Chapter 5
Blood and hemopoiesis

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Component：red and white blood cells, platelet and plasma

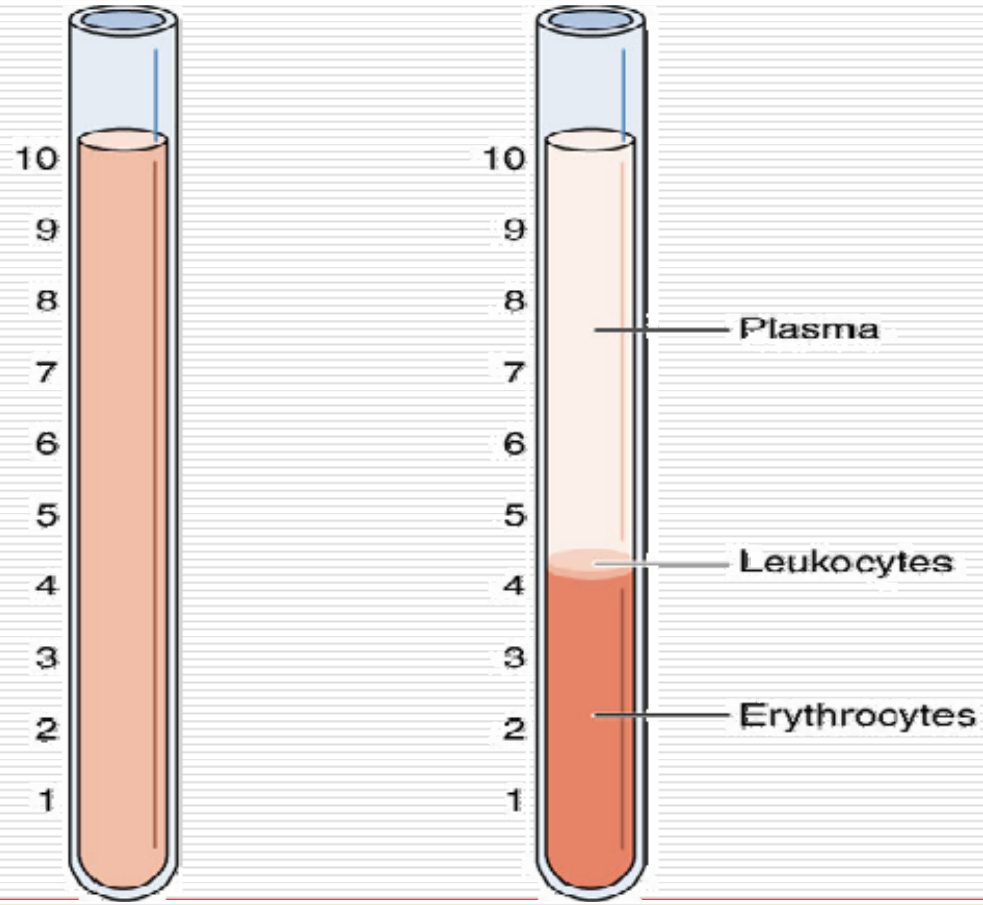
Plasma：90% water, plasma protein et al

Function: circulatory fluid, maintain microenvironment of cells

Serum：

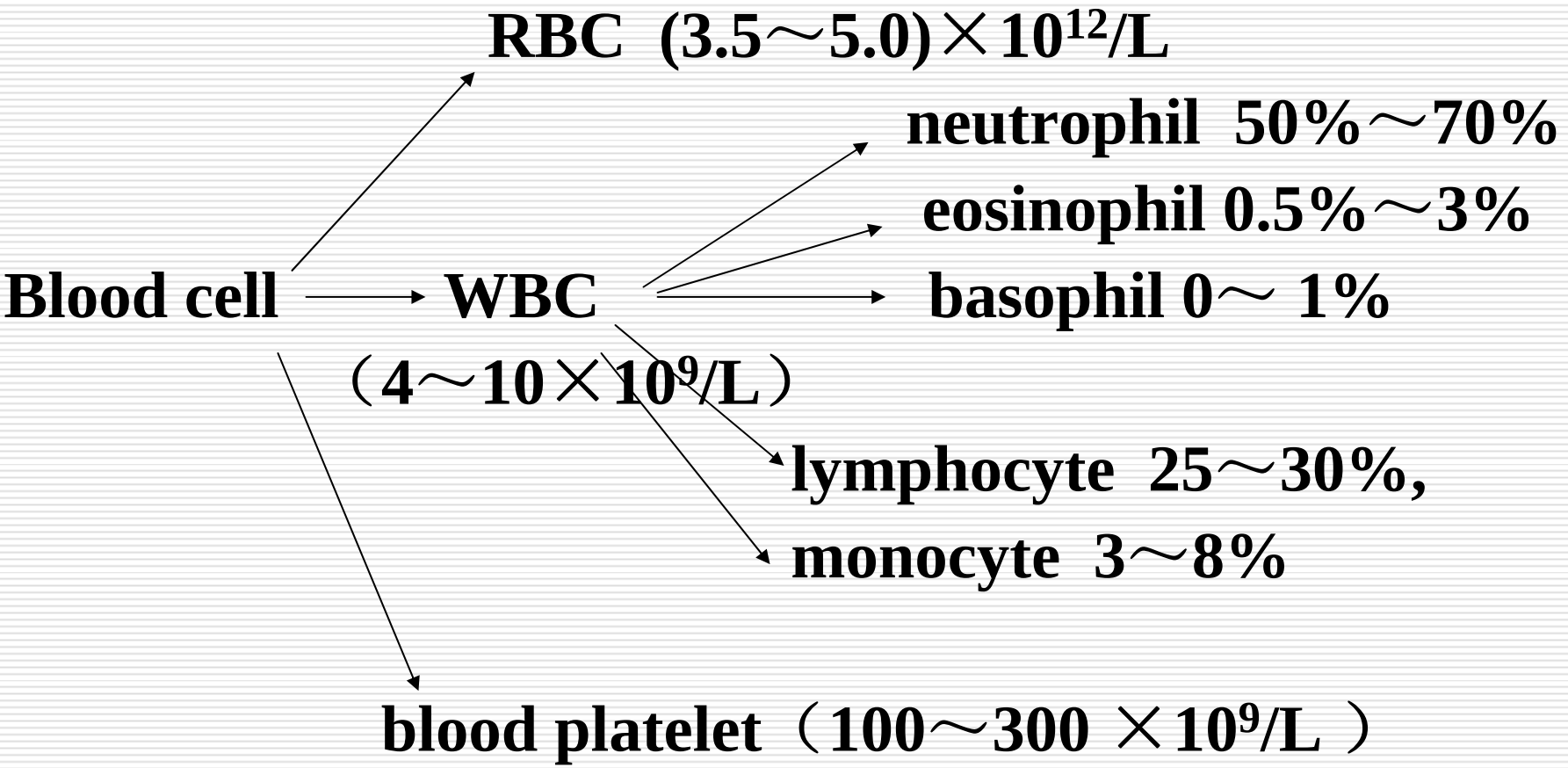
Blood picture：examination of morphology, quantity and percent of blood cells and content of Hb

Separation of blood cells



Classification of blood cells

（Wright or Giemsa staining）



Ⅰ. Erythrocyte (red blood cell)

LM： 7.5 μ m, biconcave disk shape cell, without nuclei and organelles, filled with hemoglobin (Hb)

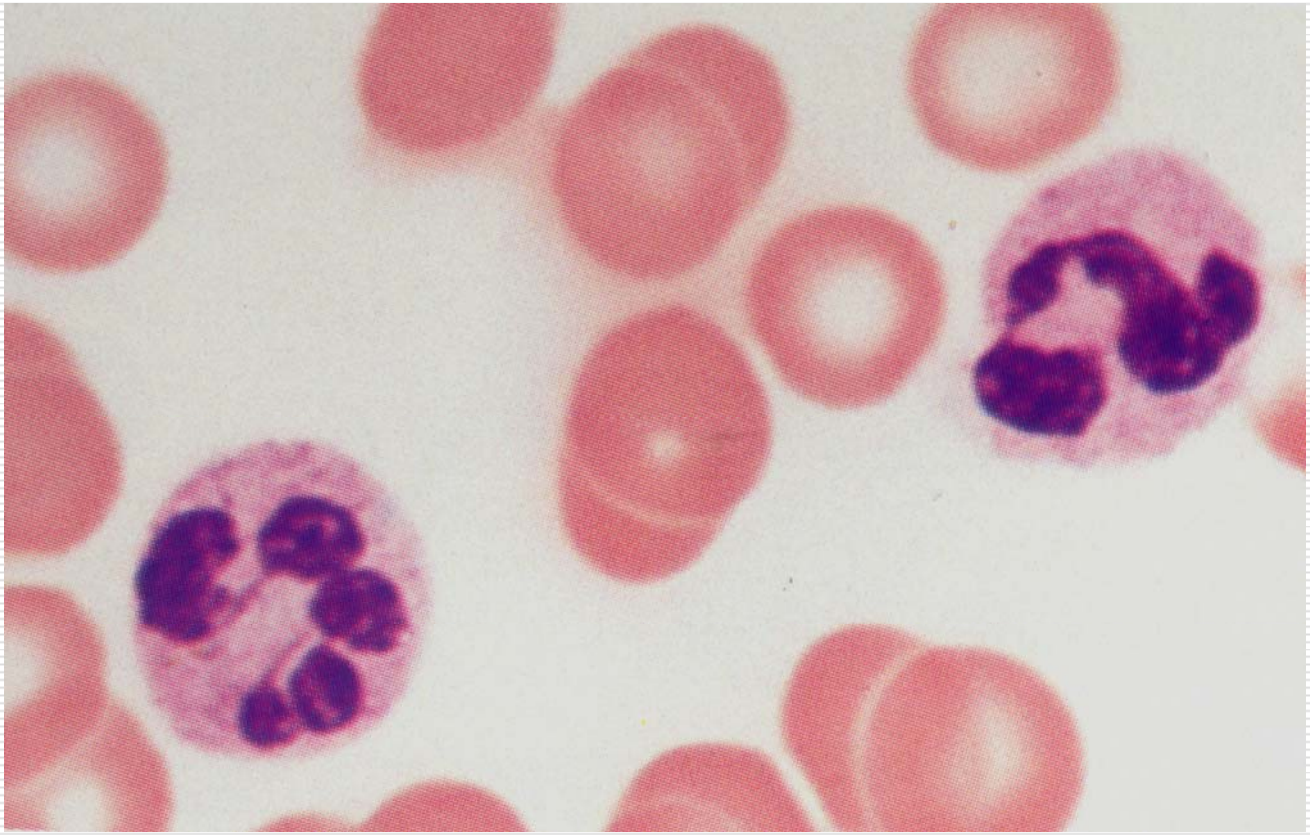
Hemoglobin: 120~150g/L (male)

110~140g/L (female)

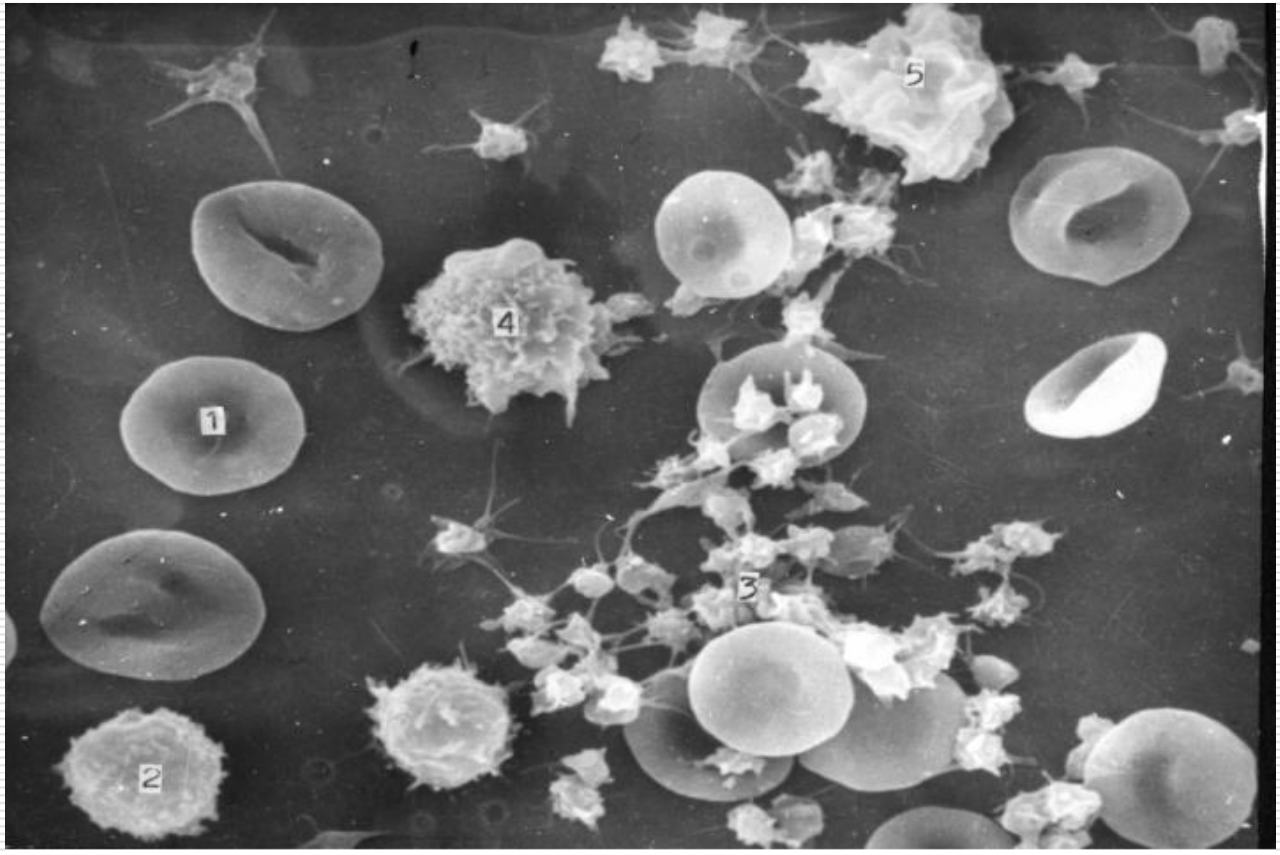
＜100 g/L anemia

- **Hb is a protein-containing Fe and functions to blind and transport O_2 and CO_2.**

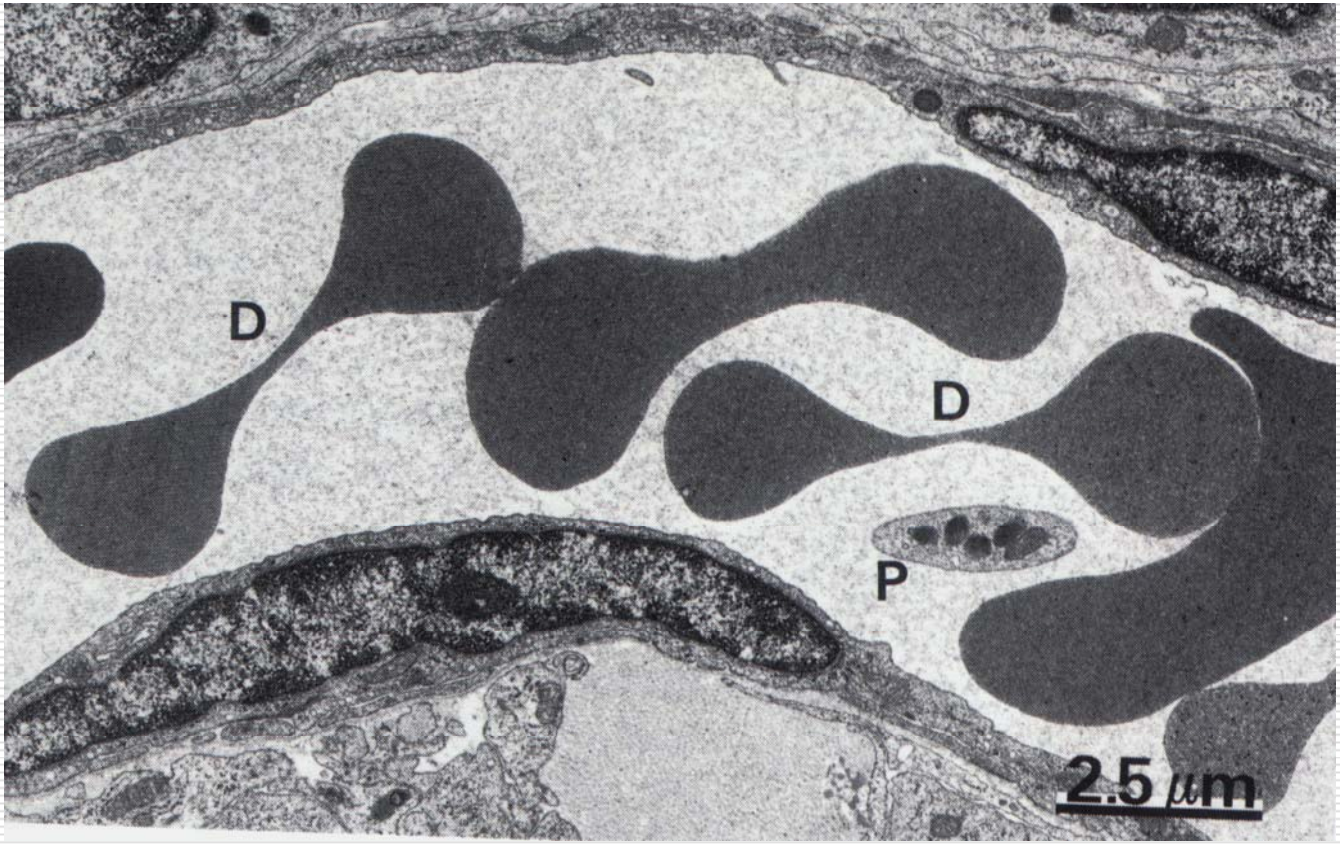
RBC and neutrophil（LM）



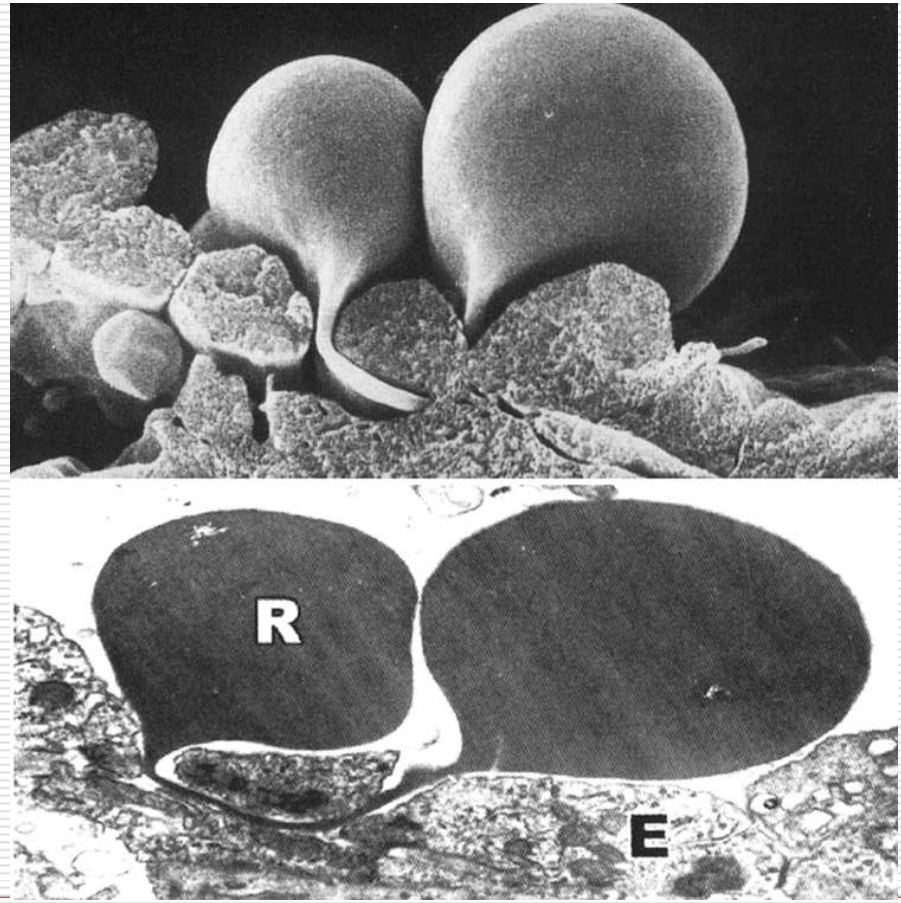
RBC and blood platelet（SEM）



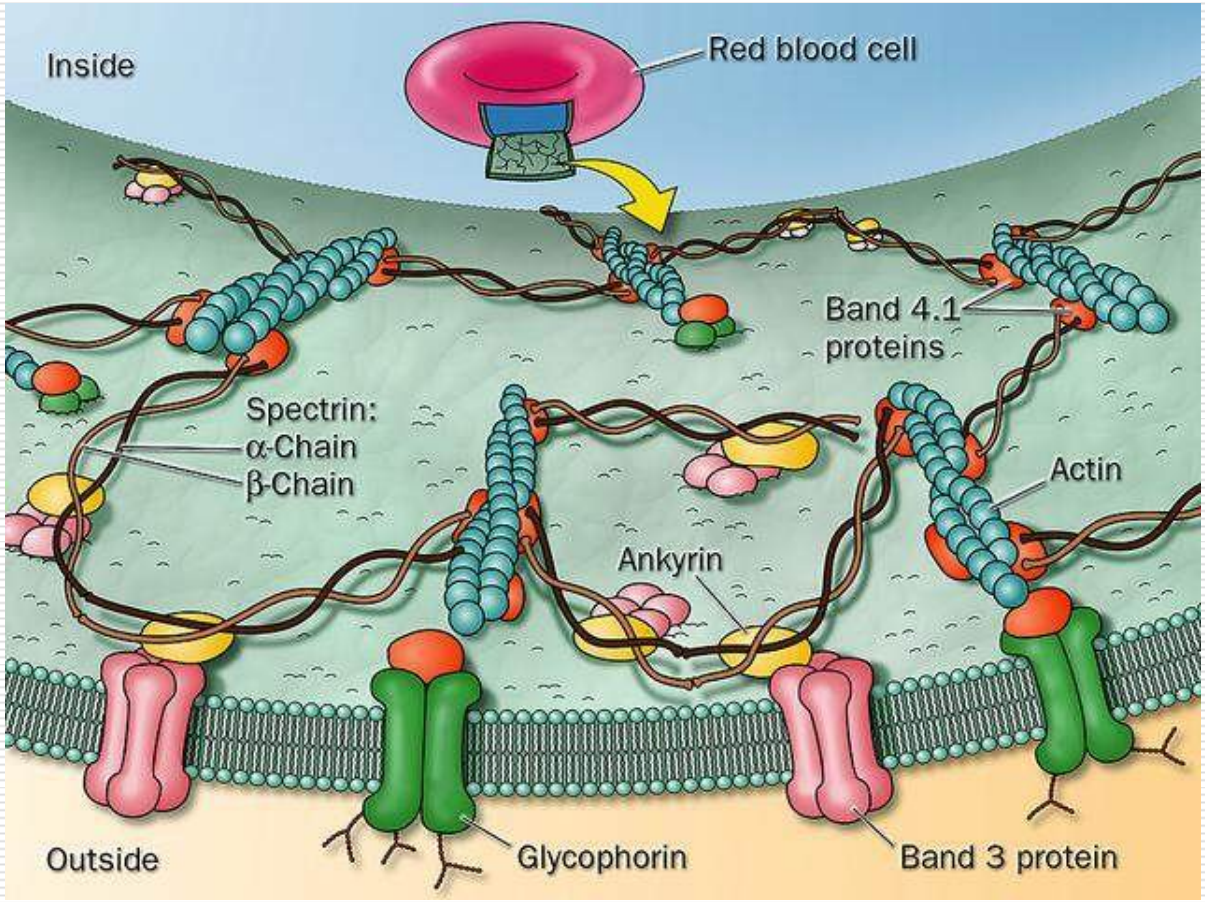
Plasticity of RBC



红细胞的可塑性



红细胞骨架蛋白


Inside
Red blood cell
Band 4.1
proteins
Spectrin:
α-Chain
β-Chain
Actin
Ankyrin
Outside
Glycophorin
Band 3 protein

Characters: ① elasticity, plasticity

spectrin and actin (erythrocyte membrane skeleton)

② ABO blood type antigen

③ hemolysis

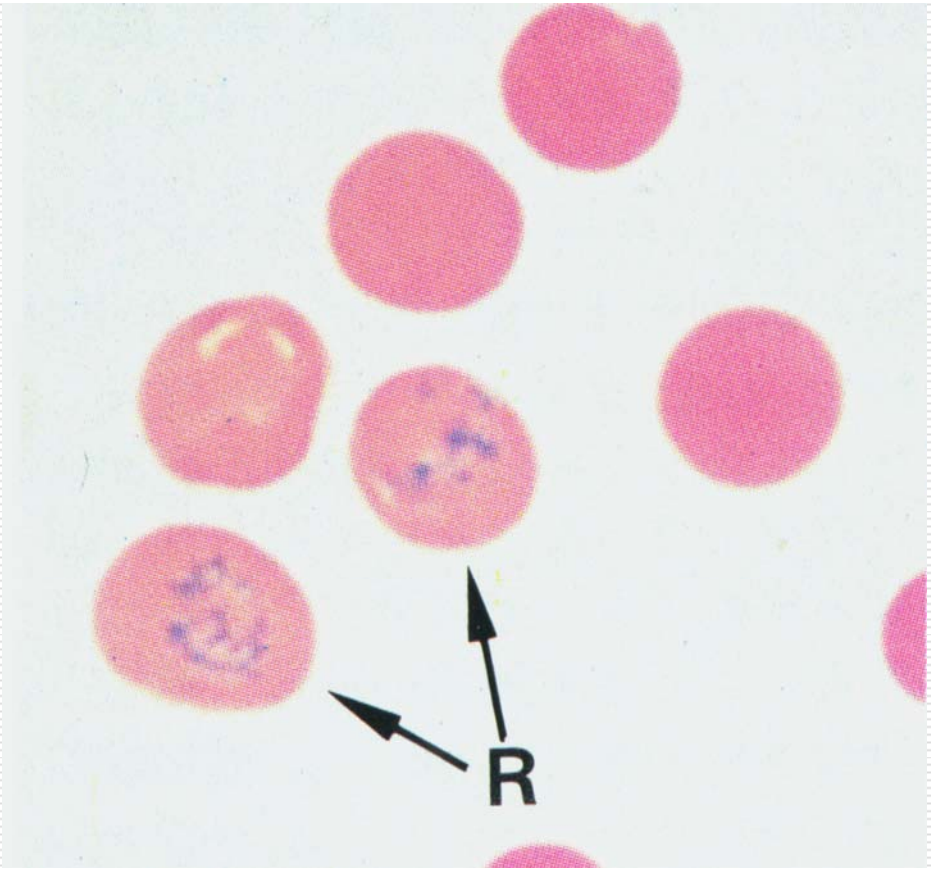
Lifespan：120 days

Reticulocyte：residual ribosome

Percent：Adult 0.5%～1.0%

infant : 3%-6%

Reticulocyte

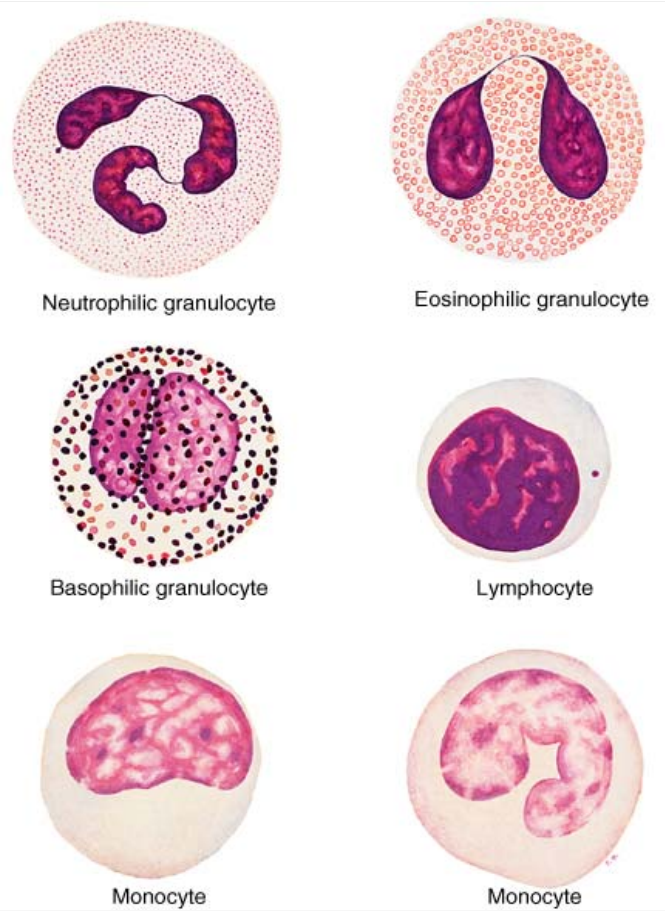


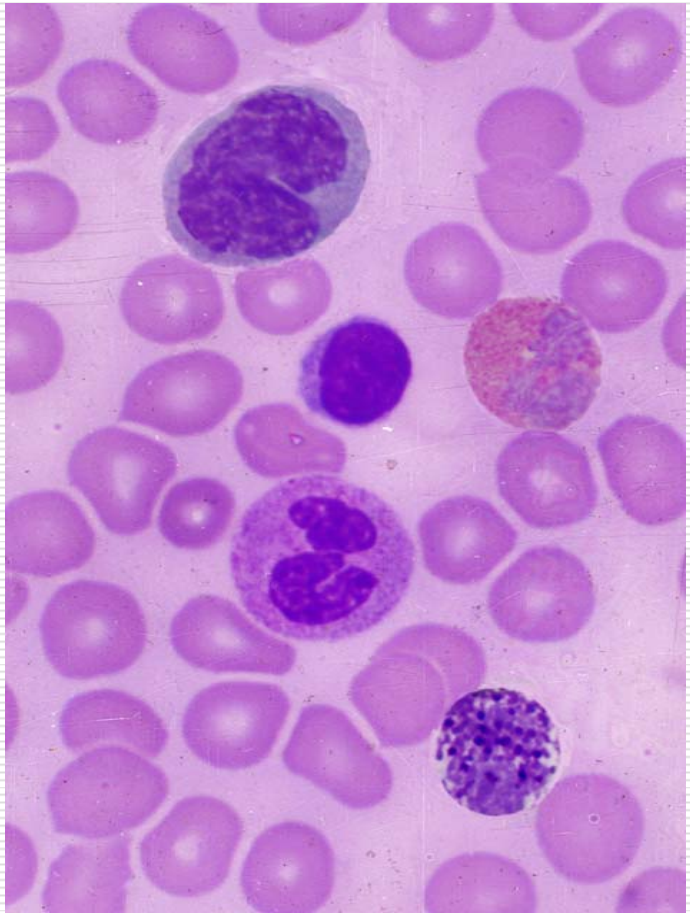
Ⅱ. Leukocyte (white blood cell)

Classification of leukocyte

- Granulocyte
  - neutrophil
  - basophil
  - eosinophil
- Agranulocyte:
  - monocytes
  - lymphocyte

WBC of model（LM）





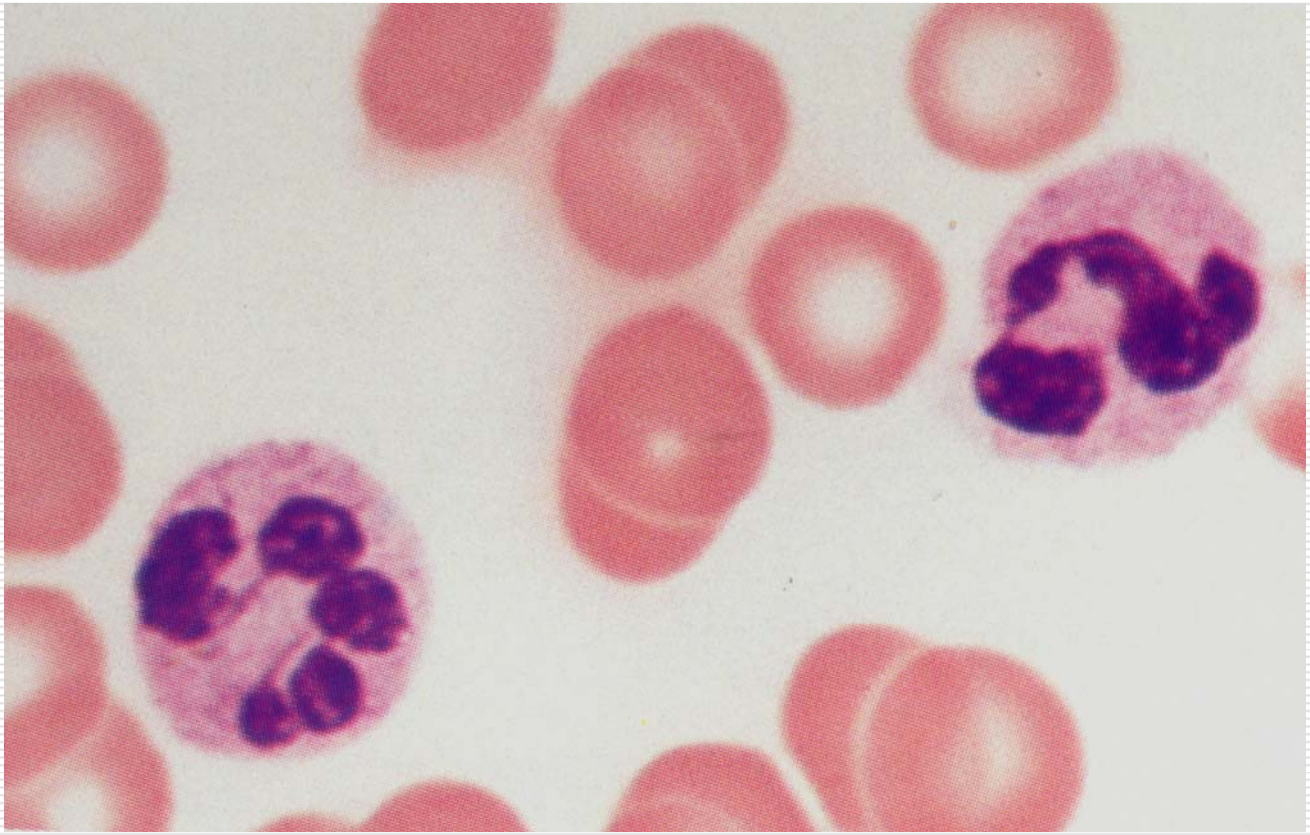
1. Neutrophilic granulocyte (neutrophil)

Percent: 50%～70%

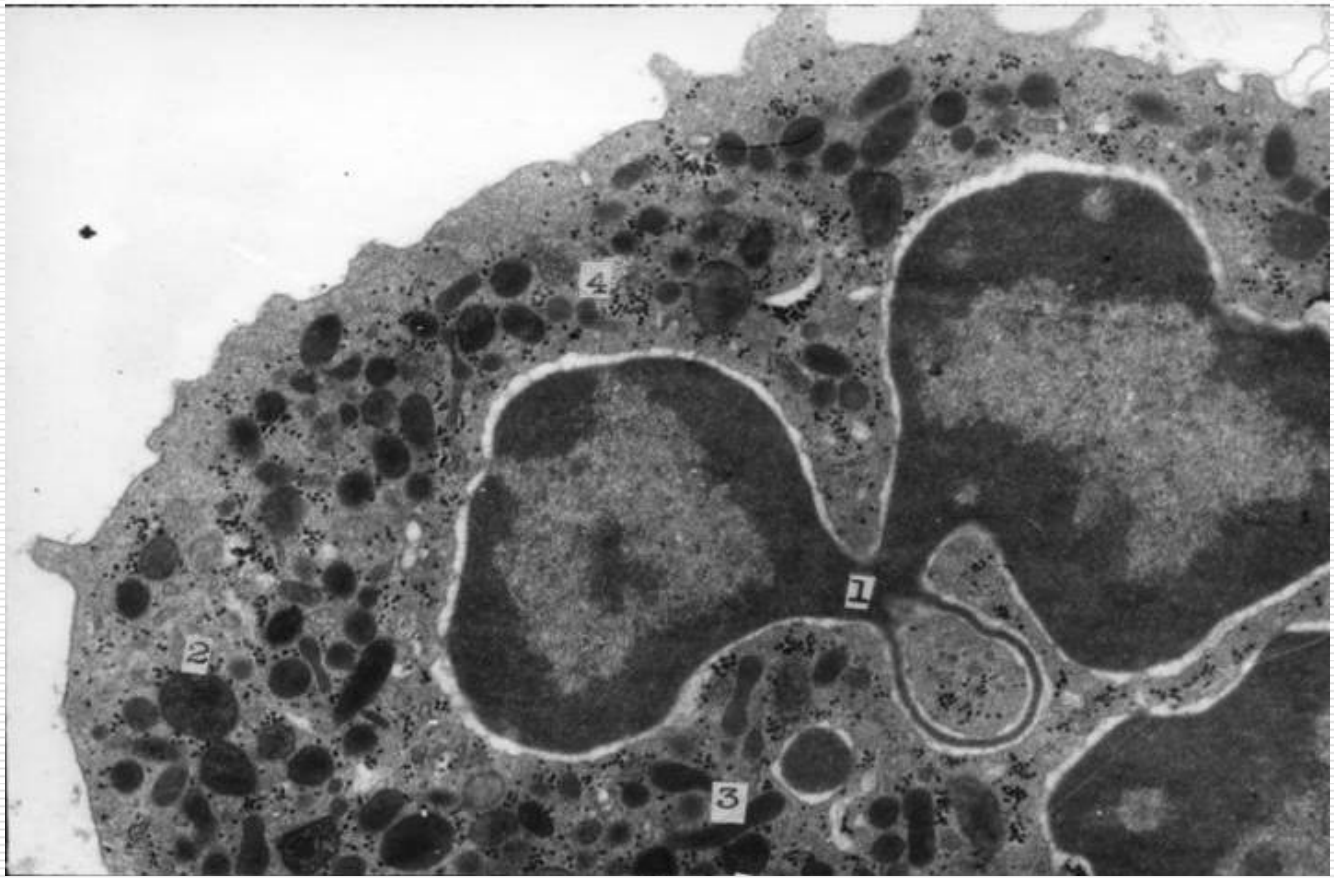
LM: sphere shape cell (10～12 μm)

2 ~ 5 lobes of nucleus interlinked by a fine thread chromatin, pink-staining cytoplasm containing fine granules

RBC and neutrophil（LM）



Neutrophil（TEM）



Nucleus left migration

Nucleus right migration

EM：two kinds of granules：

① larger and electron-dense azurophilic granules (lysosome) ,containing alkaline phosphatase and peroxidase

② smaller irregularly-shaped and electron-medium specific granules ,containing phagocytin and lysozyme

Function: emigration from blood vessles to phagocytose bacteria and foreign bodies, and form the major components of pus

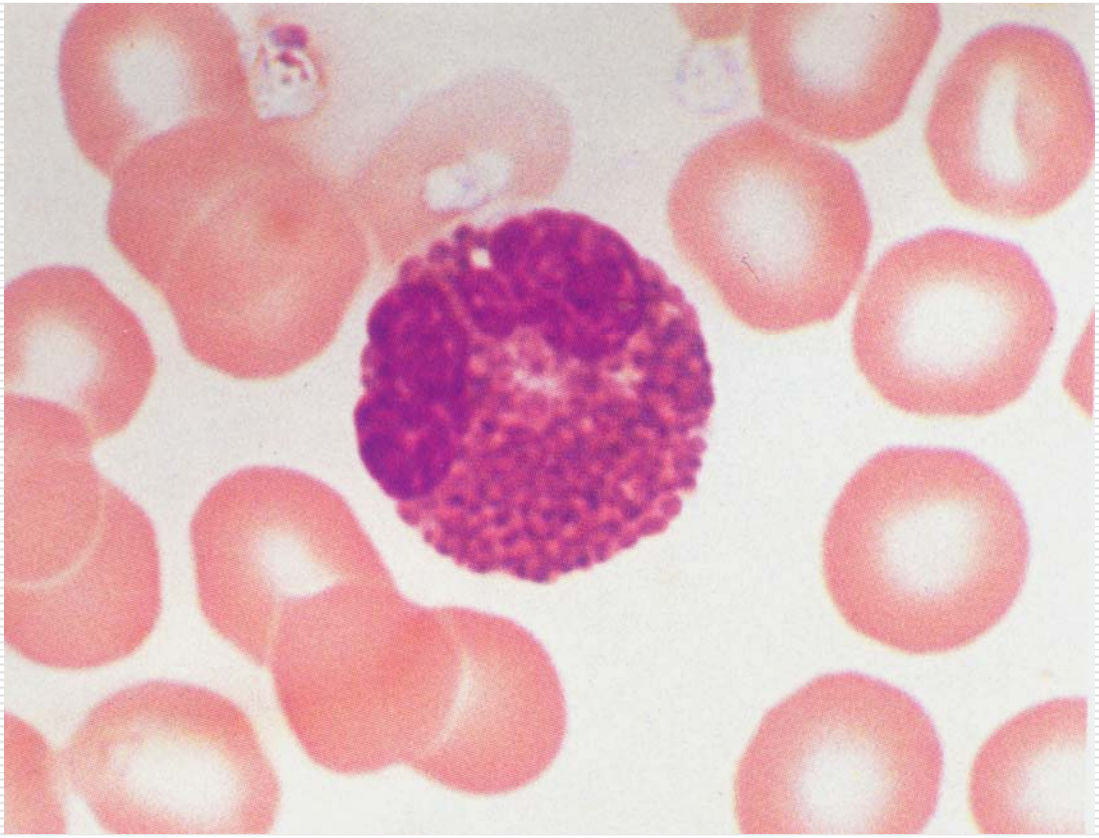
Lifespan: 1~3 days

2. Eosinophilic granulocyte (eosinophil)

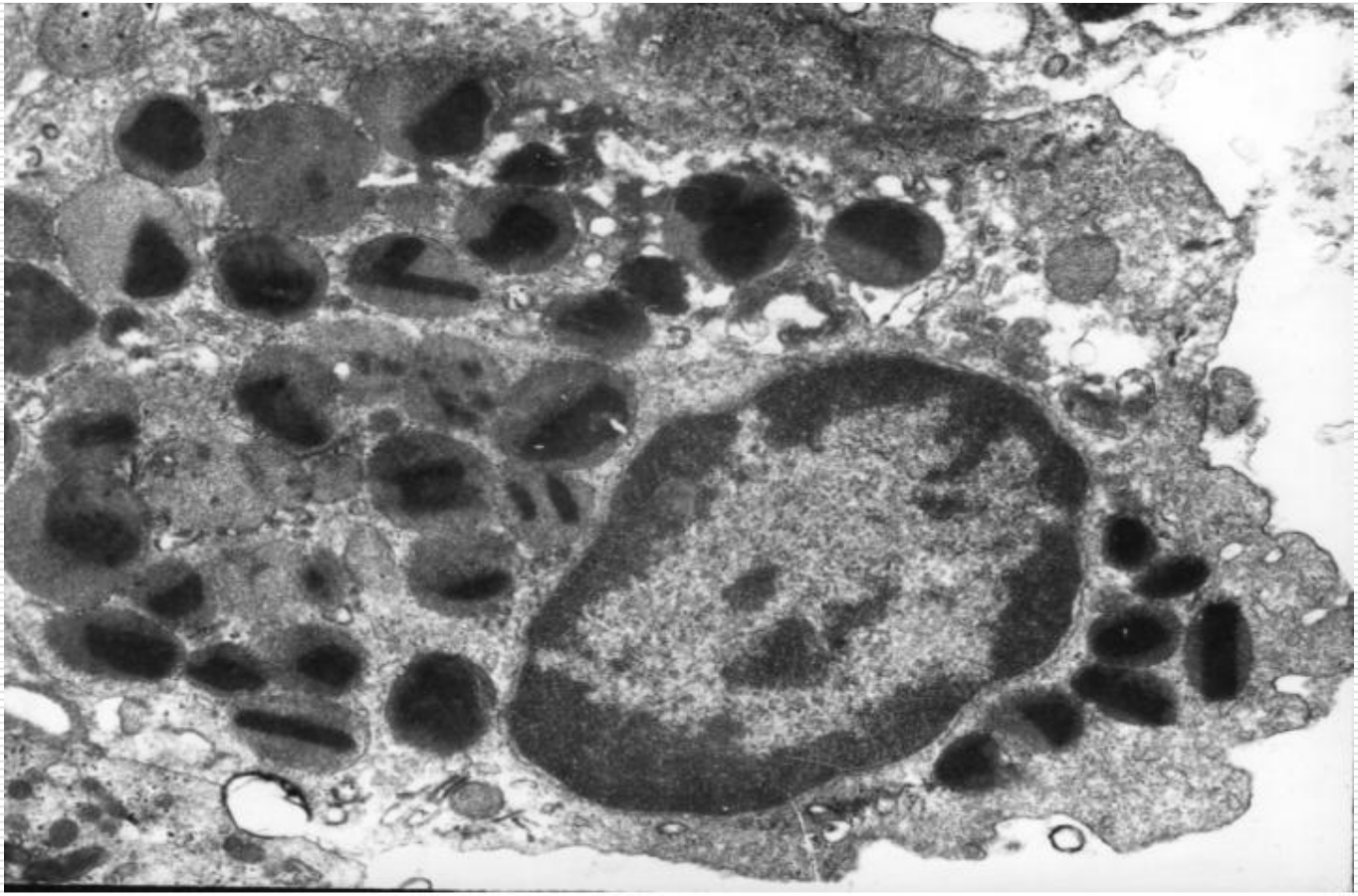
LM：sphere shape cell (10～15 μ m), The usually two lobes of nucleus and the cytoplasm filled with eosinophilic granules

EM：The granules surrounded by a unit membrane and an elongated crystalloid core inside, containing histaminase and arylsufatase

Eosinophil（LM）



Eosinophil （TEM）



Function: to break down the histamine and leukotrienes

to participate in the body against parasitic infections and allergic reaction

Lifespan: 8~12 days

3. basophi1ic granulocyte (basophil)

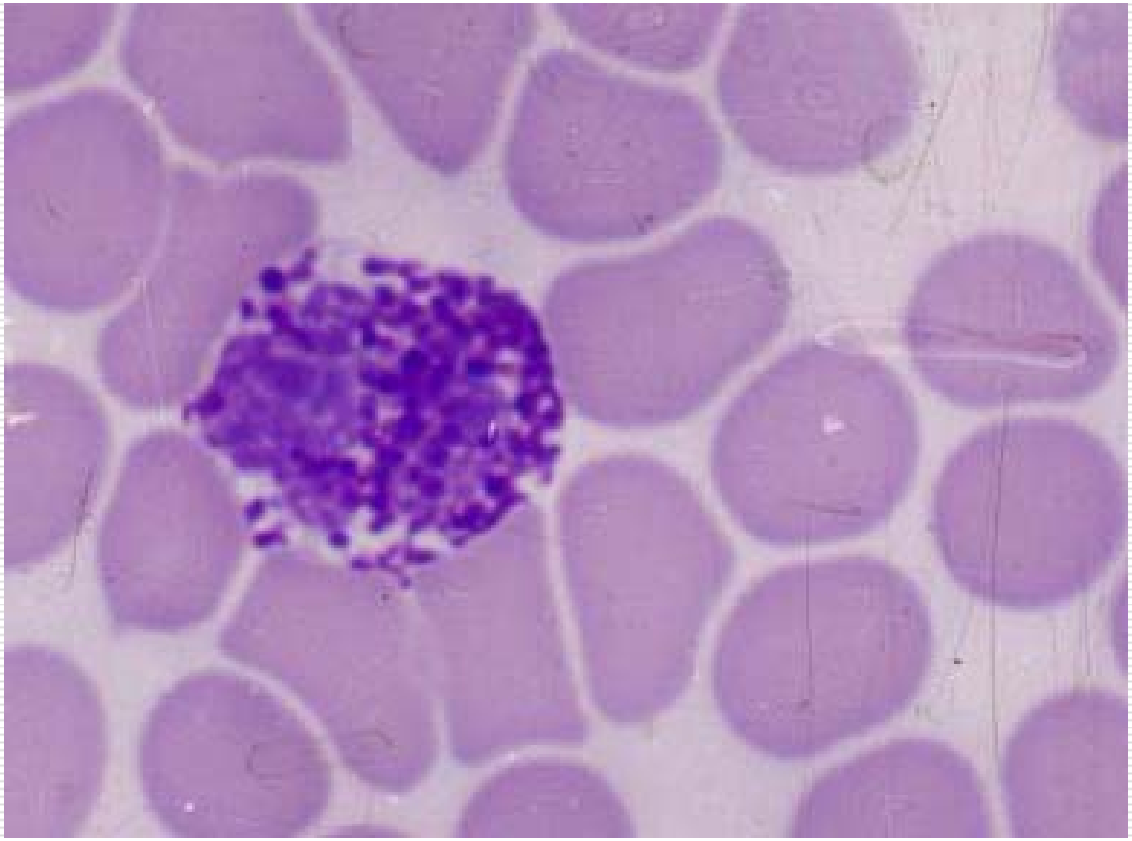
LM： sphere shape (10～12 μ m), S-shaped irregular nucleus, large basophilic granules in cytoplasm

EM： electron-dense the granules bounded by a membrane, containing heparin, histamine and leukotrienes

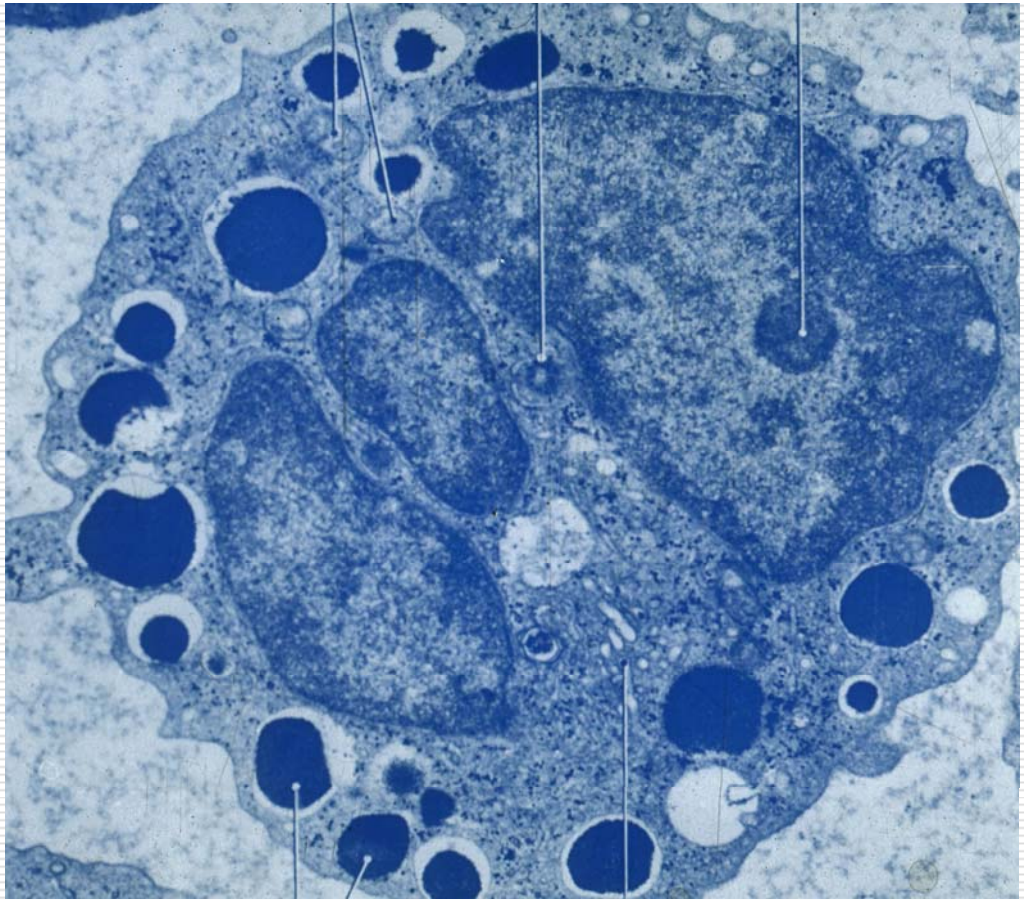
Function: to participate in allergic and inflammatory reaction

Lifespan:12～15 days

Basophil（LM）



Basophil （TEM）

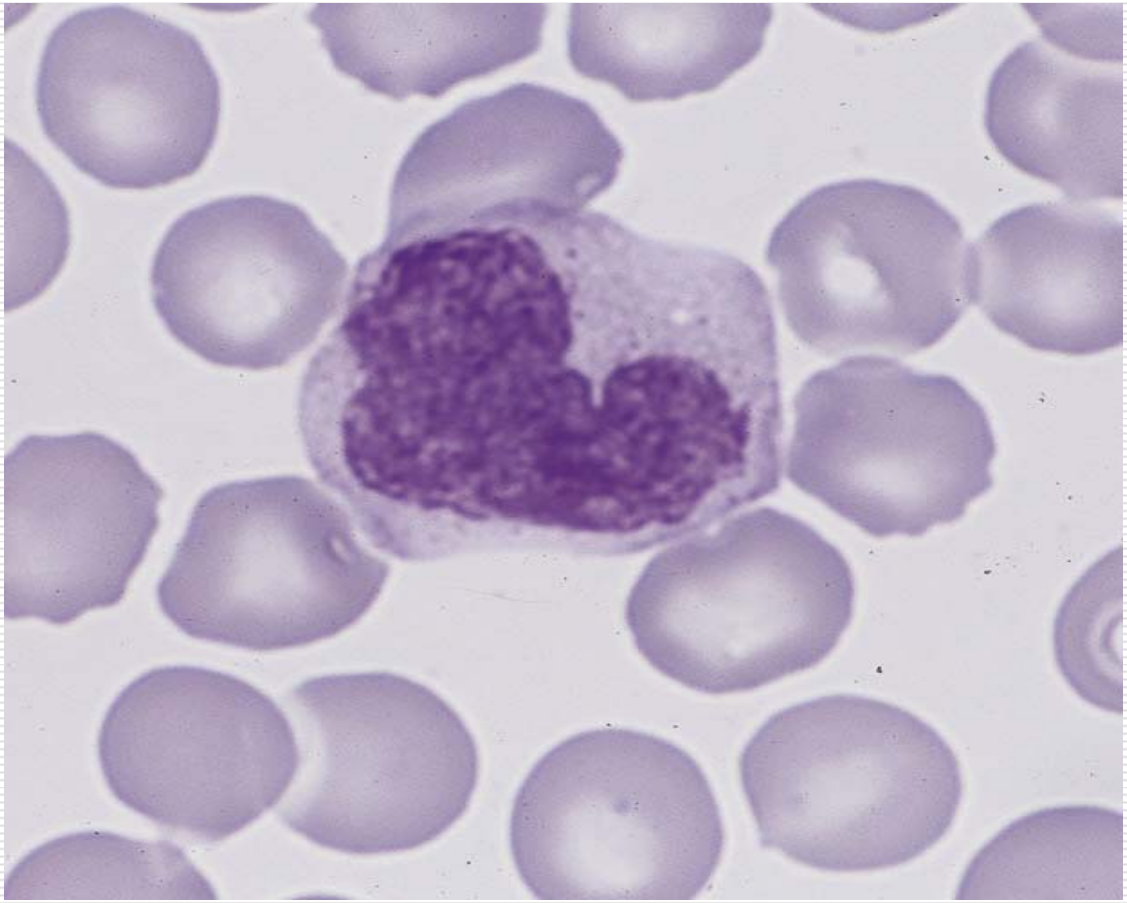


4. Monocyte

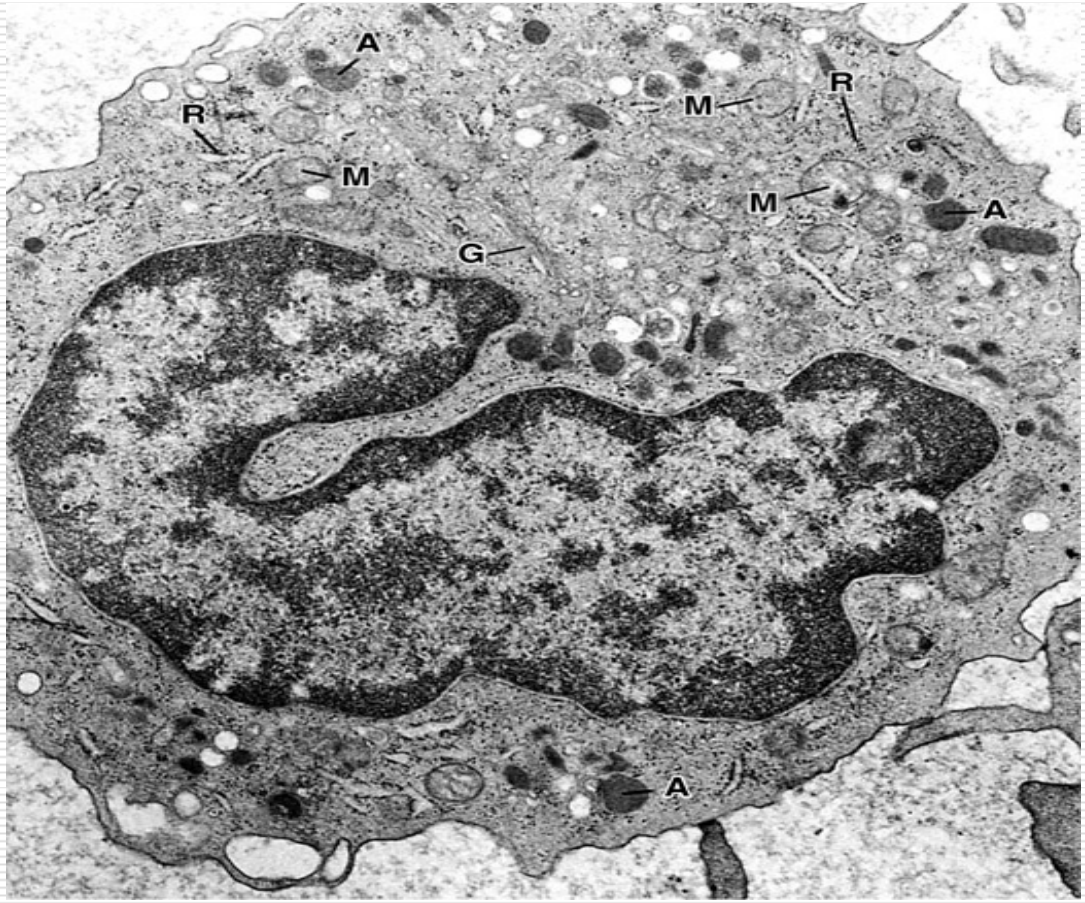
LM： 14～20 μ m, oval, horseshoe, or kidney-shaped nucleus, a delicate network-like chromatin, basophilic cytoplasm

EM： many fine azurophilic granules, some rough endoplasmic reticulum, few free ribosomes

Monocyte（LM）



Monocyte （TEM）



Function：penetrate into the connective tissue, and differentiate into macrophage, the liver, and Kupffer cell, the nerve tissue, and microglial cell

Lifespan：2 months or more

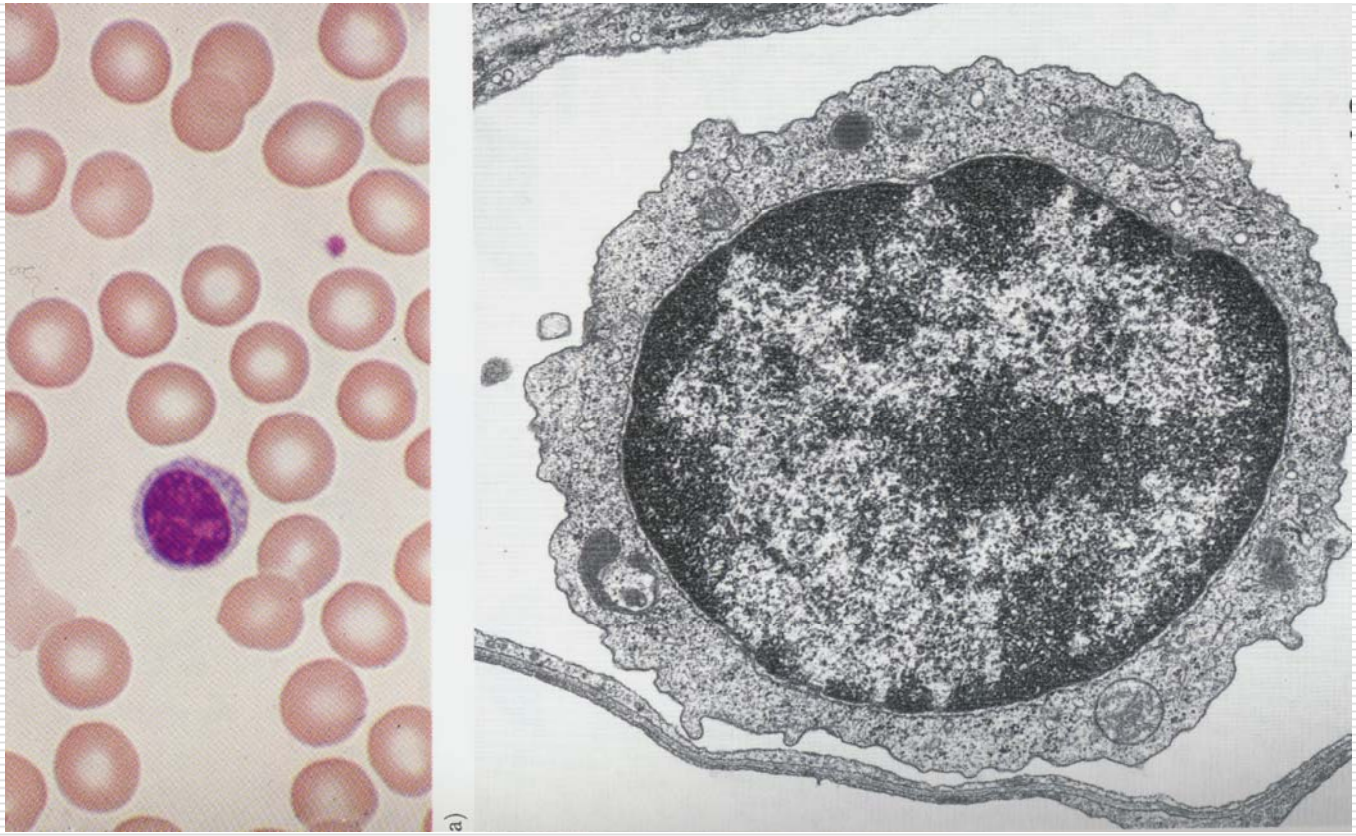
5. Lymphocyte

LM：sphere shape and small, medium and large kinds of cell, slightly basophilic cytoplasm, spherical nucleus, condensed chromatin

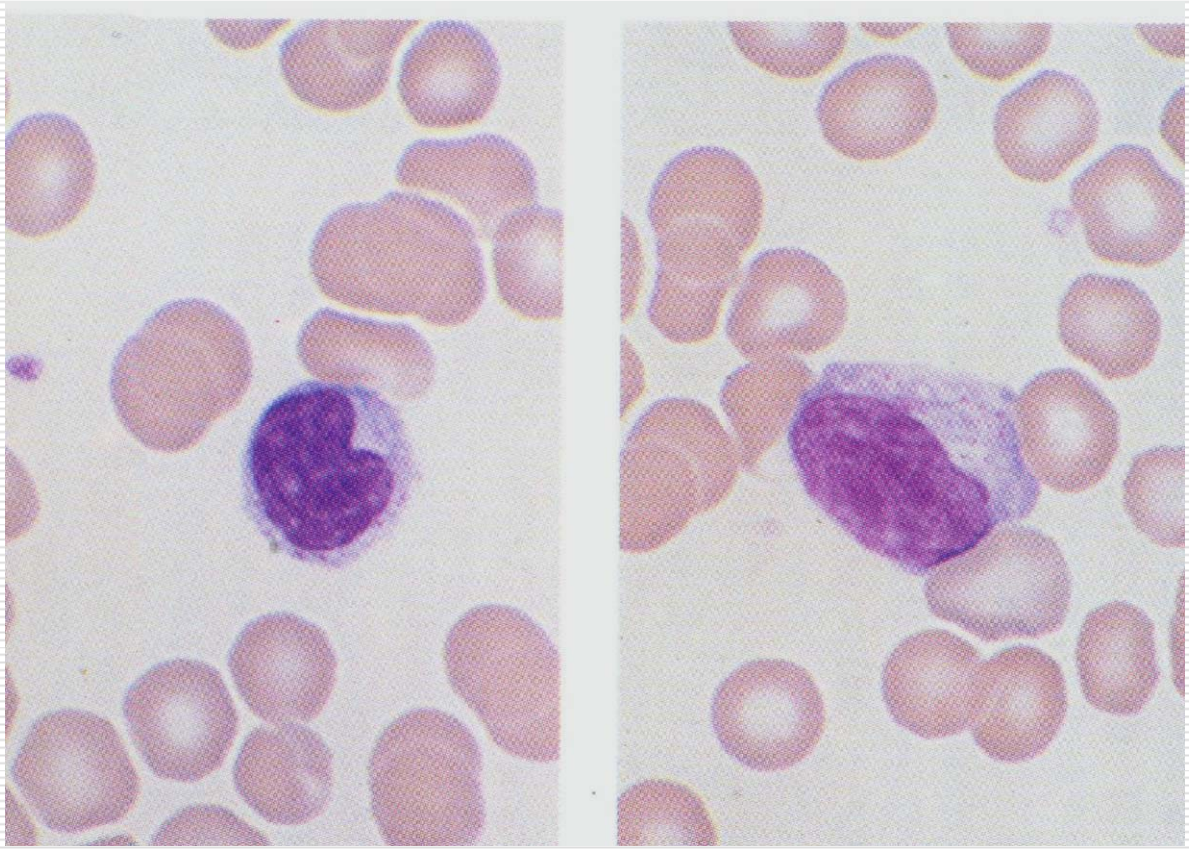
EM: azurophilic granules, few organelles, many free ribosomes

Function: provide the body with an immunological defense

Small lymphocyte（LM and TEM)



Large lynphocyte and monocyte（LM）

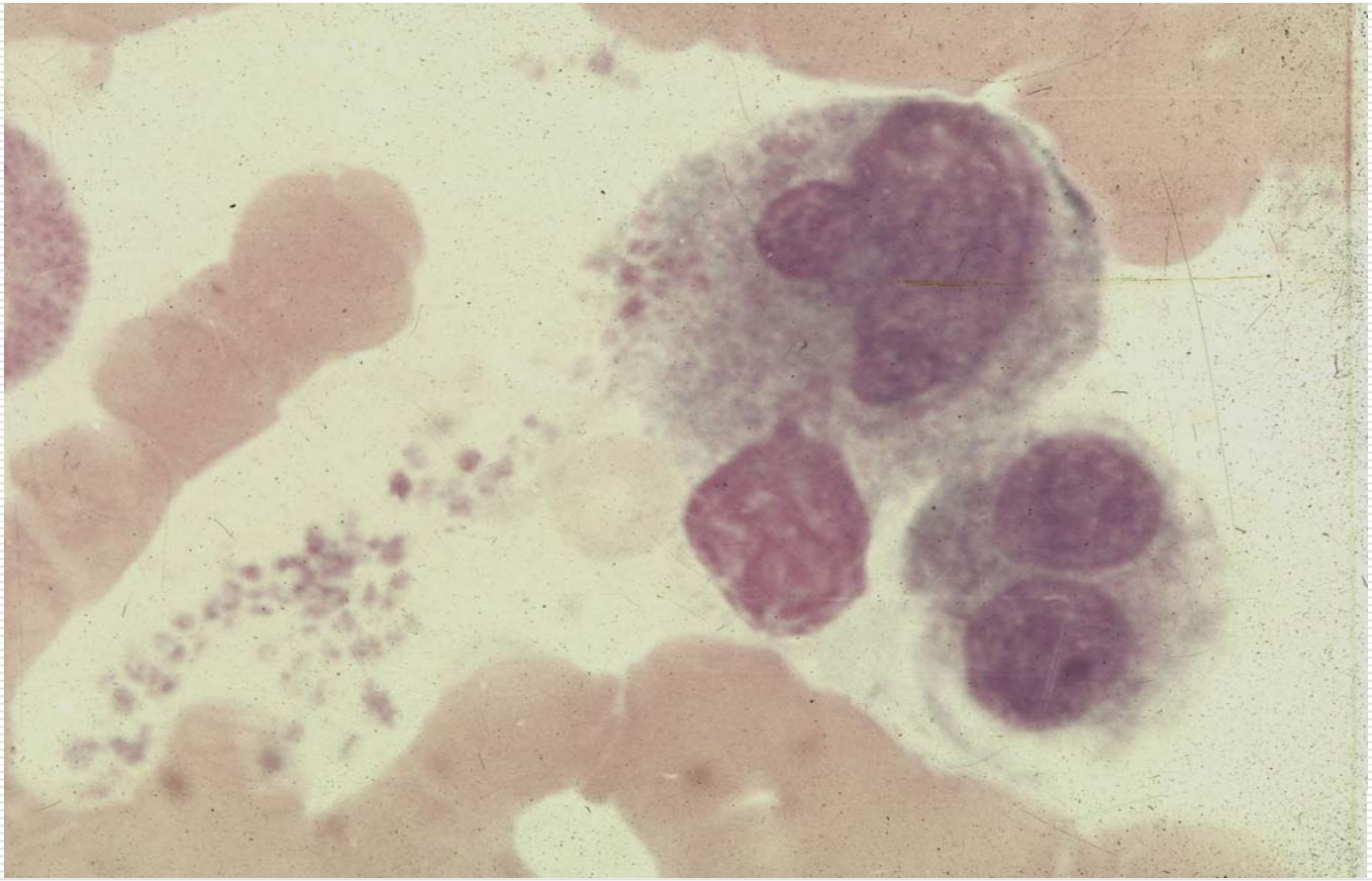


Ⅲ. Blood platelet

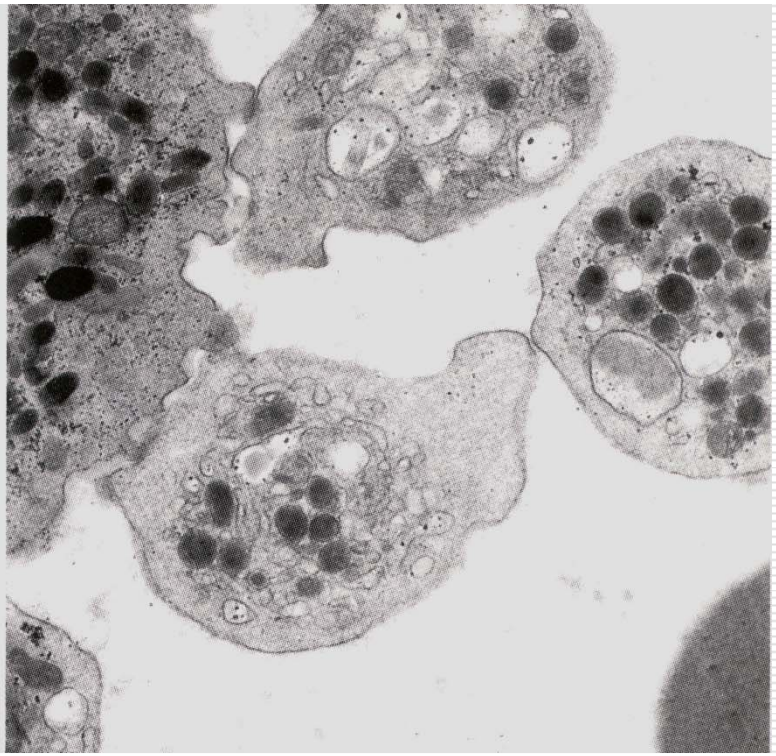
- So call thrombocyte
- Origin: cell fragments anucleated by cytoplasm of megakaryocyte in the bone marrow

LM： 2～4 μ m, basophilic cytoplasm including granulomere and hyalomere

Megakaryocyte（LM）



Blood platelet（LM and TEM)



EM：specific granule: platelet factor Ⅳ, platelet derived growth factor, PDGF

dense granule：electron dense core, containing 5-HT、ATP、ADP、Ca2+、NA

open canalicular system, dense tubular system (granulomere)

microfilament and microtubules (hyalomere)

Function: to assist in haemostasis, the arrest of bleeding

Lifespan: 7~14 days

＜50×10^9/L : bleeding

Ⅳ. Bone marrow and hemopoiesis

Metabolism of blood cells

1.Hemotopoietic organ: yolk sac ⟶ liver ⟶ spleen ⟶ bone marrow

- **Erythrocyte system, granulocyte system, monocyte system and megakaryocyte-blood platelet system, lymphocyt system (lymphoid tissue and organ)**

2. The structure of the bone marrow

2.1 Haemopoietic tissues

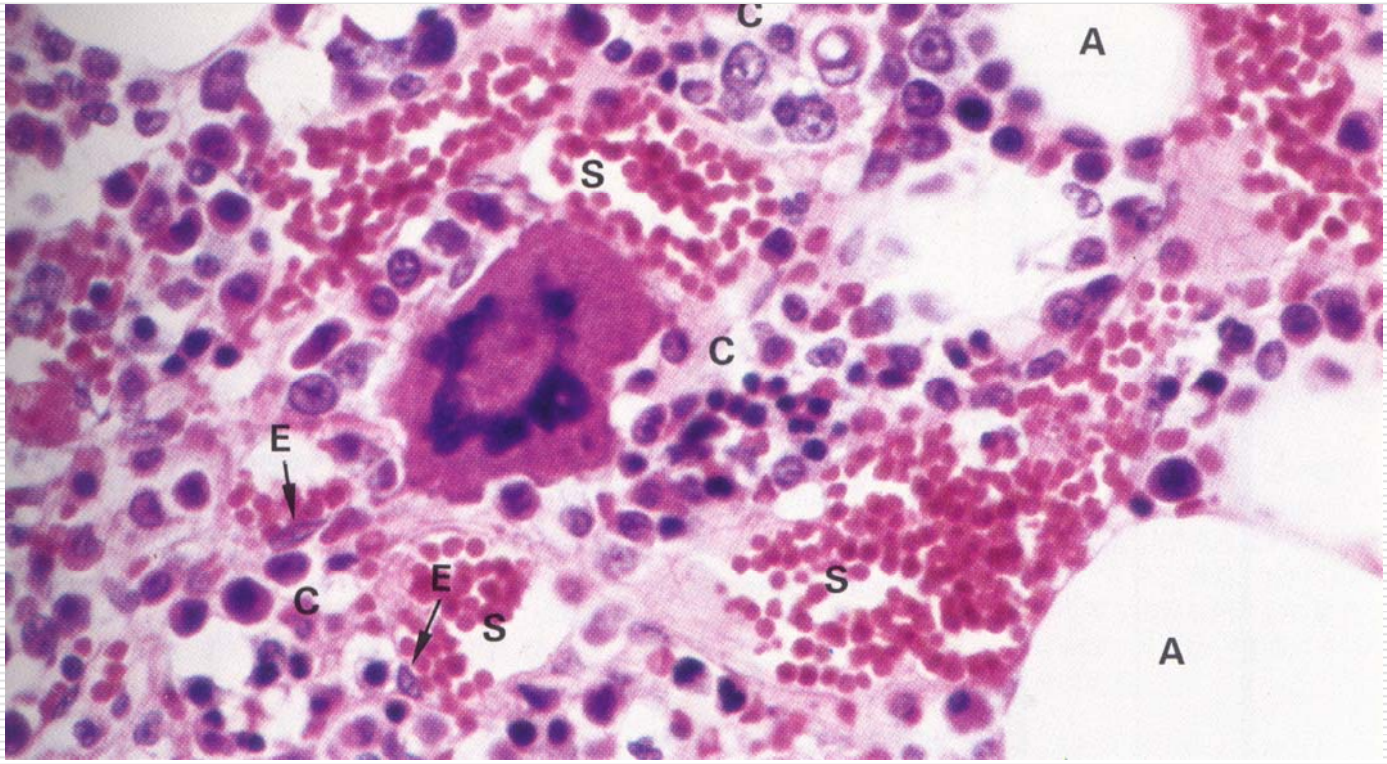
- Organization: reticular tissue, hemopoietic cell and matrix cells
- Hemopoietic inductive microenvironment

macrophage

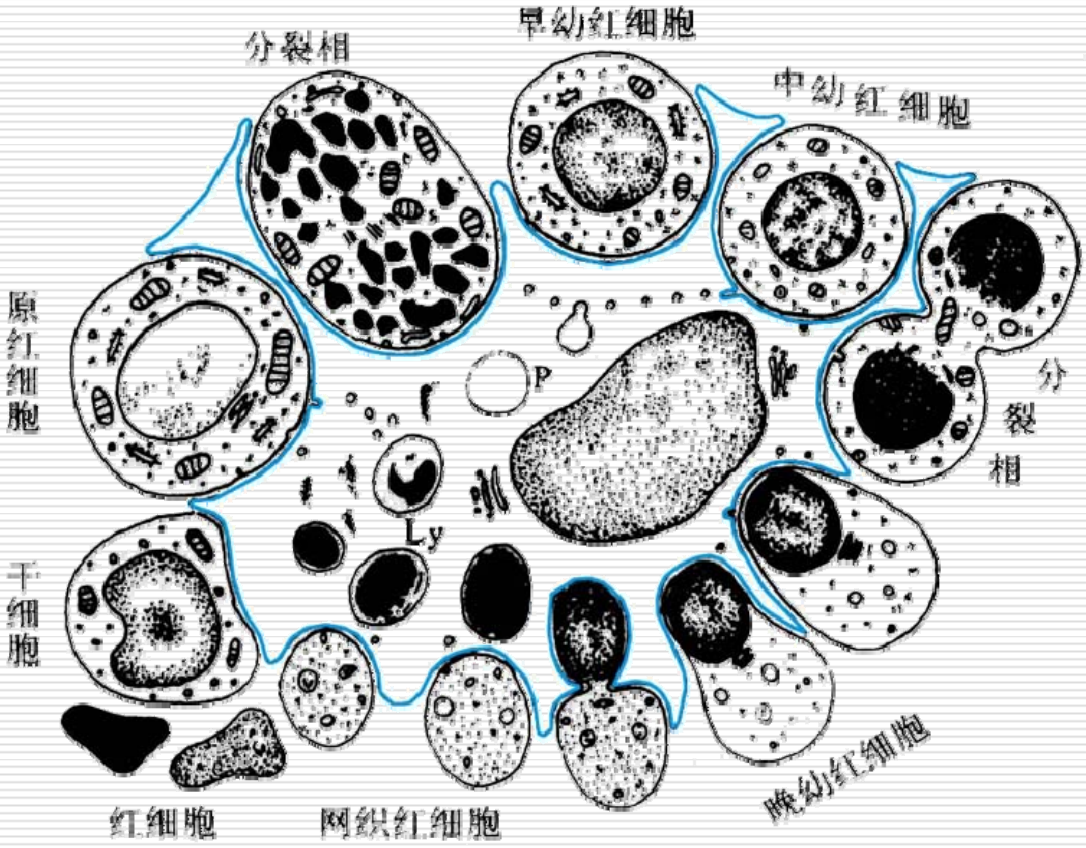
matrix cells { fibroblast , reticular cell
mesenchymal stem cell
endothelium

2.2 Blood sinus

Red bone marrow（LM）



Erythroblastic islet (model)

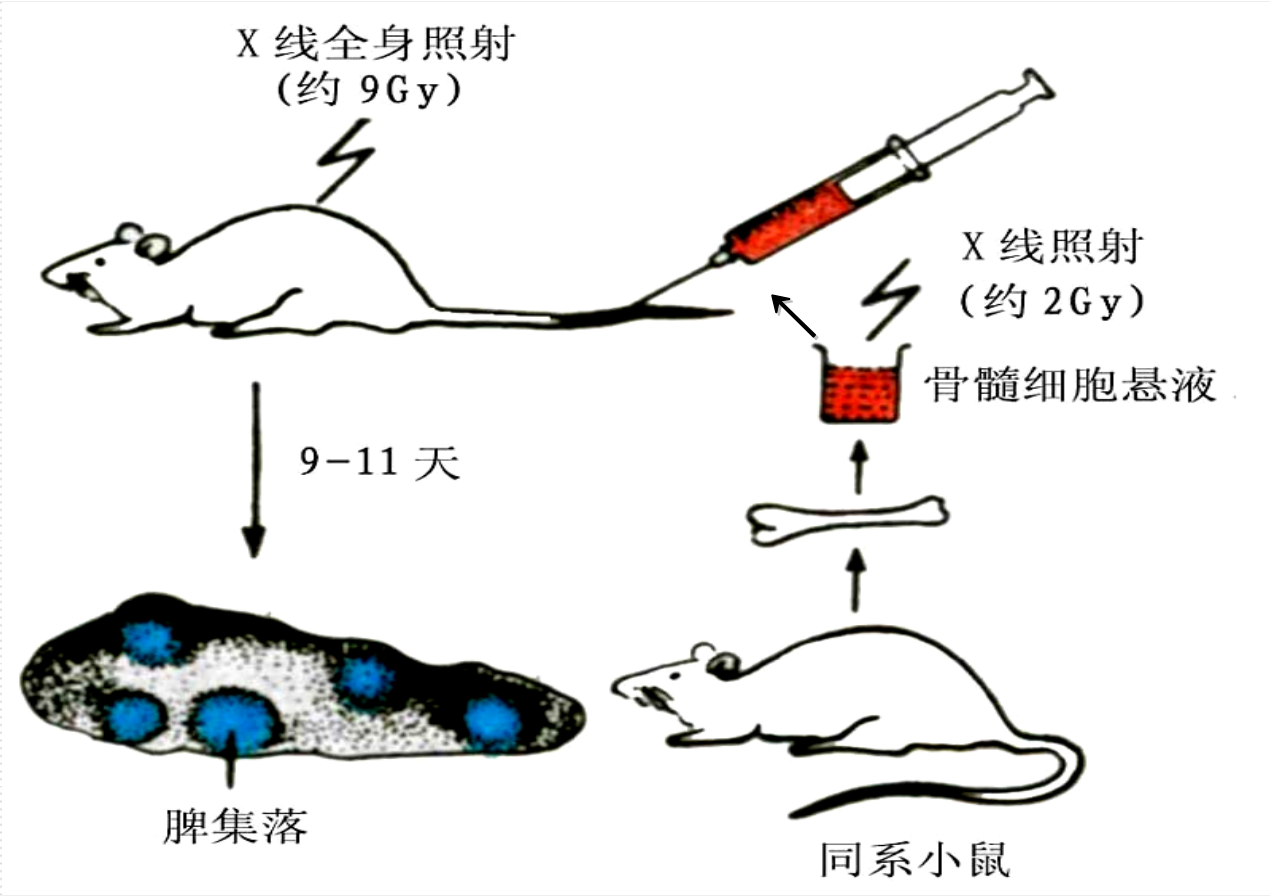


3.Hemopoietic Stem Cell and Hemopoietic Progenitor

(1) Hemopoietic Stem Cells

(2) Hemopoietic Progenitor

Spleen colony



4. Morphous Evolution During Hemopoiesis

General pattern:

4.1 Erythropoiesis erythroblastic islet

- **proerythroblasts**
- **early erythroblast**
- **intermediate erythroblast**
- **late erythroblast**
- **reticulocyte**
- **erythrocyte**

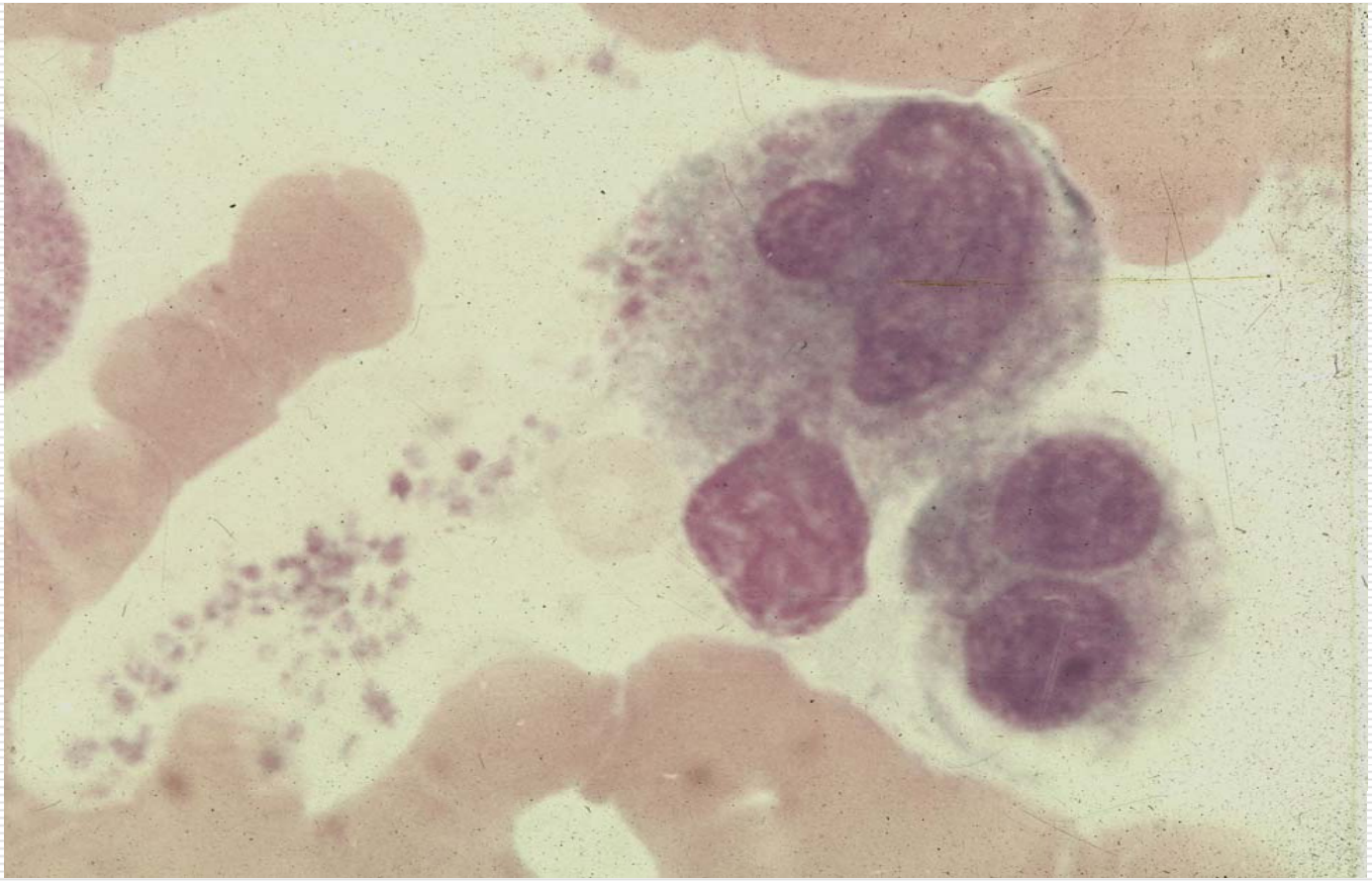
4.2 Granulocytopoiesis

granuloblast → progranulocyte → granular cell

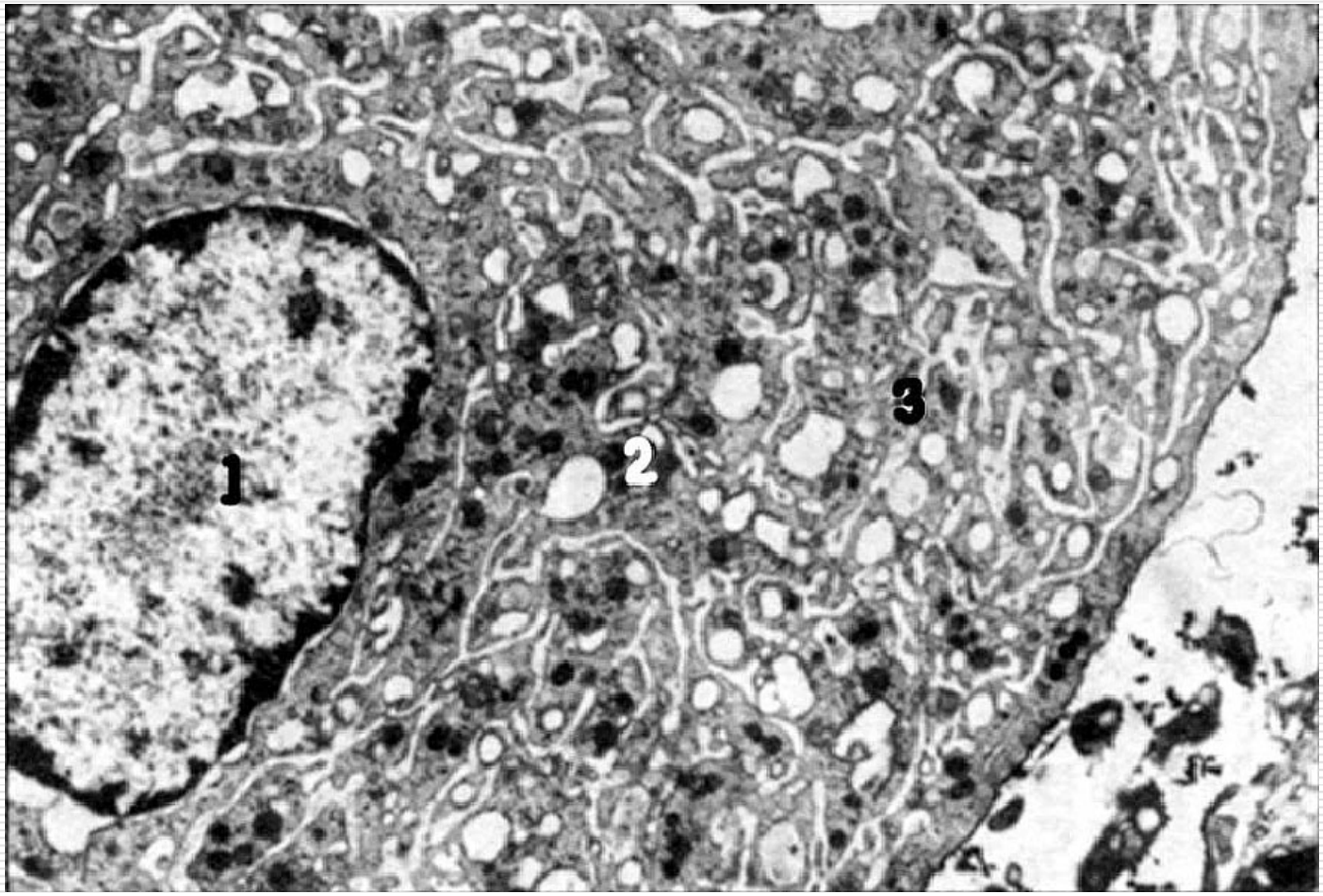
4.3 Monocytopoiesis

Monoblast → Promonocyte → monocyte

Megakaryocyte（LM）



Megakaryocyte （TEM）



4.4 Thrombocytopoiesis

megakaryoblast→promegakaryoblast→
megakaryoctyes→thrombocyte

4.5 Lymphcytopoiesis

lymph stem cell → bone marrow
→ thymus

Pattern of development of blood cell (model)