Blood cells

23.01.2024

Learning outcomes

Recognize the functions of different blood cells

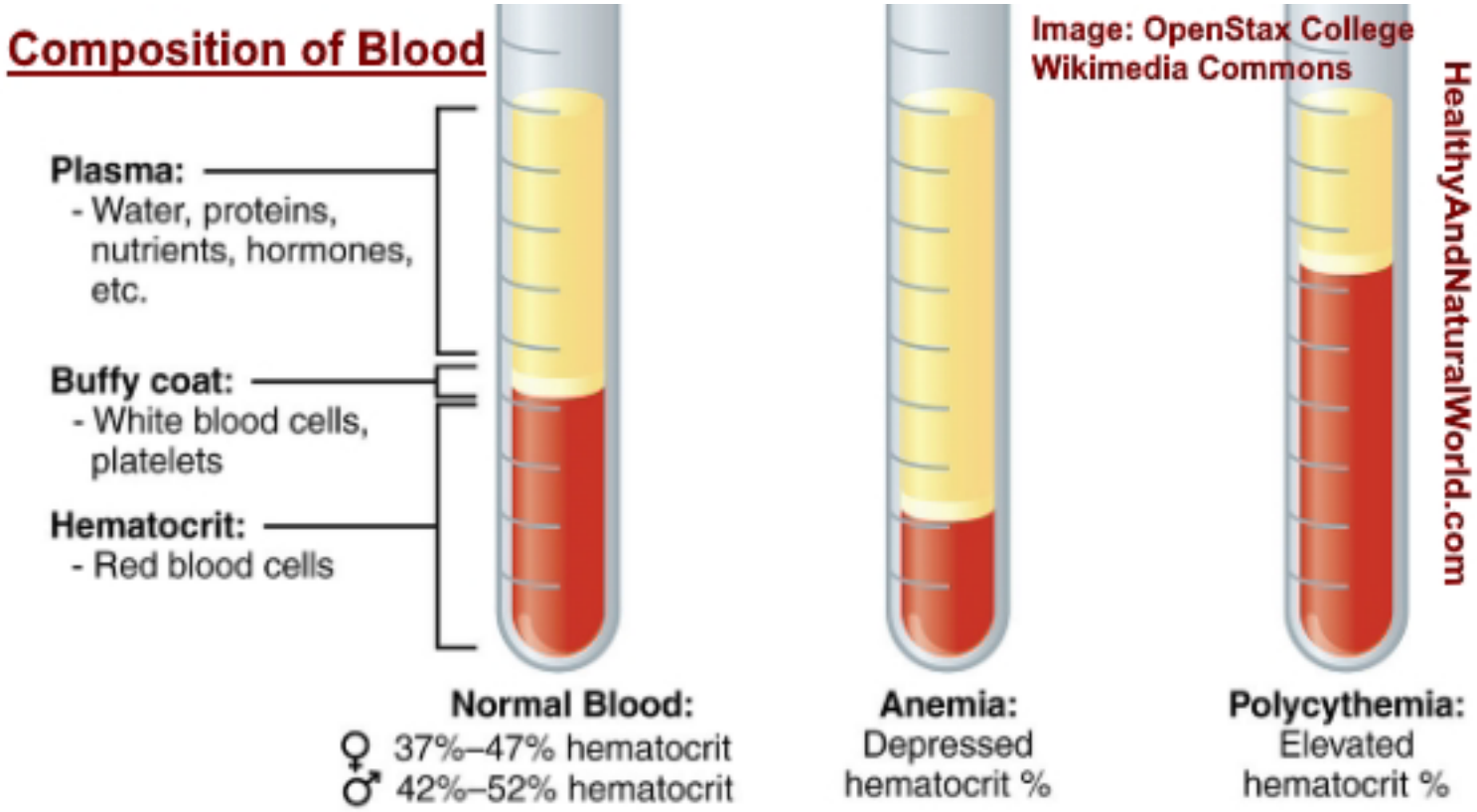
Recognize the essential anatomical structures of human cardiovascular system and their regulatory principles

Understand the cardiac functional cycle and the principles of electrocardiac activity

Perceive the cardiovascular regulation as a part of homeostasis (e.g., blood pressure)

Blood and blood cells

- 6-8% of human weight
- *Plasma* ~55%, blood cells ~45%
- Nutrients, waste products, and hormones are transferred in the blood → body metabolism can be revealed from blood
- hematocrit ~ volume of the red blood cells in the blood
- *Serum* ~ fluid and solute components which do not take part in blood clotting



Courses.lumenlearning.com

Plasma proteins are important for fluid balance, substance transportation, blood clotting and as antibodies

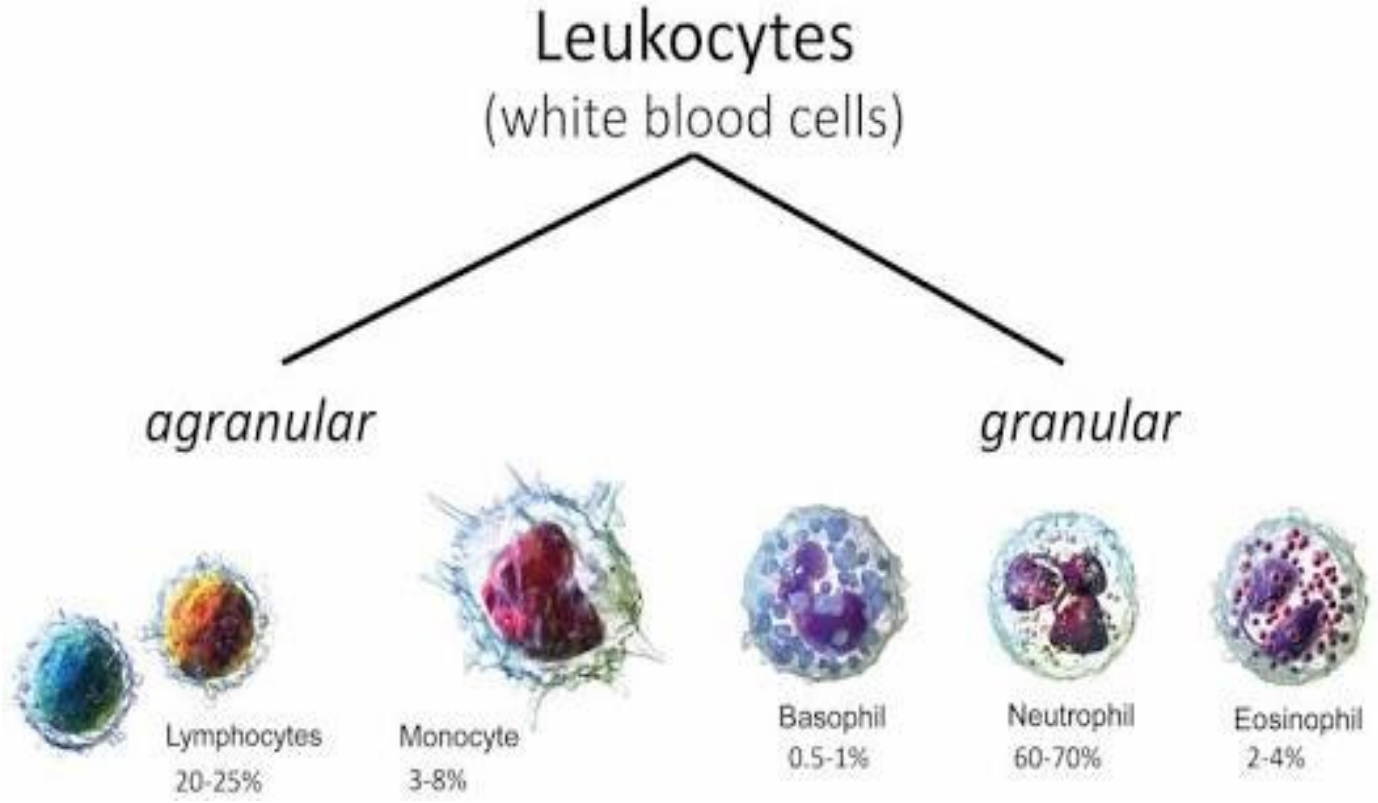
Albumin (60%)
80% of the colloid osmotic pressure (see Lecture 1)
Transportation (*e.g.,* fatty acids, hormones, medicines)

Fibrinogen (5%)
Converts into fibrin for blood clotting

Globulins (35%)
Transportation (fatty acids, iron, copper, hemoglobin, hormones)
Antibodies (Immunoglobulins)

Functions of the blood cells

- Red blood cells (*erythrocytes):* transportation of oxygen
- White blood cells (*leukocytes):* immune defence
- Platelets *(thrombocytes):* Blood clotting



Lymphocytes:
Make antibodies

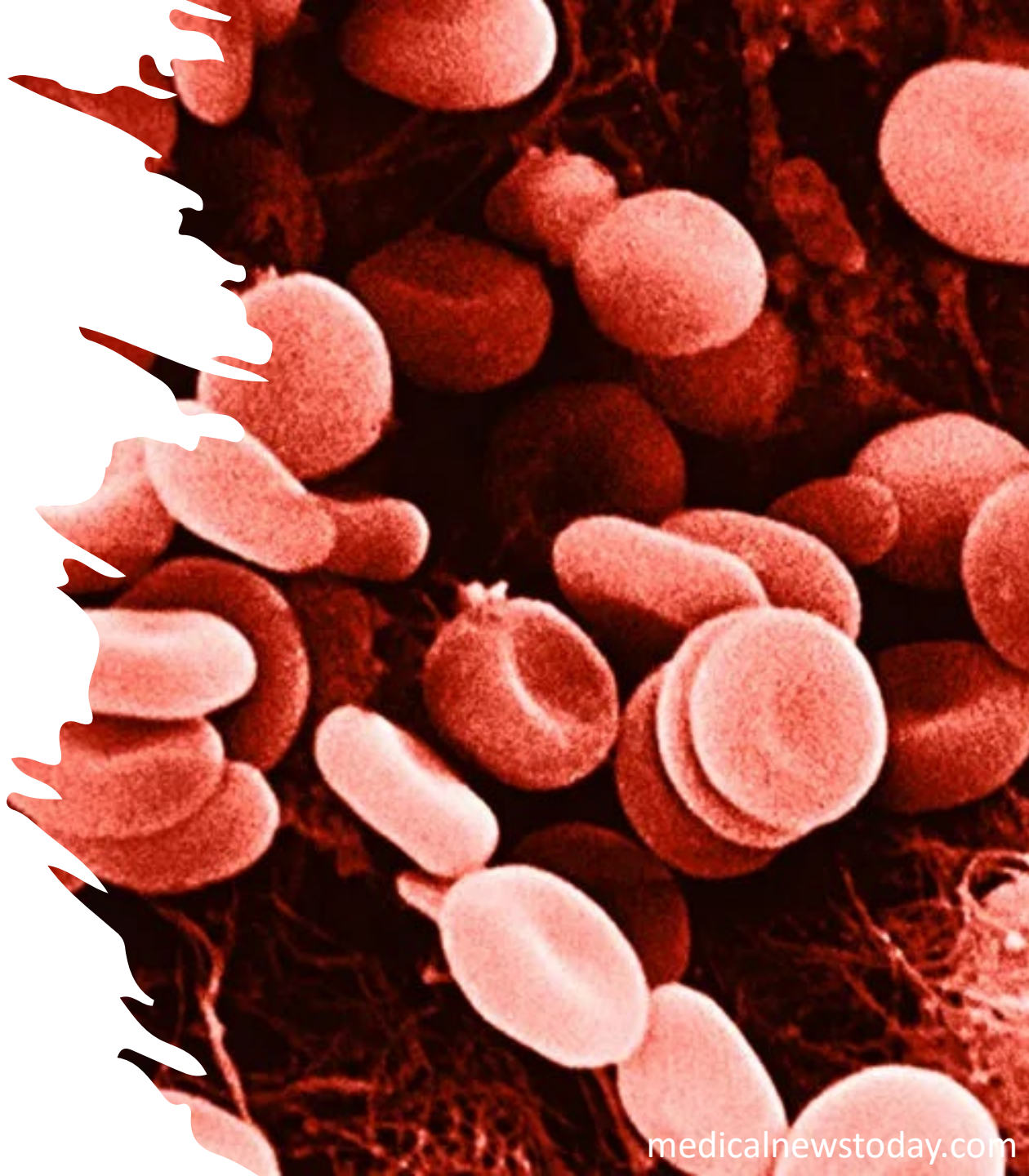
Monocytes:
Fagocytosis

Granular cells:
Fagocytosis

https://socratic.org/

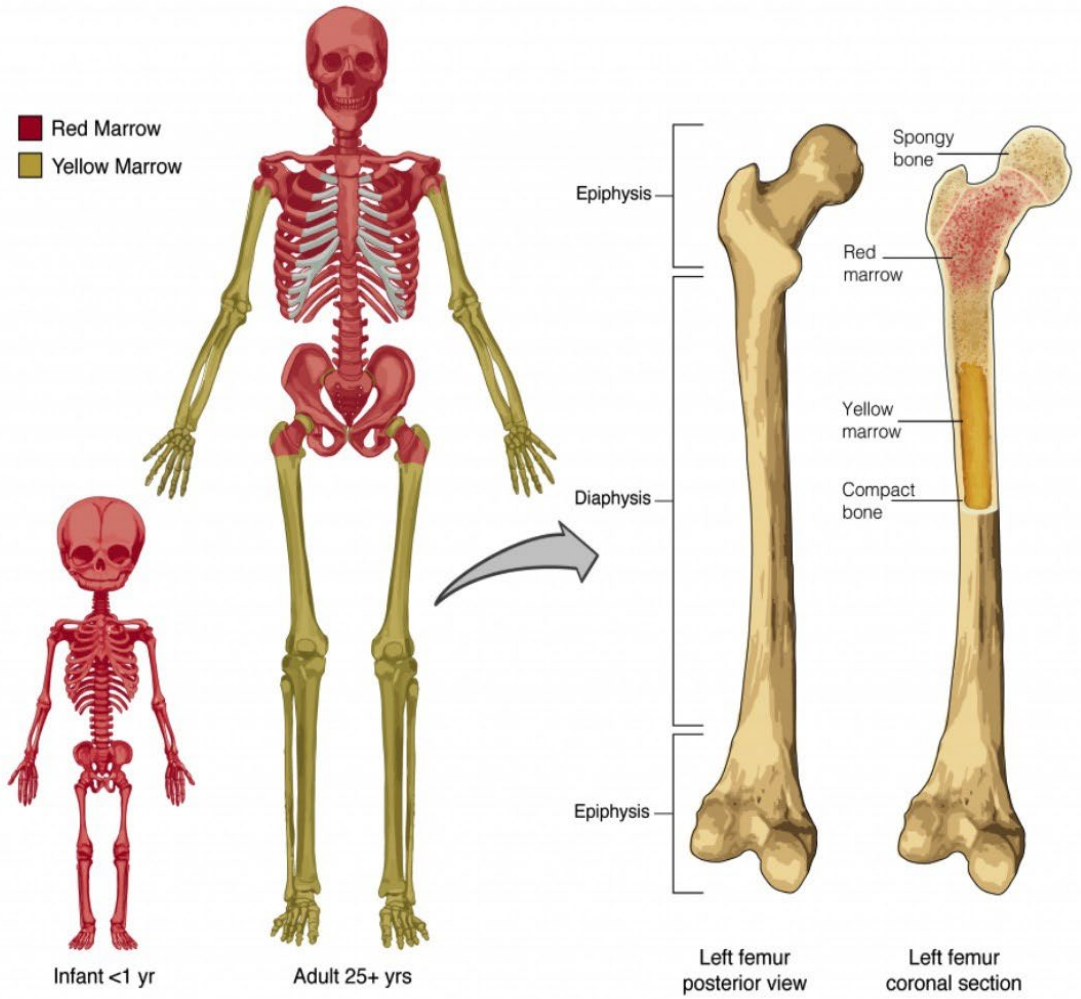
Red blood cells

- 25% of all cells
- 7-8 um, no nucleus
- 1/3 of the mass consists of *haemoglobin* with iron part with binding site for oxygen
- Production depends on *erythropoietin hormone* which is stimulated by hypoxia
- Life-time appr. 4 months
- *Hemolysis* = rupturing of red blood cells



Origin of blood cells

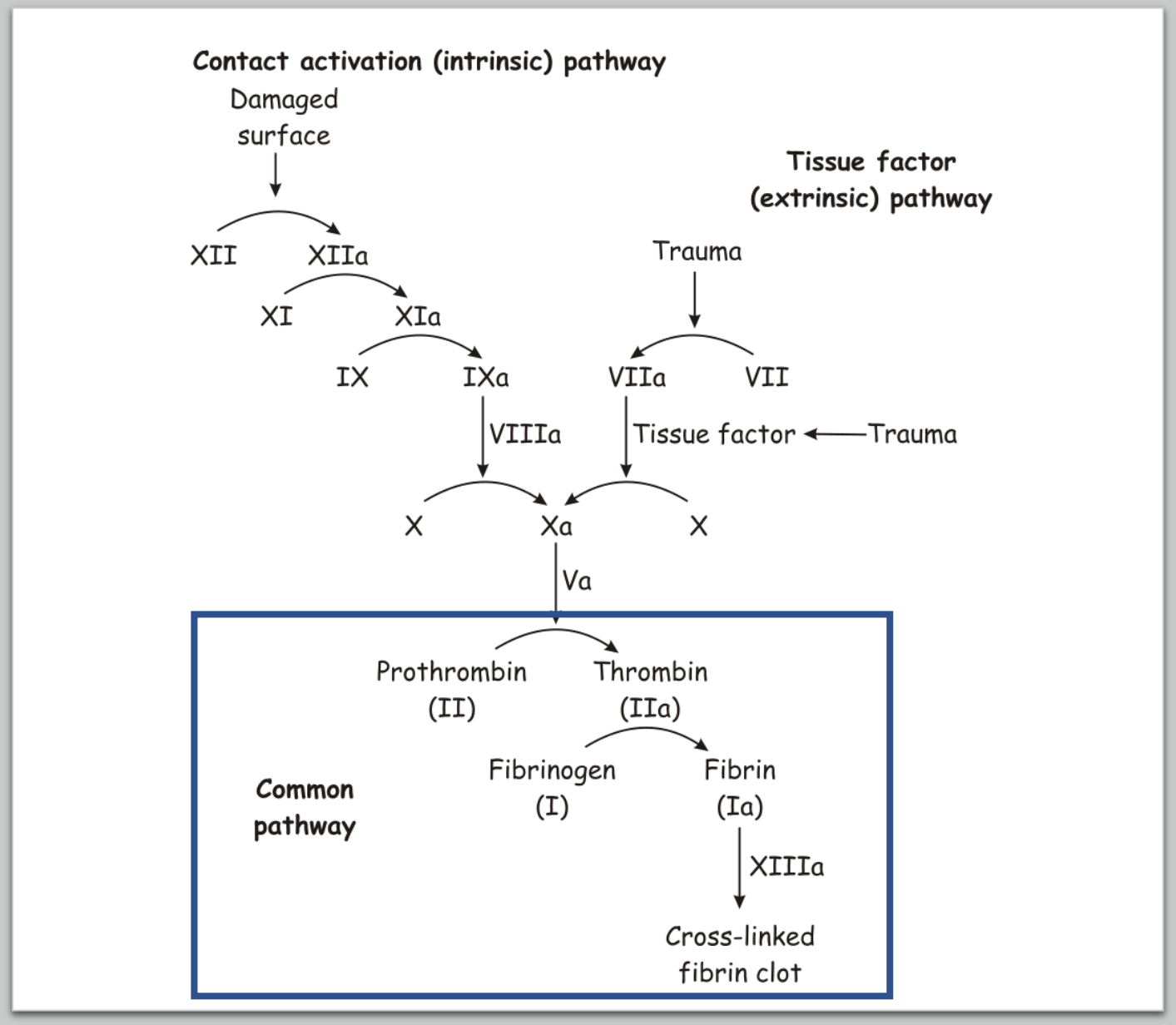
- Stem cells in bone marrow
- Red *vs.* yellow bone marrow
- Lymphocytes are activated outside bone marrow in lymphoid tissue
- In leukemia, abnormal immature white blood cells are detected in peripheral blood (‘blasts’)



Quora.com

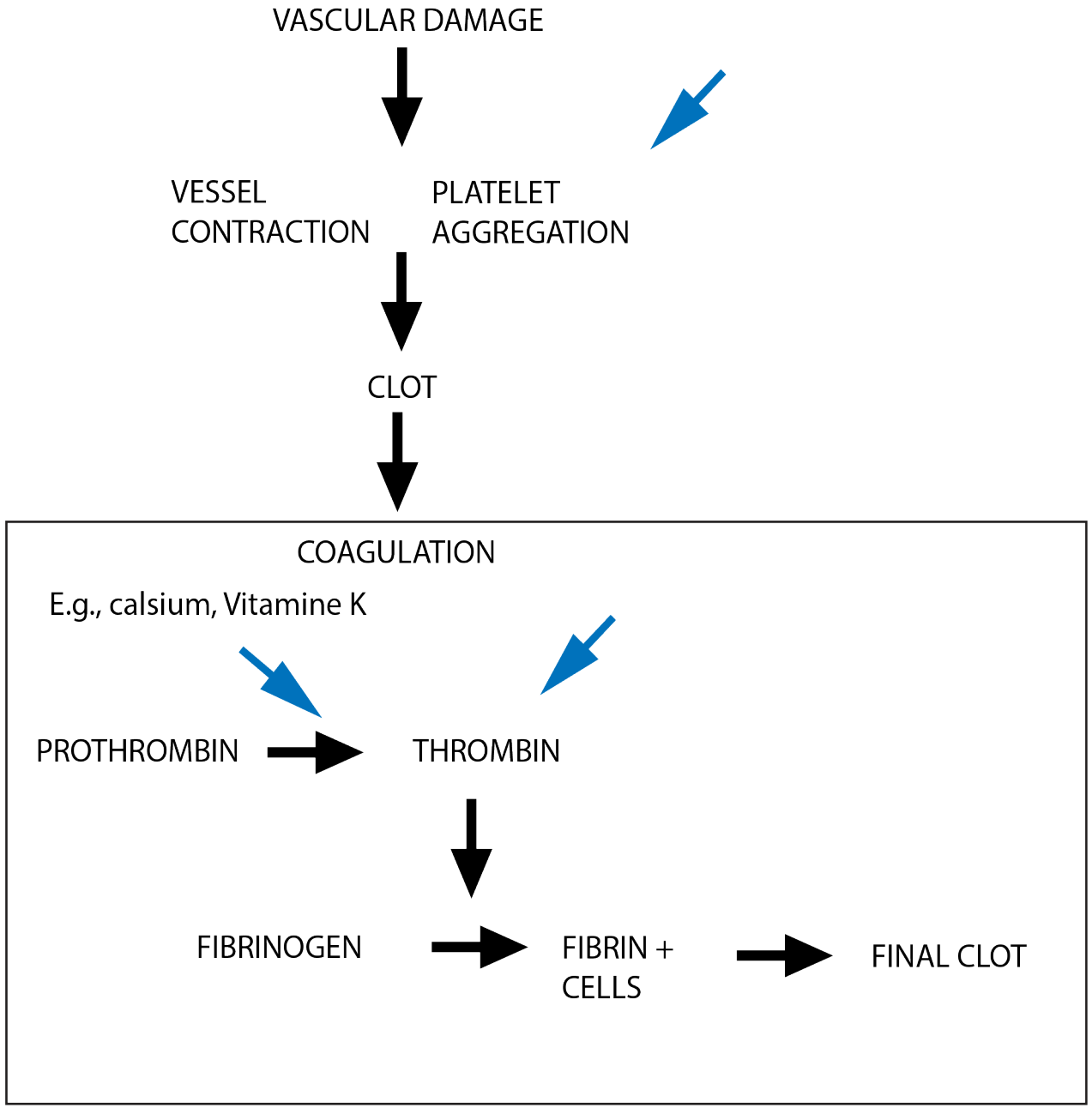
Blood clotting

- Vessel trauma activates the clotting cascade
- Small trauma → “platelet plug”
- Coagulation = Clotting factors promote the transformation of fibrinogen into fibrin
- Platelets alter the fibrin structure and are entrapped to the forming clot



Wikipedia

Blood coagulation

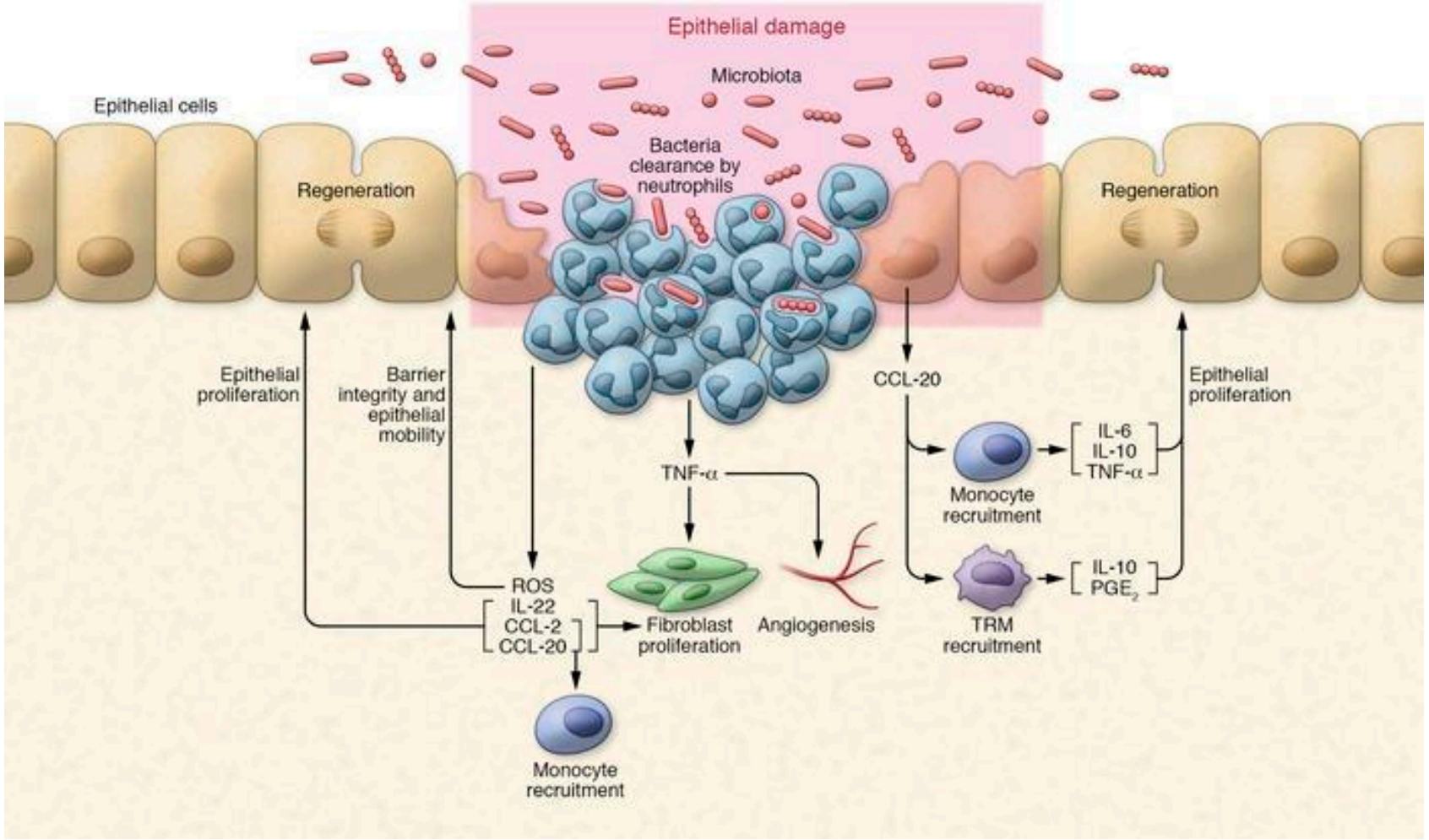


Blood cells as a part of intrinsic defence

Innate immunity

- ✓ In tissues
- ✓ Non-specific
- ✓ Stereotypical
- ✓ Neutrophiles and monocytes
- ✓ Fever
- ✓ Complement
- ✓ Interferons

→ warmth, swelling, redness, pain

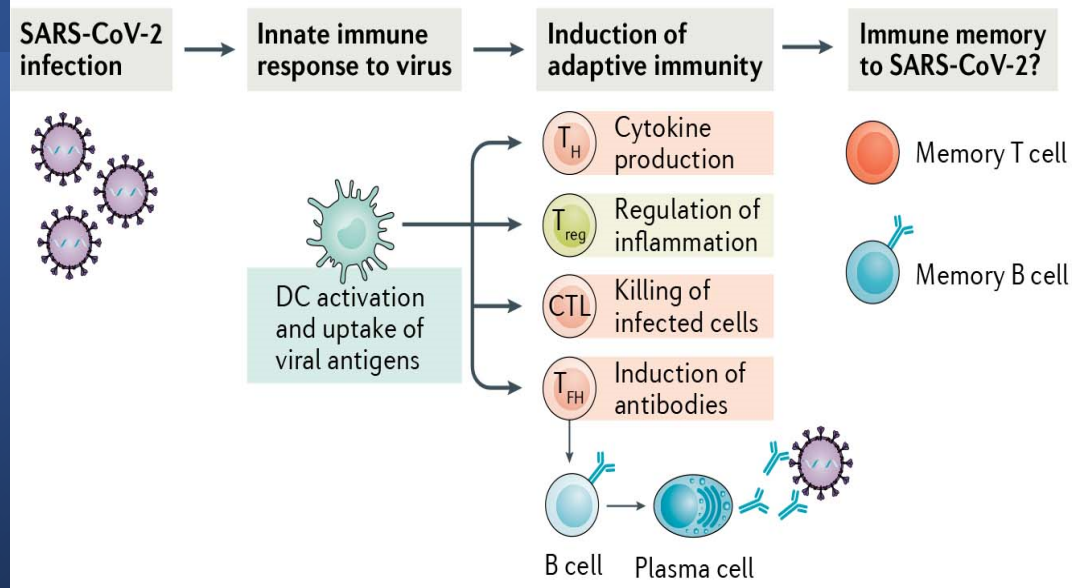


Brazil et al. 2019

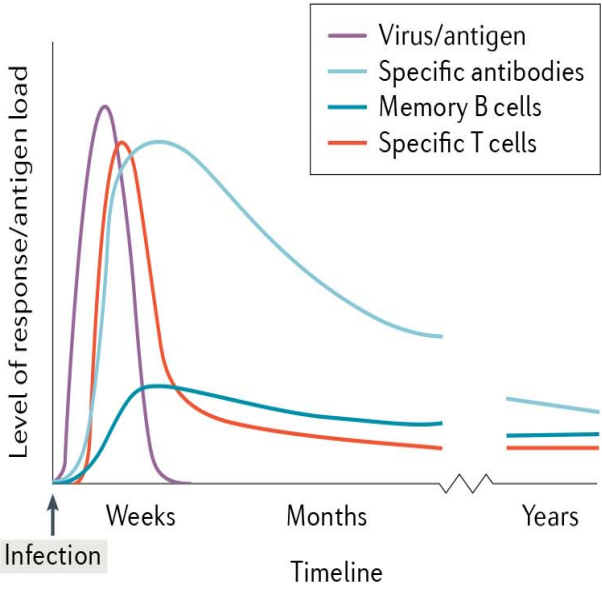
Blood cells as a part of intrinsic defence

Acquired/adaptive immunity

- ✓ Blood, lymphatic tissues
- ✓ Cell and humoral mediated
- ✓ Spesific
- ✓ Strengthens
- ✓ Immunologic memory: T and B lymphocytes
- ✓ Primary and secondary response



T cells and B cells in immunity to SARS-CoV-2.



Cox and Brokstad, 2020