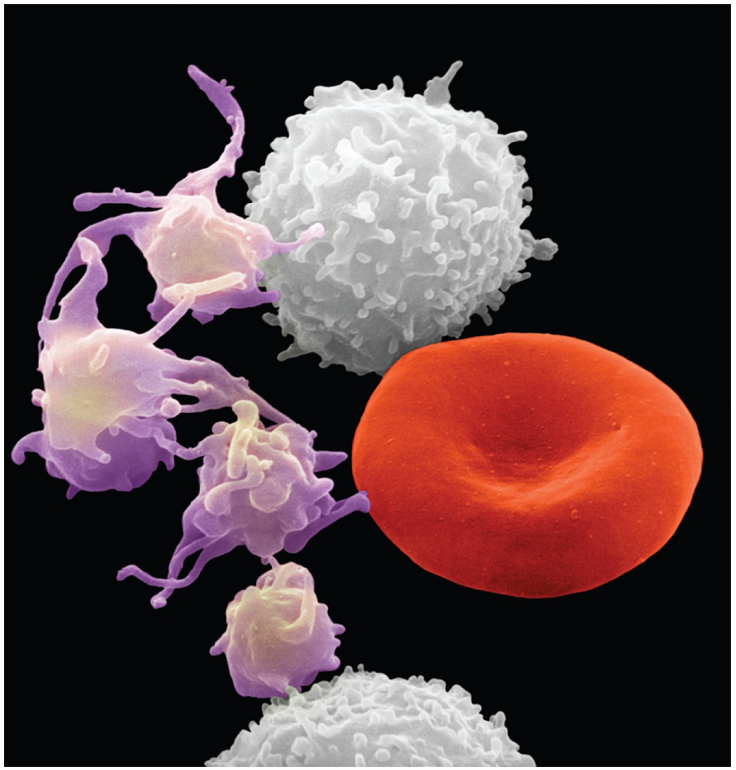
Chapter 18.2

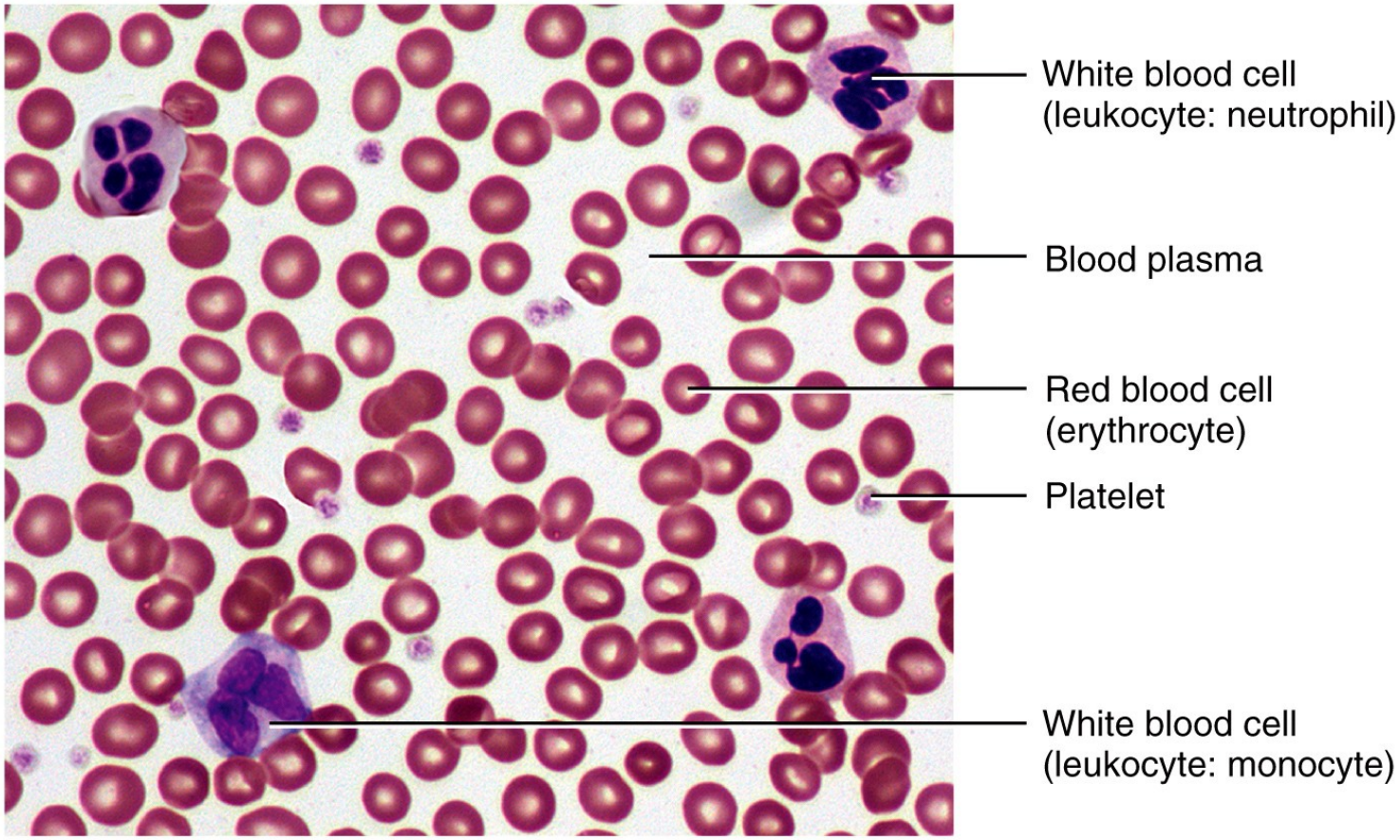
Hemopoiesis

(Erythropoiesis & Leukopoiesis)



Hemopoiesis is the production of the formed elements.

Where are they formed?



(b) Blood smear (thin film of blood spread on a glass slide)

Hemopoiesis

- Hemopoiesis = the production of the blood (especially its formed elements)
  - red bone marrow produces all nine formed elements /// hemopoietic tissues is producer of blood cells (WBC / RBC / Platelets)
  - embryonic development from yolk sac = embryonic structure - produces stem cells for first blood cells // stem cells colonize in all fetal bone marrow, liver, and spleen // liver and spleen stop producing blood cells at birth
  - after birth, all formed elements "are only born" in red bone marrow of axial skeleton plus proximal ends of femur and humerus
  - all the formed elements born in the bone marrow are released into blood as functional cells except T cells
  - T cells (type of WBC) are born in bone marrow but must travel to thymus to complete their development
- Adult daily production = 400 billion platelets / 200 billion RBCs / 10 billion WBCs

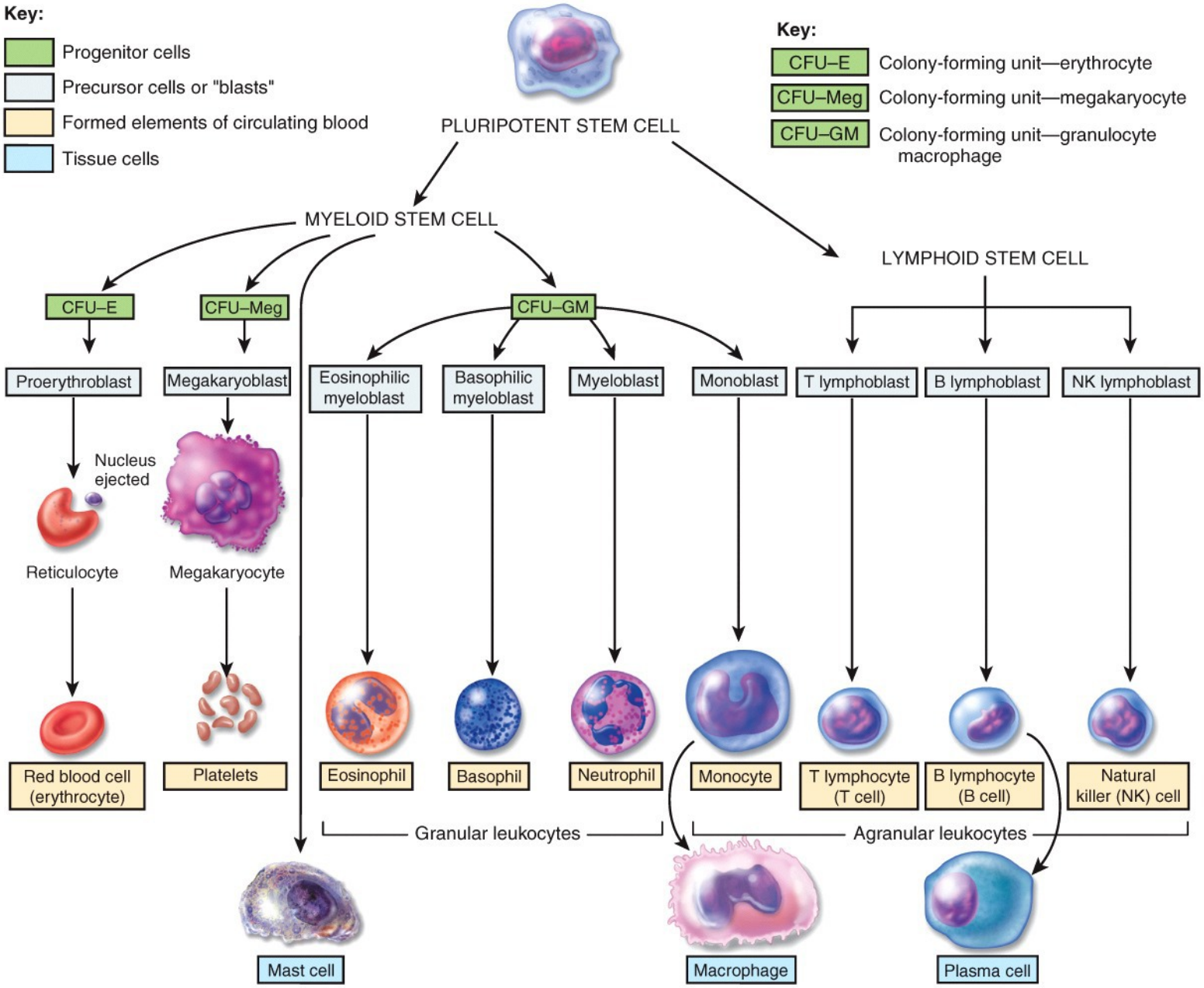
Hemopoiesis

- pluripotent stem cells (PPSC) // formally called hemocytoblasts or hemopoietic stem cells // PPSC generate specific colony forming units for each formed element

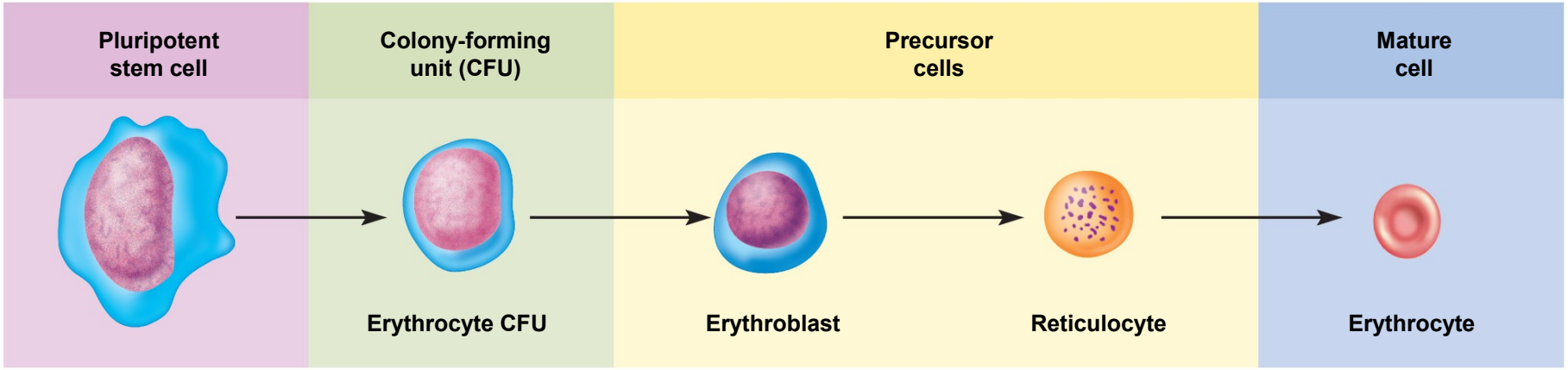
- colony forming units – specialized stem cells only producing one class of formed element of blood

- myeloid hemopoiesis – blood formation in the red bone marrow (note: sometimes called myeloid tissue or hemopoetic tissue)

- lymphoid hemopoiesis – describes blood formation in the lymphatic organs


Key:
Progenitor cells
Precursor cells or "blasts"
Formed elements of circulating blood
Tissue cells
Key:
CFU–E
Colony-forming unit—erythrocyte
CFU–Meg
Colony-forming unit—megakaryocyte
CFU–GM
Colony-forming unit—granulocyte macrophage
PLURIPOTENT STEM CELL
MYELOID STEM CELL
LYMPHOID STEM CELL
CFU–E
CFU–Meg
CFU–GM
Proerythroblast
Megakaryoblast
Eosinophilic myeloblast
Basophilic myeloblast
Myeloblast
Monoblast
T lymphoblast
B lymphoblast
NK lymphoblast
Nucleus ejected
Reticulocyte
Megakaryocyte
Red blood cell (erythrocyte)
Platelets
Eosinophil
Basophil
Neutrophil
Monocyte
T lymphocyte (T cell)
B lymphocyte (B cell)
Natural killer (NK) cell
Granular leukocytes
Agranular leukocytes
Mast cell
Macrophage
Plasma cell

Erythropoiesis



Production of RBC requires 3 to 5 days to complete (test bench mark 5 days!)

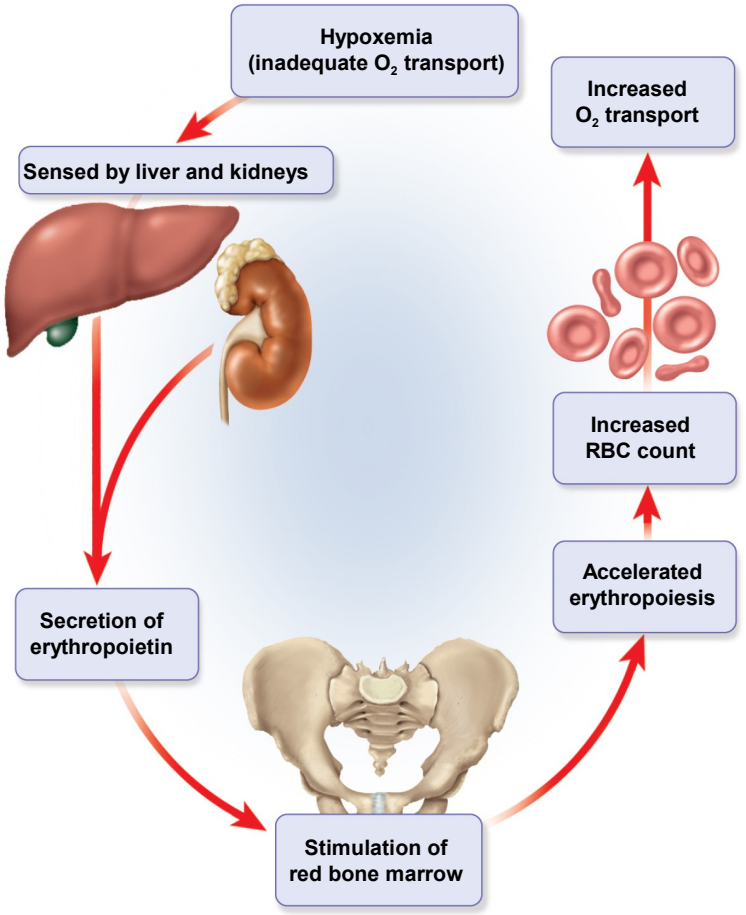
Regulatory stimulus = hypoxia

Hypoxia signals kidney to release erthropoietin (hormone)

Hormone receptors on erythrocyte CFU

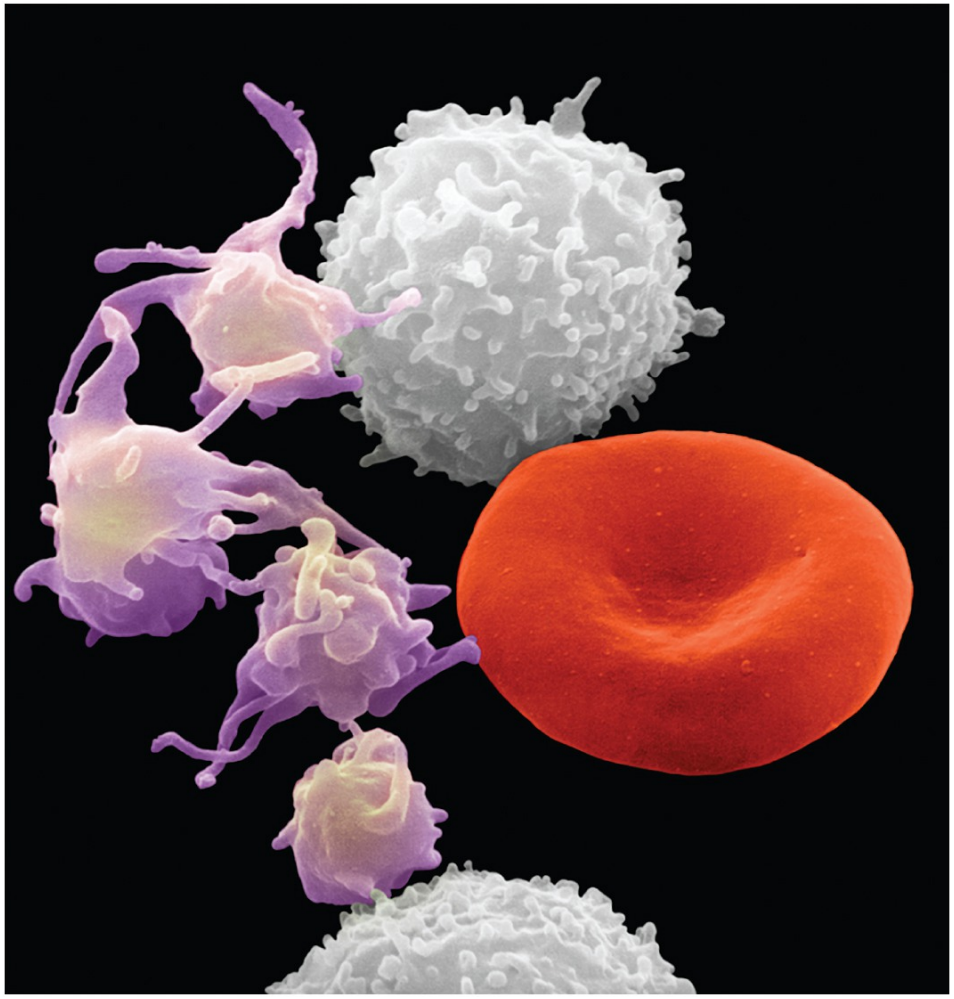
Regulating Erythrocyte Homeostasis

- negative feedback regulation
  - A drop in RBC count causes hypoxemia /// one possible stimulus for for kidneys
  - kidney produces erythropoietin // hormone // receptor on RBC-CFU
  - RBC count increases in 3 - 5 days



- stimulus causing erythropoiesis /// low levels O_2 (hypoxemia) may occur because
  - high altitude
  - increase in exercise
  - loss of lung tissue (emphysema) // reduces the respiratory membrane surface area

Leukopoiesis



Leukopoiesis

- leukopoiesis – production of white blood cells
- pluripotent stem cells (PPSCs) // produce all formed elements
    - Myeloid stem cell produce monocytes (macrophage) // along with the NEBs
    - Lymphoid stem cells produce B cells, T cells, natural killer cells
- red bone marrow produce and releases into blood granulocytes (neutrophills, eosinophils, basophils) and agranulocytes
  (monocytes and lymphocytes)
- Lymphocytes produce cells important to the immune sysem
  - B cells // born in red bone marrow, “educated” in red bone marrow, and released from RB marrow into blood as immuno-competent cells
  - T lymphocytes born in red bone // travels in blood to thymus where it T cells are “educated” then re-enters blood as fully developed T cell.
  - Natural killer cells (NK) // immune surveillance

Leukocytes (WBCs)

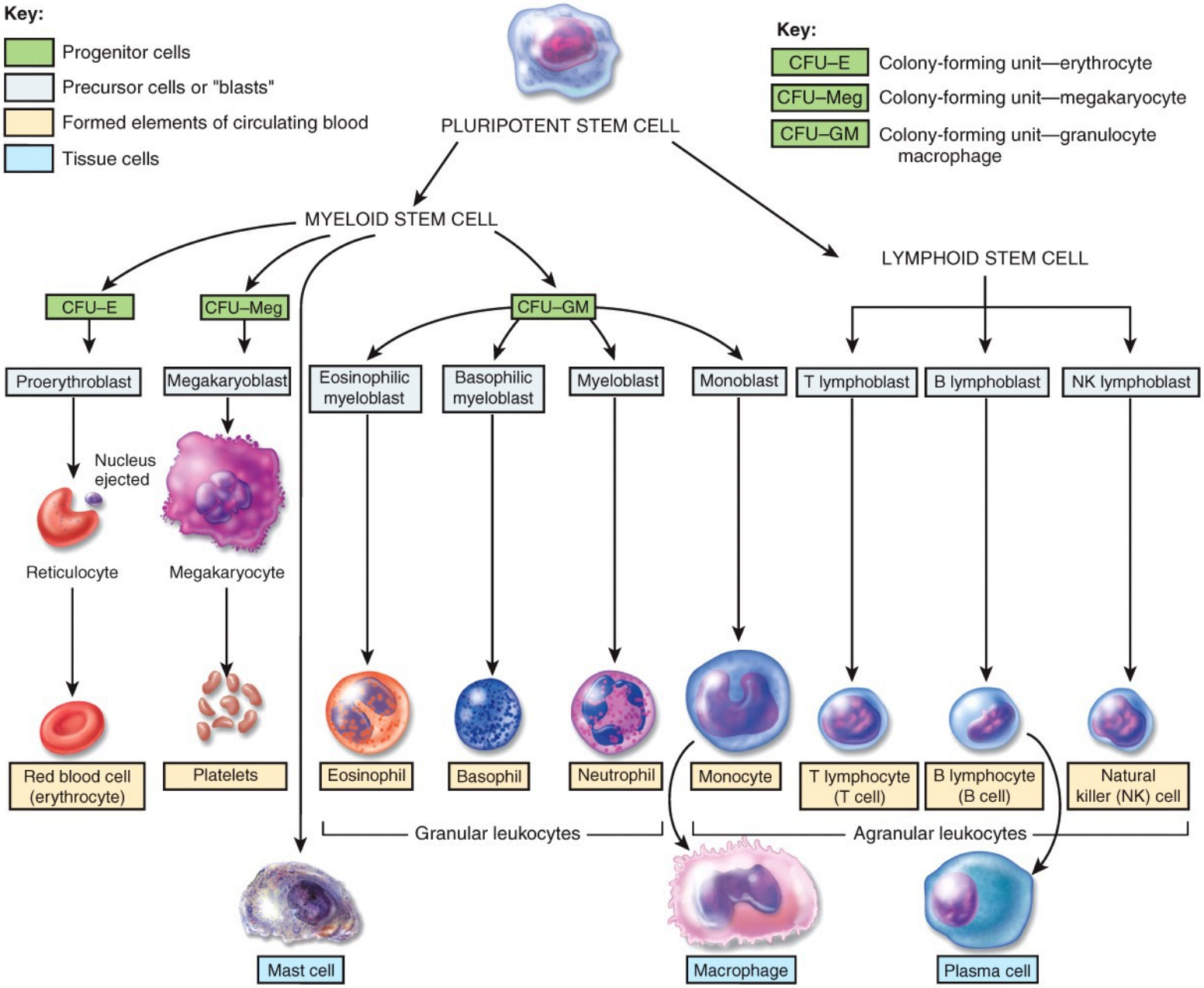
- WBC least abundant of all the formed elements // 5,000 to 10,000 WBCs/μL (the overwhelming number of these cells are neutrophils)

- Primary function of neutrophils = protect against infectious microorganisms and other pathogens present in blood // able to emigrate into tissue spaces if bacterial is present // called the "first responders"

- WBCs have conspicuous nucleus

- WBCs spend only a few hours in the blood stream before migrating out of blood and into the interstitial space
- WBC use connective tissues of the body to "wander" throughout our bodies (i.e. reticuloendothelial system)

- Retain their organelles for protein synthesis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