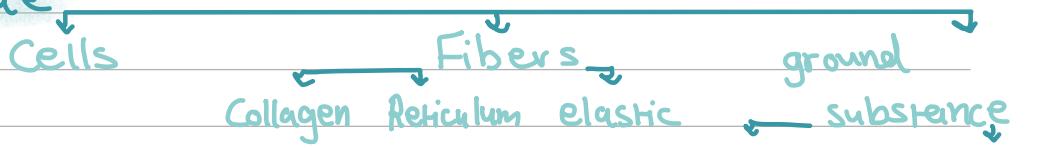


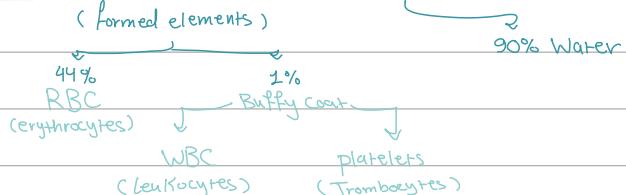
# Blood Cells

## - Connective tissue



- Blood  $\rightsquigarrow$  Origin: mesenchyme

component: Cells + Plasma  $\rightsquigarrow$  Lacks Fibers



- Hematocrit  $\rightsquigarrow$  Ratio of RBC volume to whole Blood

Male = 40% - 53%

Female = 36% - 48%

- Plasma proteins

Albumins

• secreted by liver

• Transports steroid hormones + F.A

Fibrinogen

• secreted by liver

• Clot Formation

Globulins

$\alpha$ ,  $\beta$

• secreted by Liver

• Transports fat-sol vitamins

• Lipids

• Iron

$\gamma$   
• secreted by plasma cell

- Blood Stain  $\rightsquigarrow$  Leishman's Stain

Eosin

acidic dye

pink - red

Methylene Blue

basic dye

blue - purple

Methyl Alcohol

Fixative

Azure Dye

- Erythrocytes  $\rightsquigarrow$  Male = 4.5 - 5.5 mil/mm<sup>3</sup>

Female = 4 - 5 mil/mm<sup>3</sup>

\* Live for 120 day then destroyed by Macrophages of Liver, Spleen, bone marrow

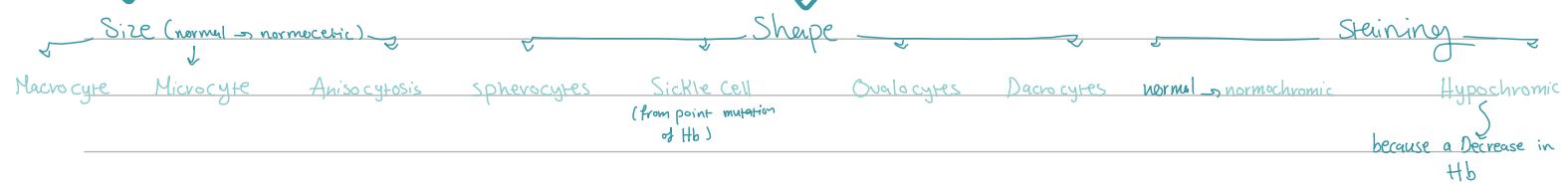
\* Biconcave shape  $\rightsquigarrow$  Central pale area 1/3 of cell  $\rightsquigarrow$  normochromic RBC (if no central pale area  $\rightsquigarrow$  spherocytosis)

\* Plasma membrane  $\rightsquigarrow$  to prevent fragmentation  $\rightsquigarrow$  cytoskeleton of (Spectrin + Ankyrin)

\* Diameter  $\rightsquigarrow$  7.5  $\mu\text{m}$

\* in low / slow circulation or ↓ Fluid  $\rightsquigarrow$  Rouleaux - reversible

## - Abnormalities of Erythrocyte -



- loss of RBC → Hypoxia → is detected by Kidneys → produce Erythropoietin → stimulate Erythropoiesis from bone marrow

↓ in RBC #n.

Anemia

↑ in RBC #n.

Polyctyhemia

- Leukocytes → travel in Blood, function outside in loose CT

Types

have single multi-lobed nucleus

Granulocytes

both have Azurophilic granules → primary granules (Lysosomes)

secondary granules

Agranulocytes

(WBC without specific granules)

Neutrophils  
• Small pale pink granules

Basophils  
• Large blue granules  
• irregular nucleus

Eosinophils  
• Large red granules

Lymphocytes

Monocytes

- Neutrophils → produced by bone marrow with 2 lobes → in Blood with 3 lobes

→ in CT with 4 lobes → about to die with 5 lobe (polymorphs)

→ short life span → in blood 6-8 hours → in CT 1-4 day → then die by Apoptosis

→ first reach the site of inflammation (cells of acute infection)

Granules →

Azurophilic  
(primary)

Lysosomes

Defensins

specific (secondary)

Lysosomes  
(kills bacteria)

Phagocytin  
(bacteriocidal)

Lactoferrin  
(bacteriostatic)

Collagenase

Myeloperoxidase  
Acid Hydrolase

\* pyogenic → bacterial infection producing Pus

\* pyrogenic → bacterial infection producing Heat

- Basophils → Rarest Leukocyte

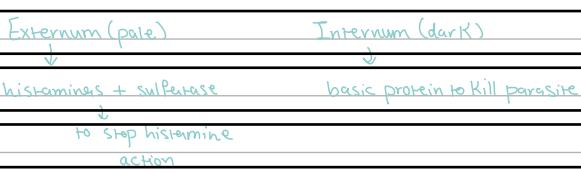
→ bilobed - (S) shaped nucleus

→ Granules contain → Histamin, Heparin → mediate inflammation in Allergies

→ Similar to Mast Cells (which have basophilic granules + scattered in Respiratory + digestive mucous)  
they both have cell surface R for IgE

## - Eosinophils

- usually bi-lobed nuclei
- red granules
- help in ending Allergic rxn + Fighting parasitic infections
- Specific granules (Crystallloid granules)



## - Monocyte

- Large leukocytes
- Bluish (unclear) cytoplasm due to → lysosomes (Azurophilic granules)
- mononuclear phagocyte system
  - ↓
    - Have 2 functions
    - Phagocytosis
    - Antigen presenting cells.
  - connective tissue → Macrophages
  - Liver → Kupffer cells
  - Epidermis → Langerhan cells
  - Lymph node / Spleen → Dendritic cells
  - Lungs → Dust cells
  - Bone → Osteoclast
  - CNS → Microglia

## - Lymphocytes

- Smallest leukocyte
- Large rounded nucleus (takes most of cell) → cytoplasm
- Adaptive immunity

small + dark → inactive

large + light → active

### T Cells

- Cell mediated immunity

### B cells

- Humoral immunity

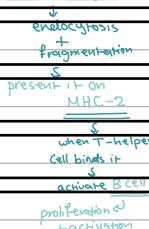
### NK Cells

- Always active

| Cytotoxic                     | Helper                         | Suppressor                           |
|-------------------------------|--------------------------------|--------------------------------------|
| Kills virus-infected cells    | Helps cytotoxic cells activate | Kills virus-infected cells           |
| transplanted neoplastic cells | CD4                            | neoplastic cells (adaptive immunity) |
| (adaptive immunity)           |                                |                                      |

| memory cells | plasma cells |
|--------------|--------------|
|              | Antibodies   |

- binds Free Antigen



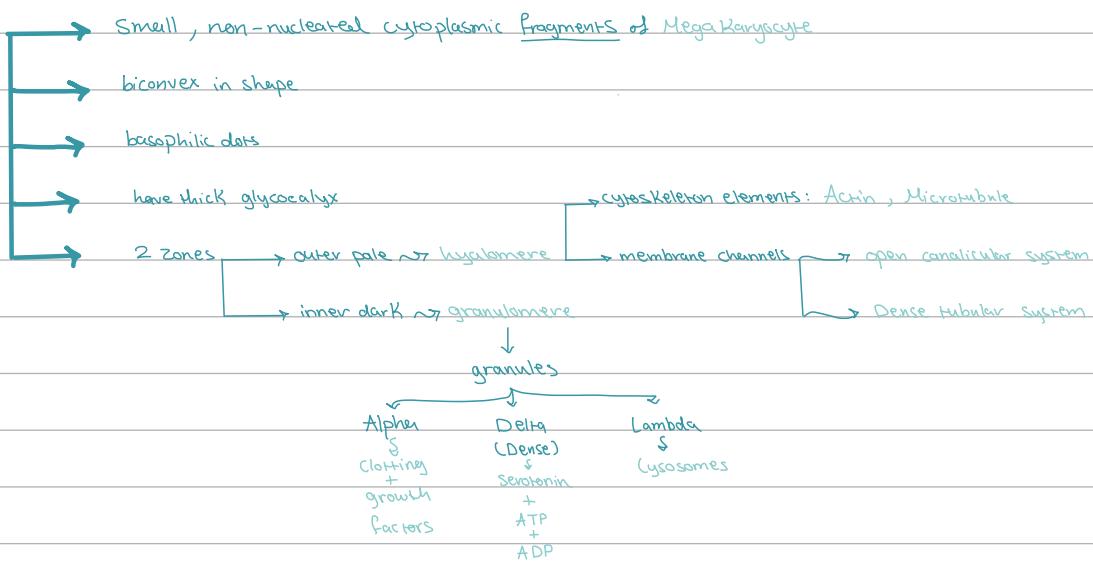
- Cytotoxic T cells → recognize Ag on MHC-1

TCR → Ag  
CD8 → MHC-1 lead to proliferate, activate release perforins (pores) + granzymes (apoptosis)

- T Helper cells → recognize Ag on MHC-2 on APC

TCR → Ag  
CD4 → MHC-2 lead to APC release IL-1 activate T-helper cell  
and T cell division  
cytotoxic T cell      dendritic cell  
if Ag → virus      if Ag → Bacteria

## Platelets (Thrombocytes)



# Hematopoiesis

Hematopoiesis → Blood Cell Formation

Sites of hematopoiesis

1. yolk sac

2. Liver + Spleen

(extramedullary hemopoiesis)

3. bone marrow

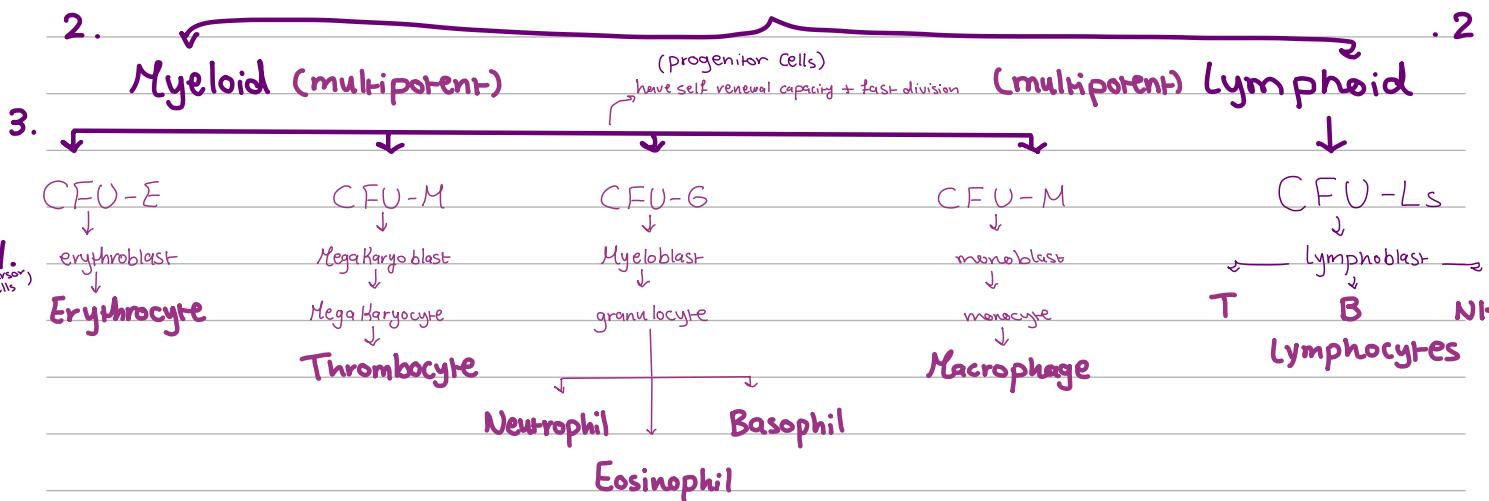
{ (medullary hemopoiesis)

Red bone marrow

- Hematopoietic Stem cells
- Macrophages
- Sinusoidal capillaries → discontinuous basement membrane
- reticular tissue for support. (stroma)
- small number of adipocytes

1. Hematopoietic Stem Cells  
(HSC) (pluripotent)

← have self renewal capacity + slow rate of division

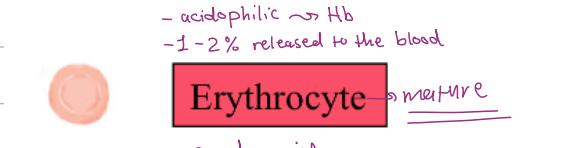
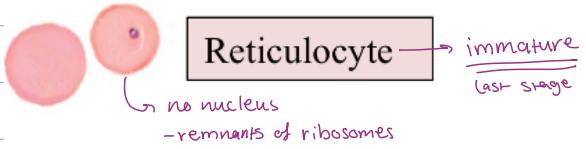
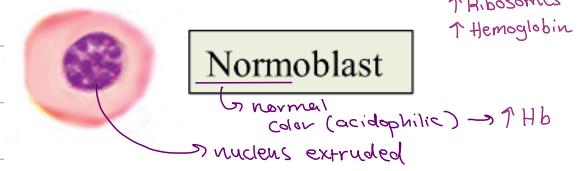
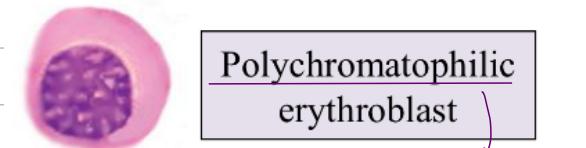
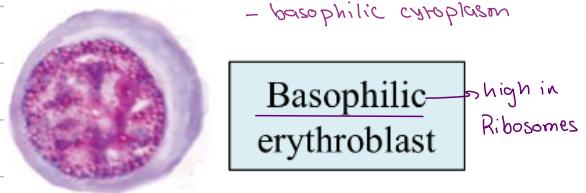
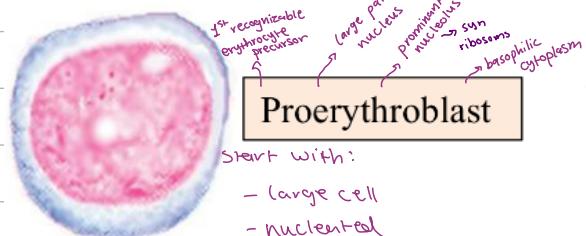


# 1. Erythropoiesis

- takes about 1 week

- rate is controlled by erythropoietin, and availability of iron, B<sub>12</sub>, folic acid, precursor proteins

## • Steps



end with:

- small cell
- no nucleus
- acid cytoplasm

Nuclear maturation  
Condensation & disappearance  
Synthesis of hemoglobin

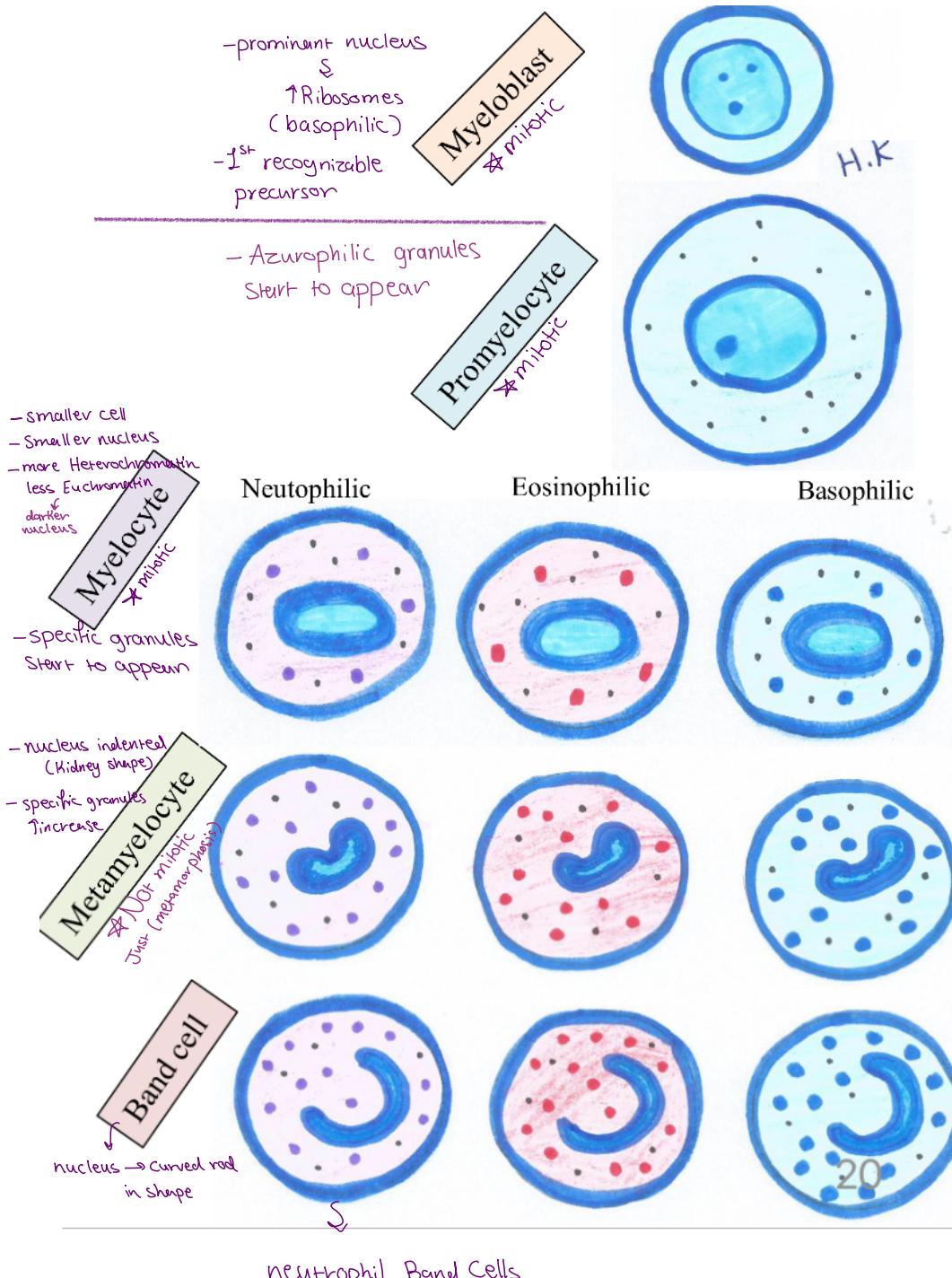
Cytoplasmic maturation  
more acidic

## 2. Granulopoiesis

- takes about 2 weeks

- Stages

→ cytoplasmic changes → synthesis of granules [specific / non specific / Azurophilic]  
 → Nuclear changes → Condensation + Segmentation of the nucleus (lobulation)



- should not exceed 5% in blood

Immature neutrophil Band Cell, can indicate Bacterial infection

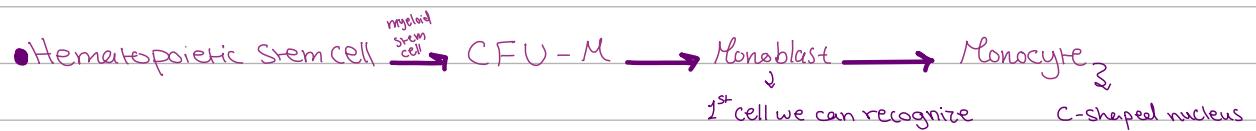
- After Condensation + Segmentation of nucleus of Band Cells

Mature Lymphocytes

### 3. Thrombopoiesis



### 4. Monocytopoiesis



### 5. Lymphopoiesis

