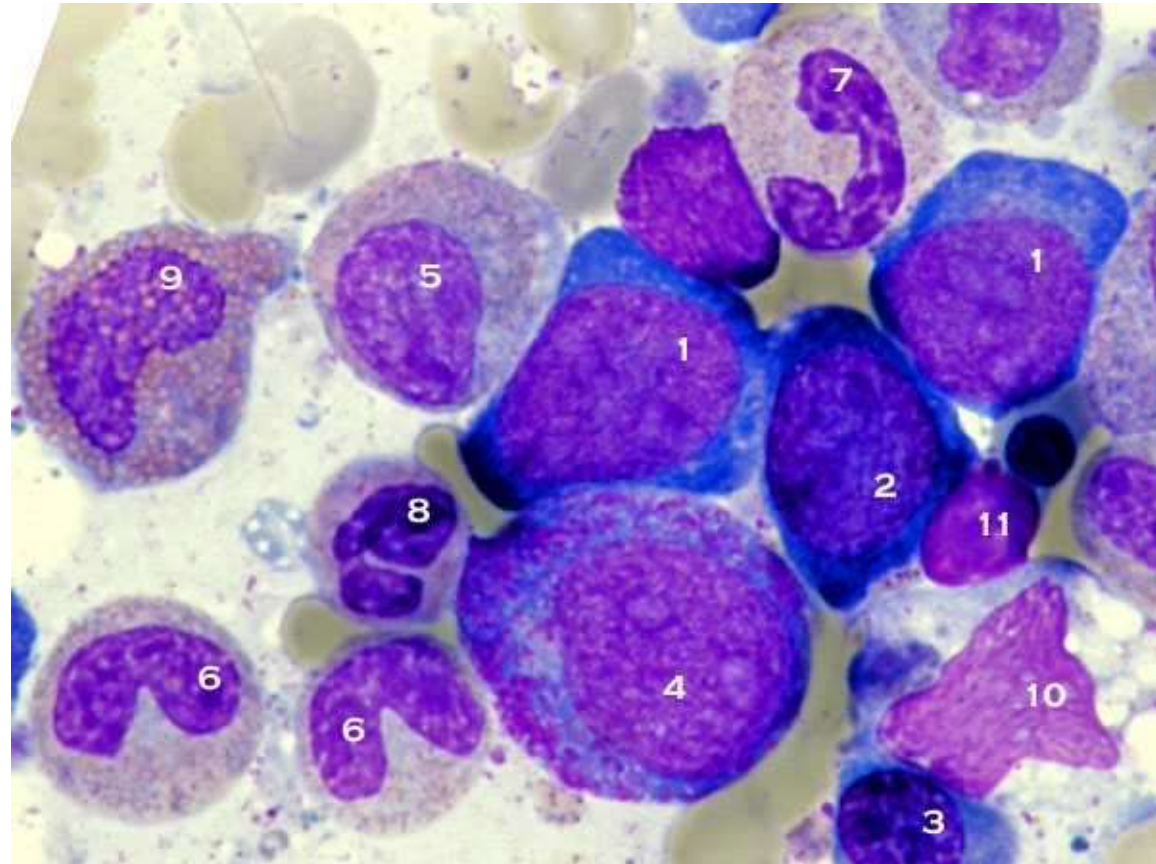
7 = Late band neutrophil

8 = Segmented neutrophil

9 = Band eosinophil

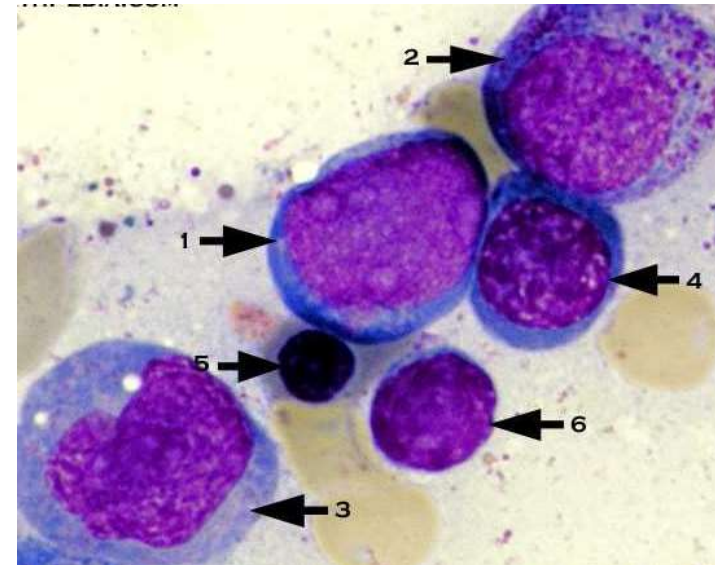
10 = Monocyte

11 = Small lymphocyte.b



NORMAL BONE MARROW

- A **myeloblast (#1)** is the earliest recognizable cell in the myeloid series. It has scant agranular to sparsely granular cytoplasm and large nucleus with fine chromatin and one to three prominent nucleoli. The quality of chromatin is the most important morphologic feature to identify a myeloblast.
- A **promyelocyte (#2)** is the next morphologic stage in myeloid maturation where cells accumulate more cytoplasm and azurophilic granules and the nucleus becomes smaller and show coarser chromatin with small to distinct nucleoli.
- A **monocyte (#3)** is shown with abundant cytoplasm and finer and fewer granules than a promyelocytes and no prominent nucleoli.



NORMAL BONE MARROW

In myeloid series the cells mature in the following order: Myeloblast >> Promyelocyte >> Myelocyte >> Metamyelocyte >> Band neutrophil >> Segmented neutrophil (or eosinophil or basophil).

In the erythroid series the cells mature in the following order: Proerythroblast >> Basophilic erythroblast >> Polychromatic erythroblast >> Orthochromatic erythroblast >> Reticulocyte >> Mature red cell.

NORMAL BONE MARROW

1 = Myeloblast

2 = Promyelocyte

3 = Myelocyte

4 = Metamyelocytes

5 = Band neutrophil

6 = Segmented neutrophil

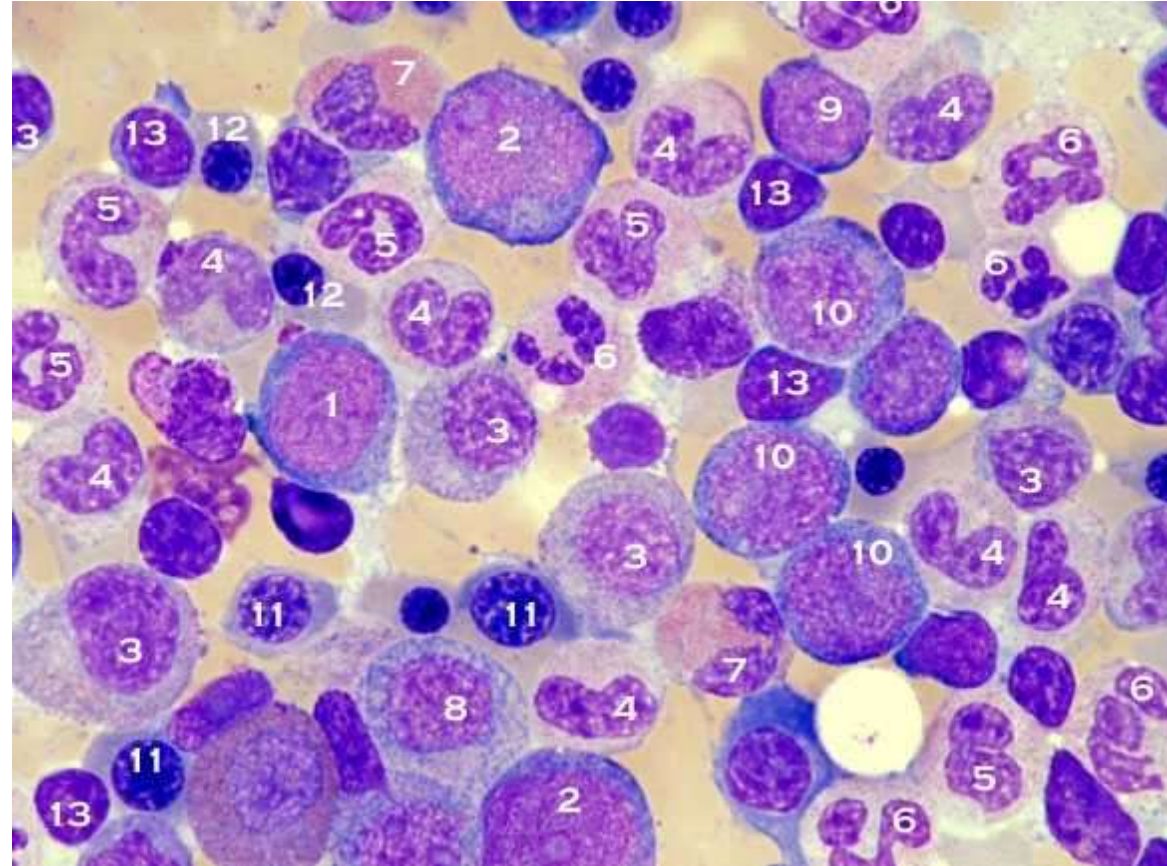
7 = Eosinophil

8 = Monocyte

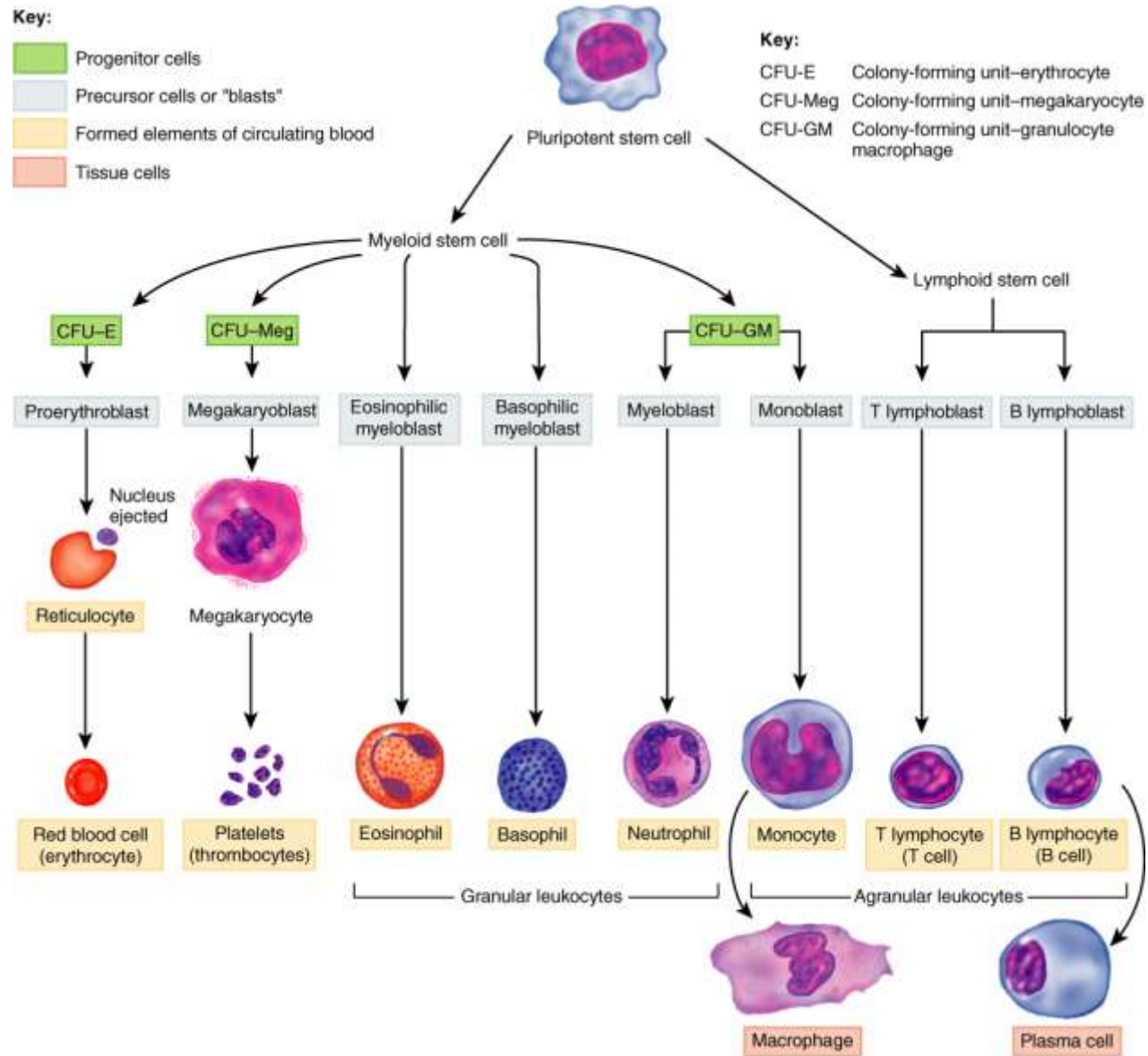
9 = Proerythroblast

10 = Basophilic erythroblasts 11 = Polychromatic erythroblast

12 = Orthochromatic erythroblast 13 = Lymphocyte.n



Summary of Blood cells formation



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