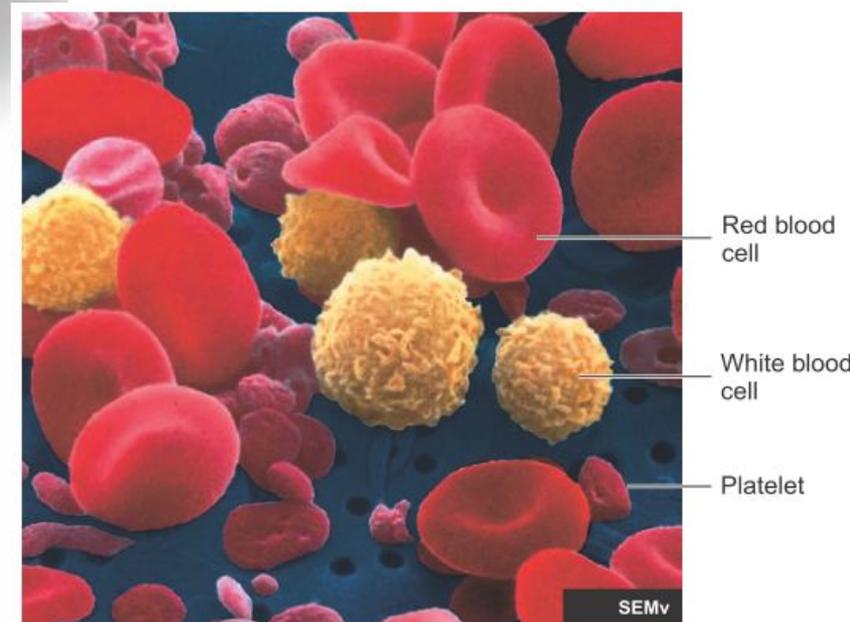
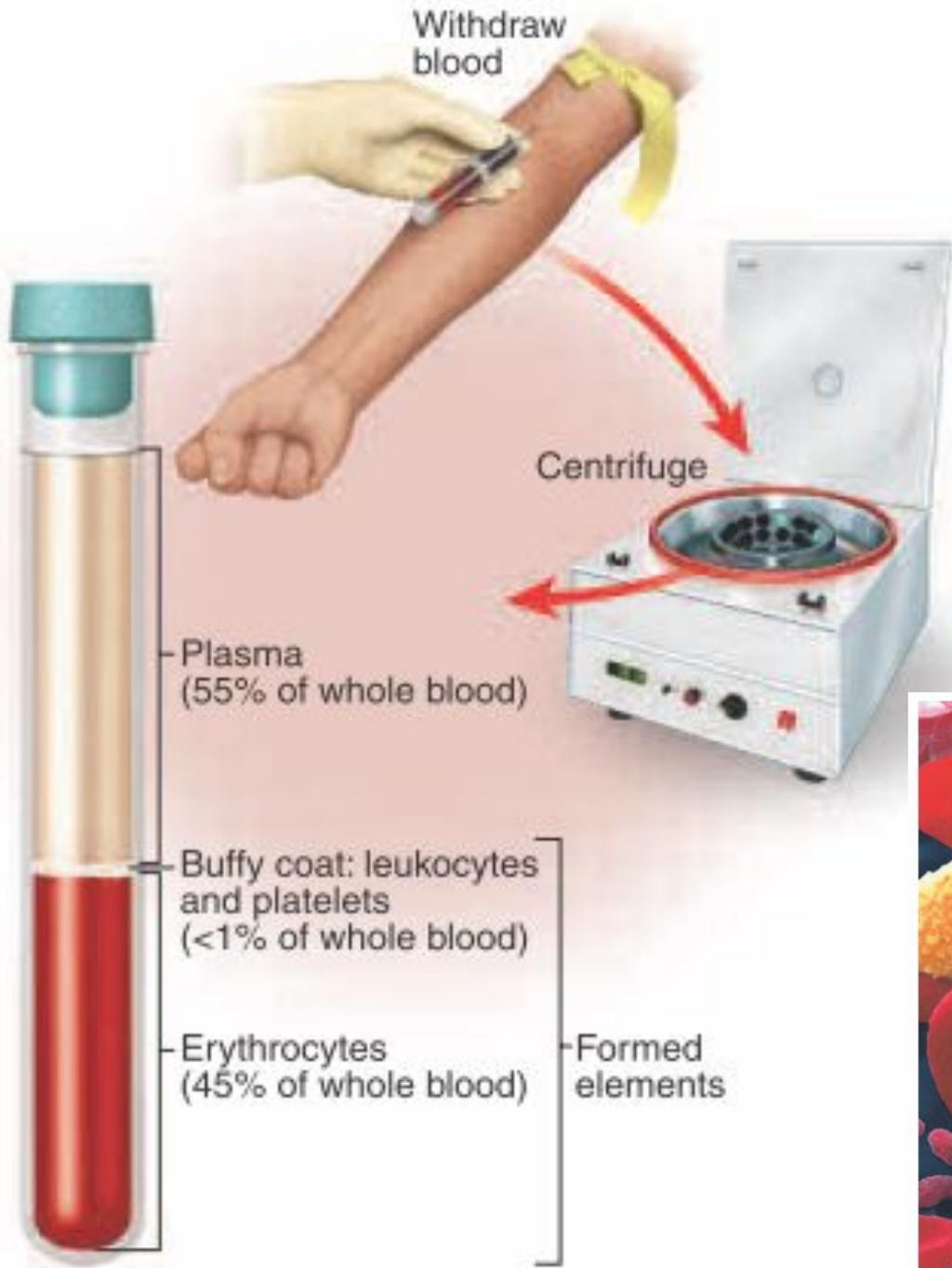


Форменные элементы крови



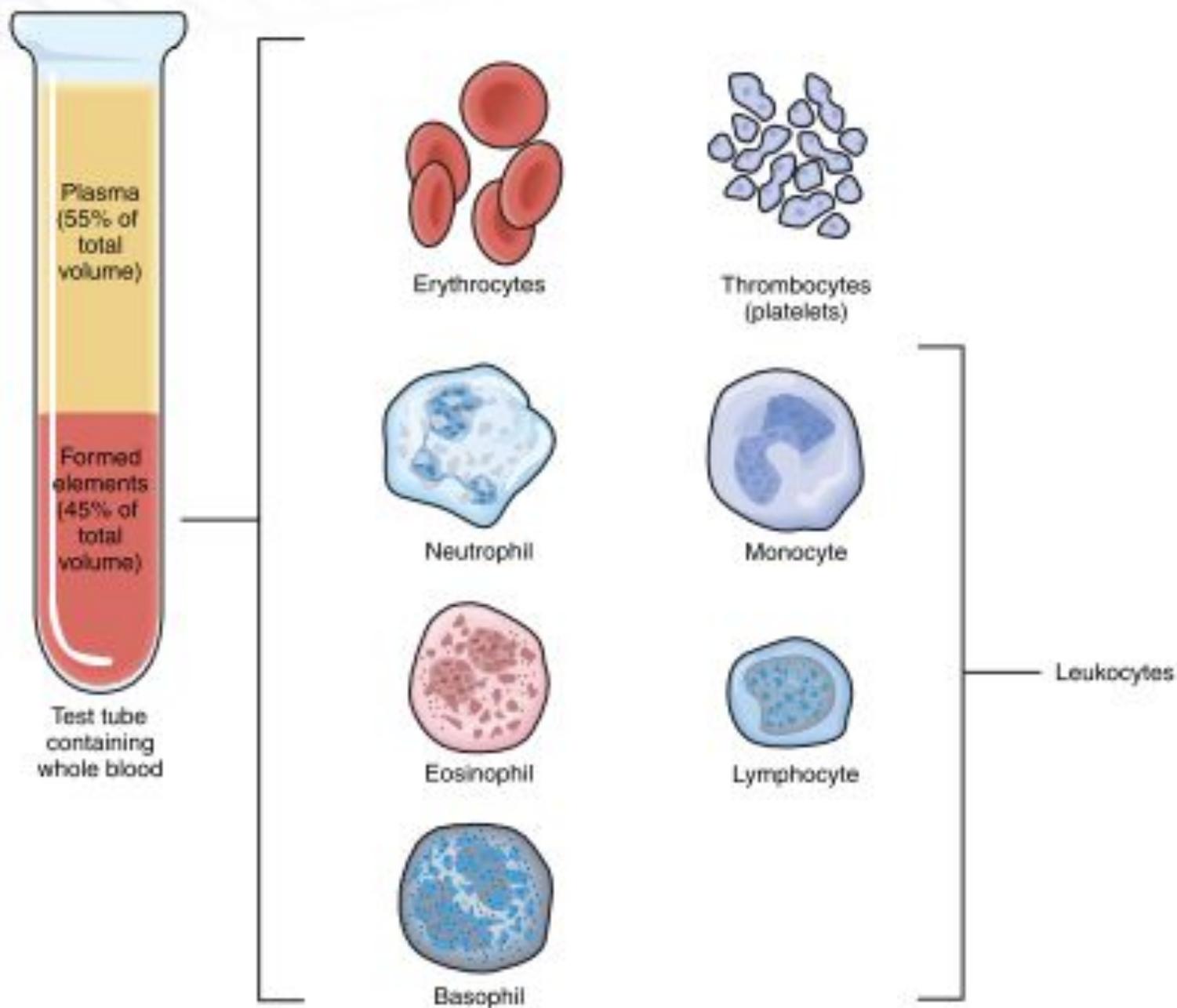
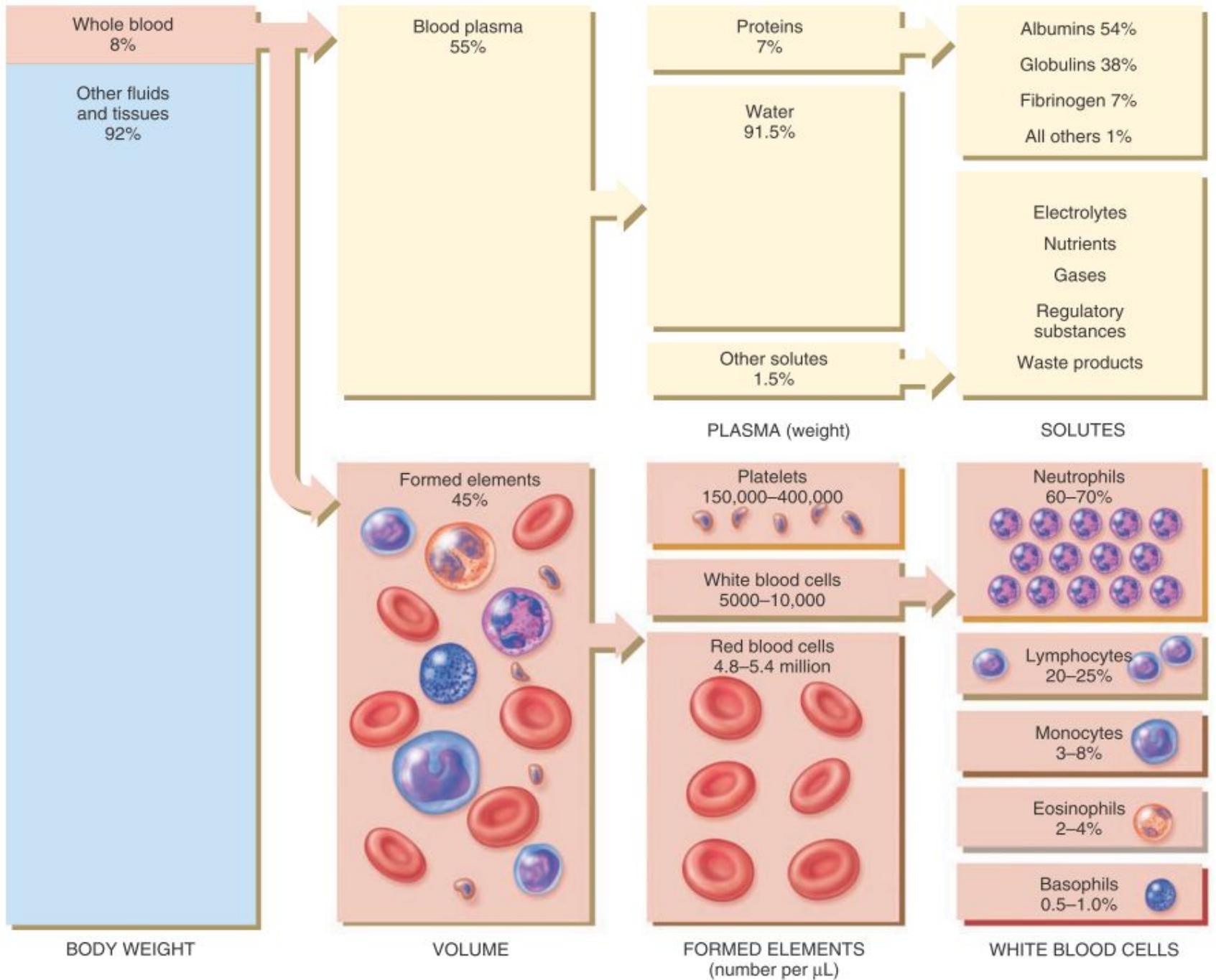
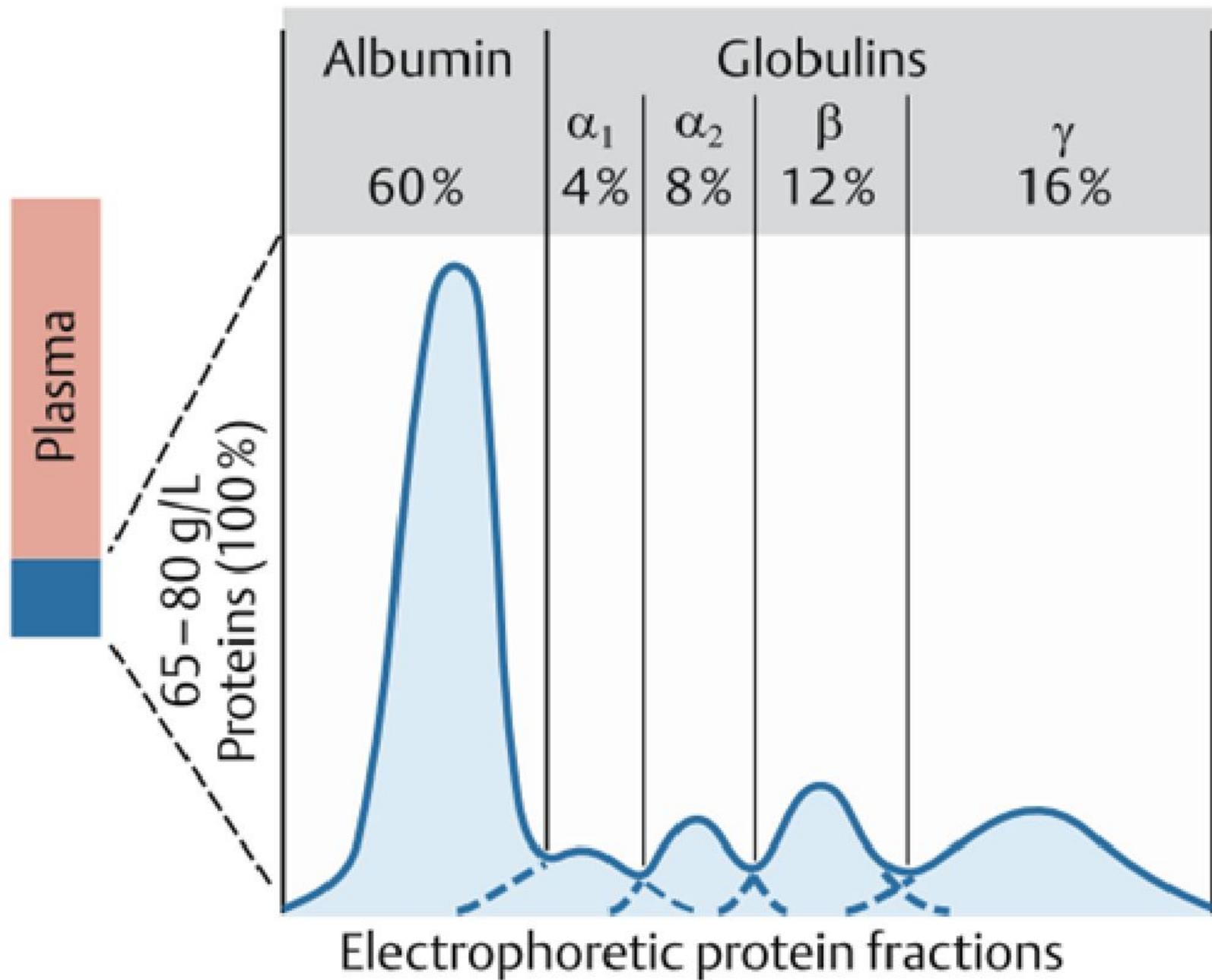


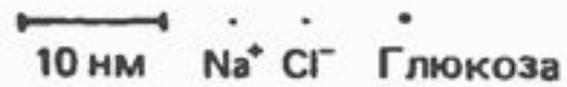
FIGURE 13-1. The major components of blood.



B. Plasmaproteins



Шкала



Альбумин
69,000



Гемоглобин
64,450



β_1 -Глобулин
90,000



γ -Глобулин
156,000



α_1 -Липопротеин
200,000

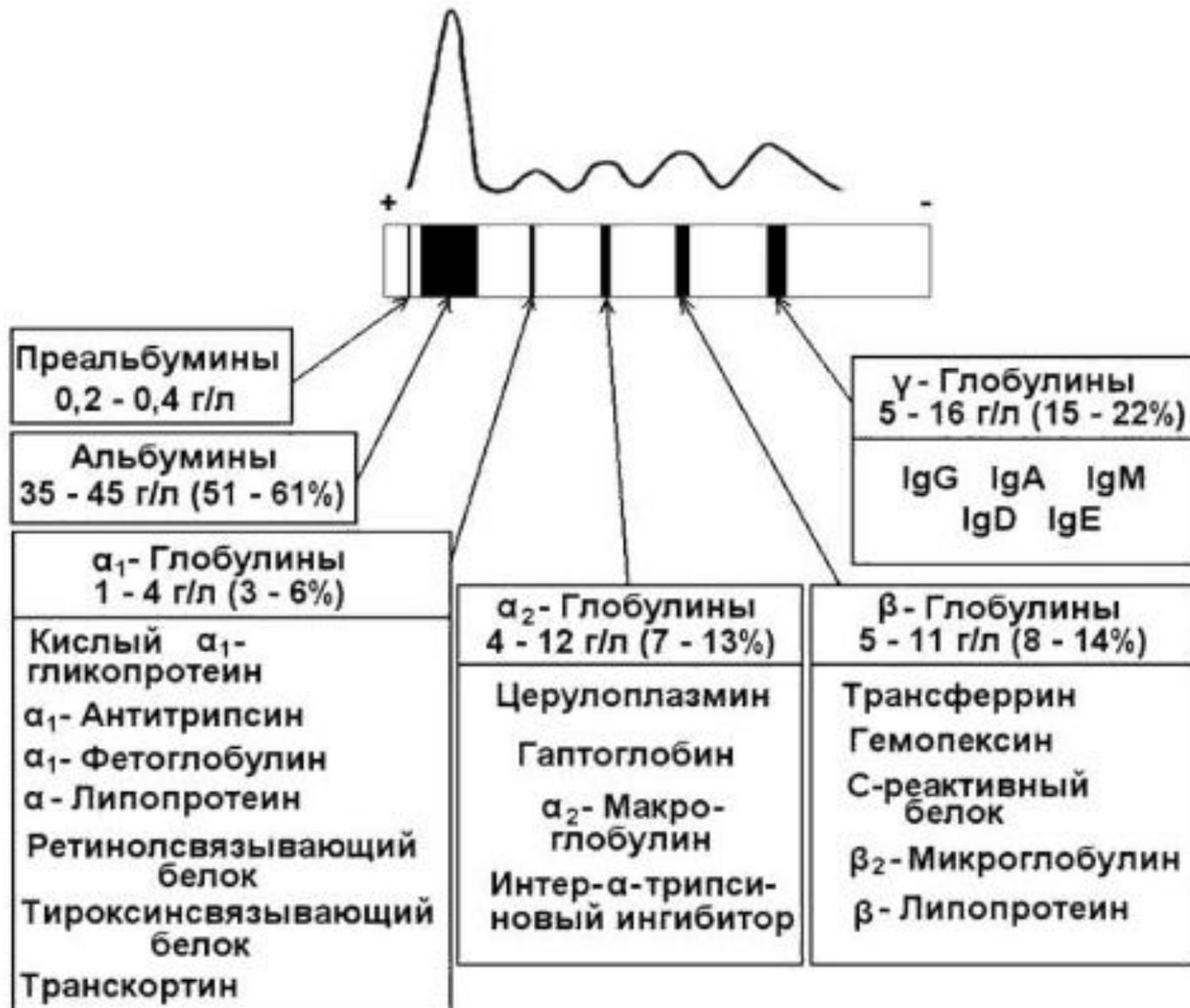


β_1 -Липопротеин
1,300,000

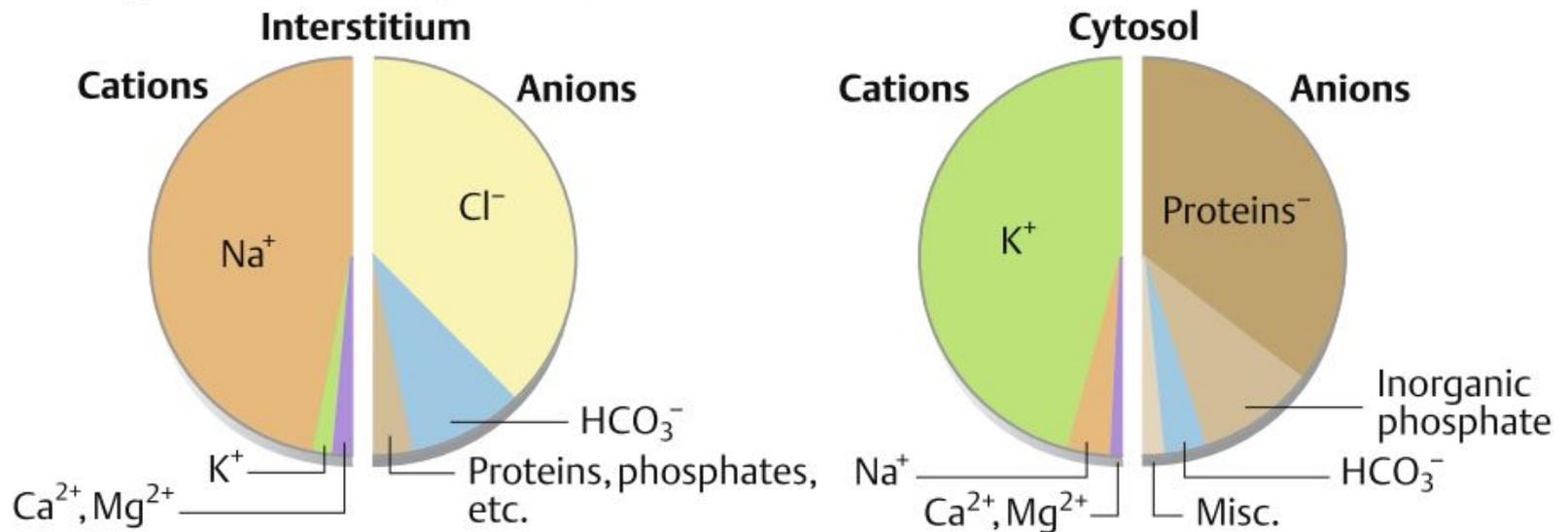


Фибриноген
340,000

Белковые фракции плазмы крови



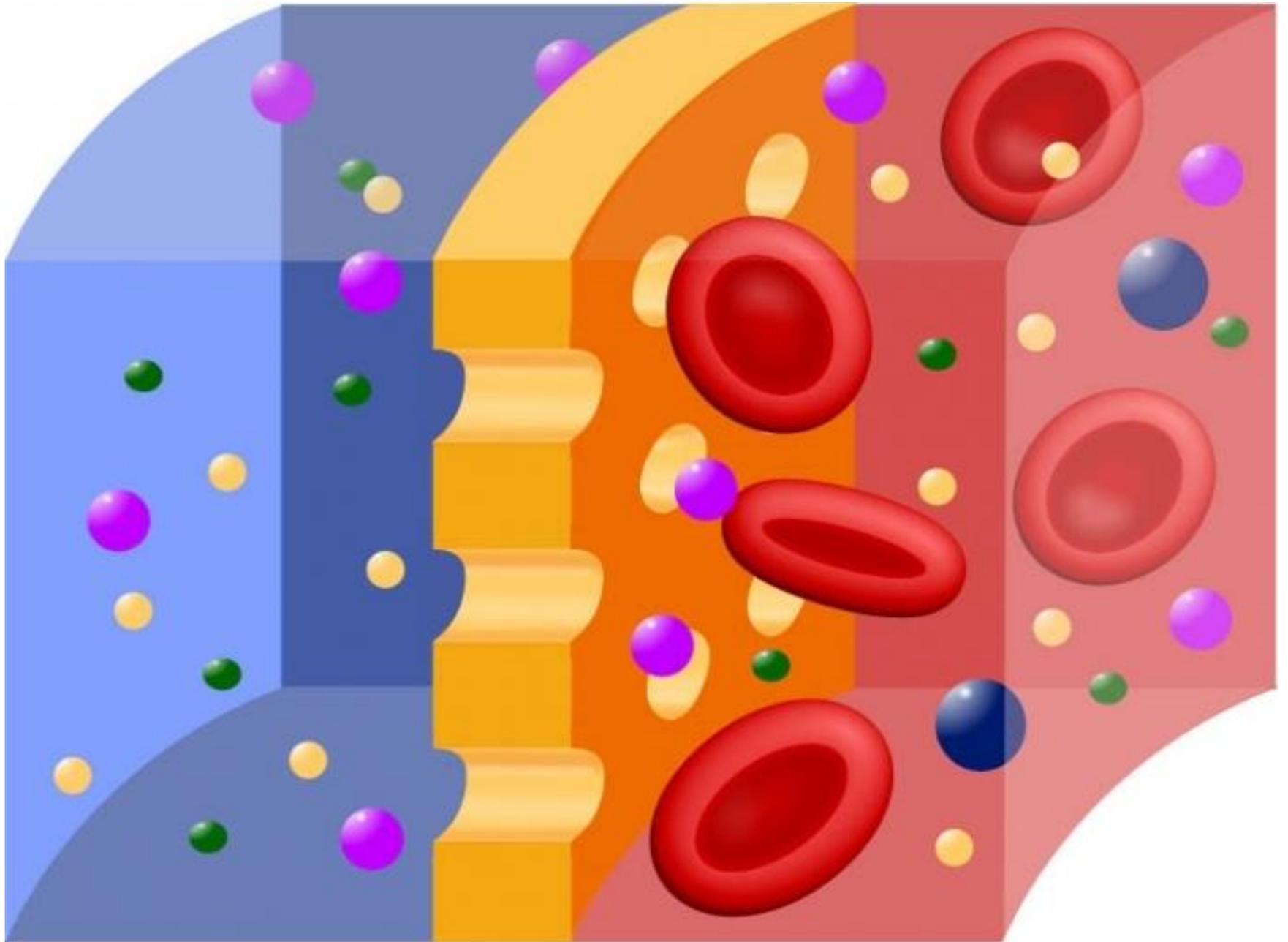
C. Ion composition of body fluids



		mEq/L (mmol/L)			
		Plasma	Serum	Interstitium	Cytosol
Cations	Na ⁺	142	153	145	ca. 12
	K ⁺	4.3	4.6	4.4	ca. 140
	Free Ca ²⁺	2.6 (1.3*)	2.8 (1.3)	2.5 (1.5)	<0,001
	Free Mg ²⁺	1.0 (0.5**)	1.0 (0.5)	0.9 (0.45)	1.6
Sum		150	162	153	ca. 152
Anions	Cl ⁻	104	112	117	ca. 3
	HCO ₃ ⁻	24	26	27	10
	Inorganic phosphate	2	2.2	2.3	ca. 30
	Proteins	14	15	0.4	ca. 54
	Misc.	5.9	6.3	6.2	ca. 54
Sum		150	162	153	ca. 152

*) Total plasma Ca: 2.5 mmol/L; **) Total plasma Mg: 0.9 mmol/L

Группа	Белки	Мол. масса, кДа	Функция
Альбумины:	Транстиретин Альбумин 45 г/л	50-66 67	Транспорт тироксина и триодтиронина Поддержание осмотического давления, транспорт жирных кислот, билирубина, желчных кислот, стероидных гормонов, лекарств и неорганических ионов
α_1 -Глобулины:	Антитрипсин Антихимотрипсин Липопротеин (ЛВП) Протромбин Транскортин Кислый гликопротеин Тироксин-связывающий глобулин	51 58-68 200-400 72 51 44 54	Ингибирование трипсина и др. протеиназ Ингибирование химотрипсина Транспорт липидов Фактор свертывания крови II, предшественник тромбина (3.4.21.5) Транспорт кортизола, кортикостерона и прогестерона Транспорт прогестерона Транспорт тироксина и триодтиронина
α_2 -Глобулины:	Церулоплазмин Антитромбин III Галтоглобин Холинэстераза (3.1.1.8) Плазминоген Макроглобулин Ретинол-связывающий белок Витамин D-связывающий белок	135 58 100 около 350 90 725 21 52	Транспорт ионов меди Ингибирование свертывания крови Связывание гемоглобина Расщепление эфиров холина Предшественник плазмина (3.4.21.7) Связывание протеиназ, транспорт ионов цинка Транспорт витамина А Транспорт кальциферолов
β -Глобулины:	Липопротеин (ЛНП) Трансферрин Глобулин, связывающий половые гормоны Транскобаламин С-реактивный белок	2000-4500 80 65 38 110	Транспорт липидов Транспорт ионов железа Транспорт тестостерона и эстрадиола Транспорт витамина B ₁₂ Активация комплемента
γ -Глобулины:	IgG IgA IgM IgD IgE	150 360 935 172 196	Поздние антитела Антитела, защищающие слизистые Ранние антитела Рецепторы В-лимфоцитов Реагин (см. с.288)



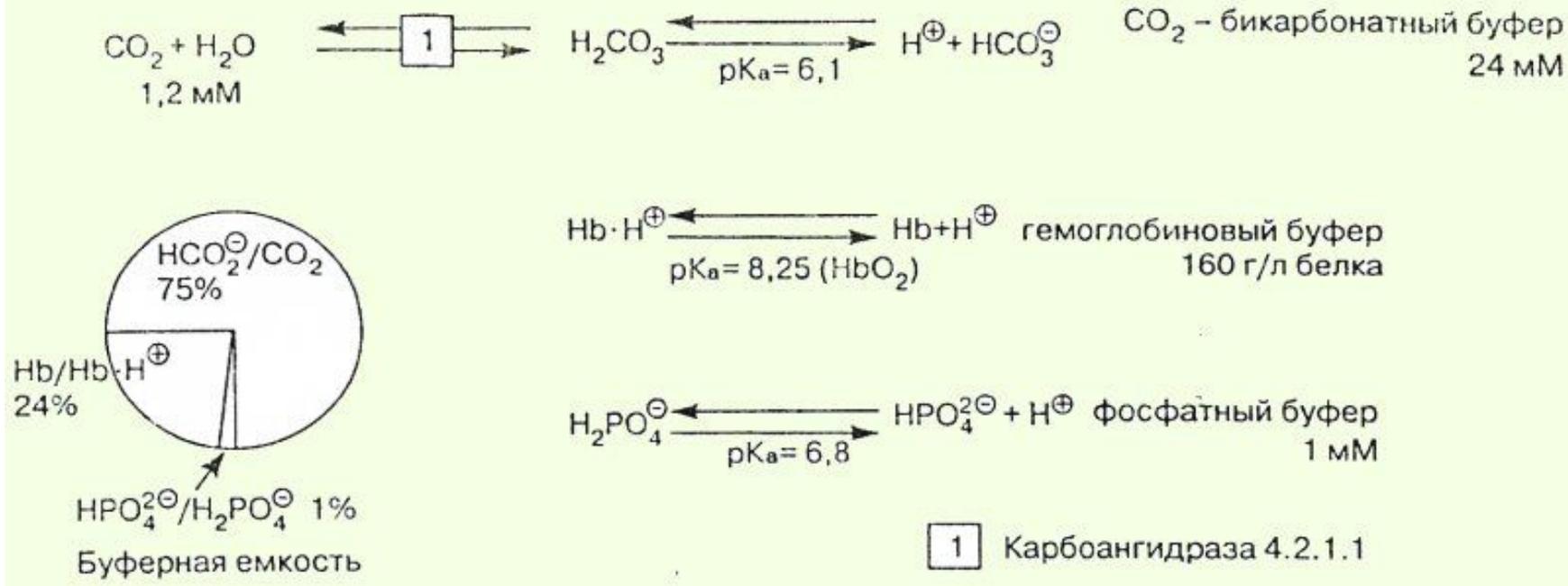


Рис. 20.2. Буферные системы плазмы крови

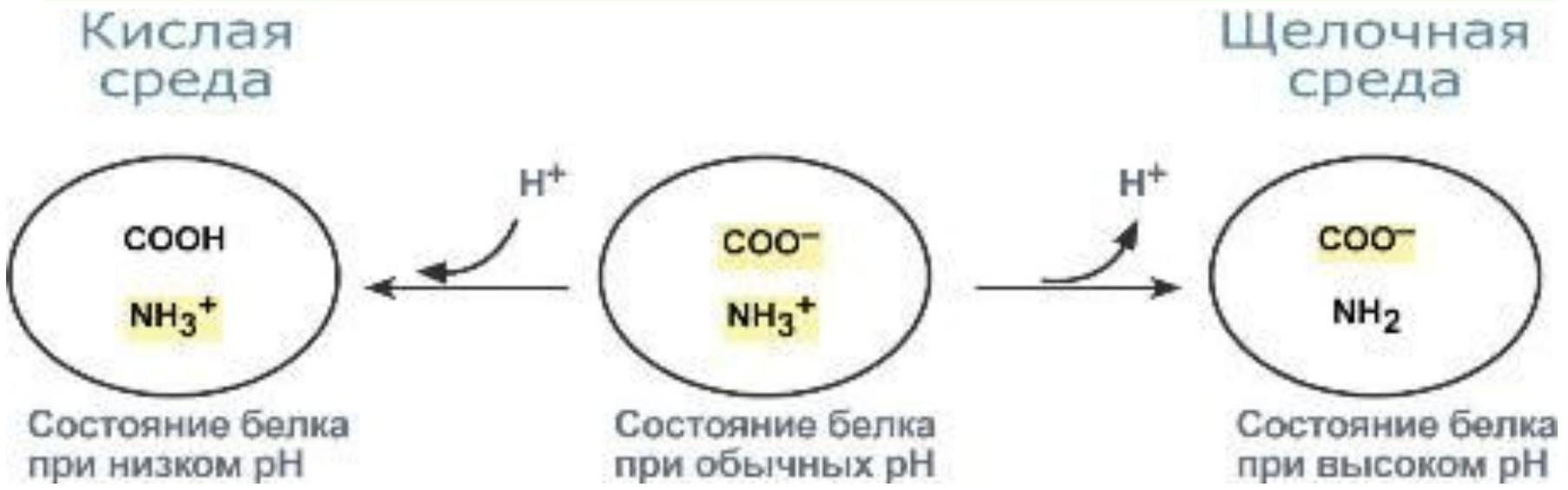
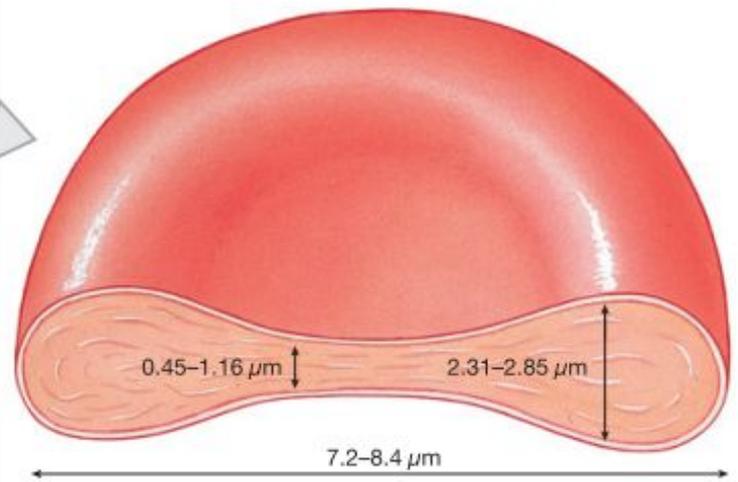
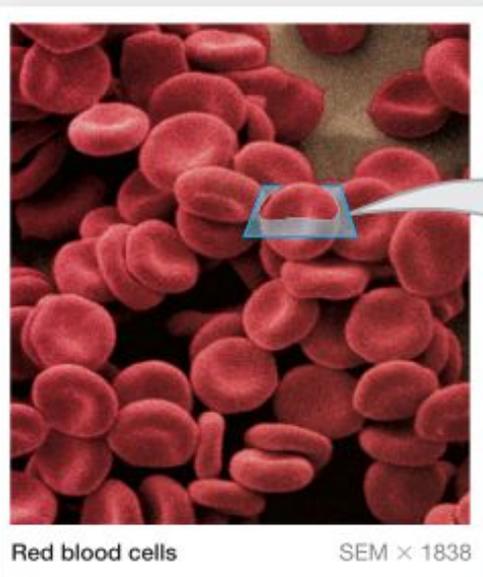
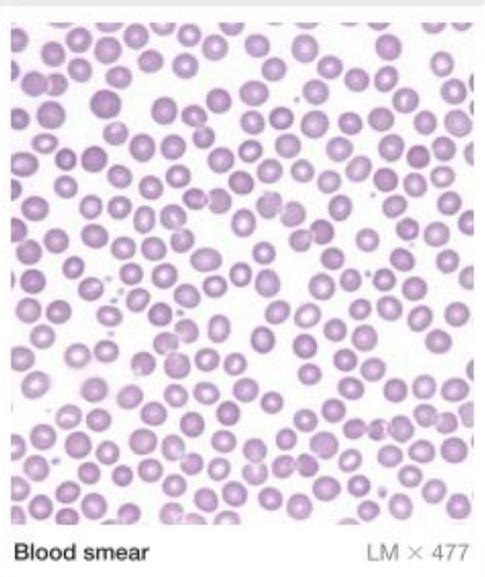


Figure 19–2 The Anatomy of Red Blood Cells.

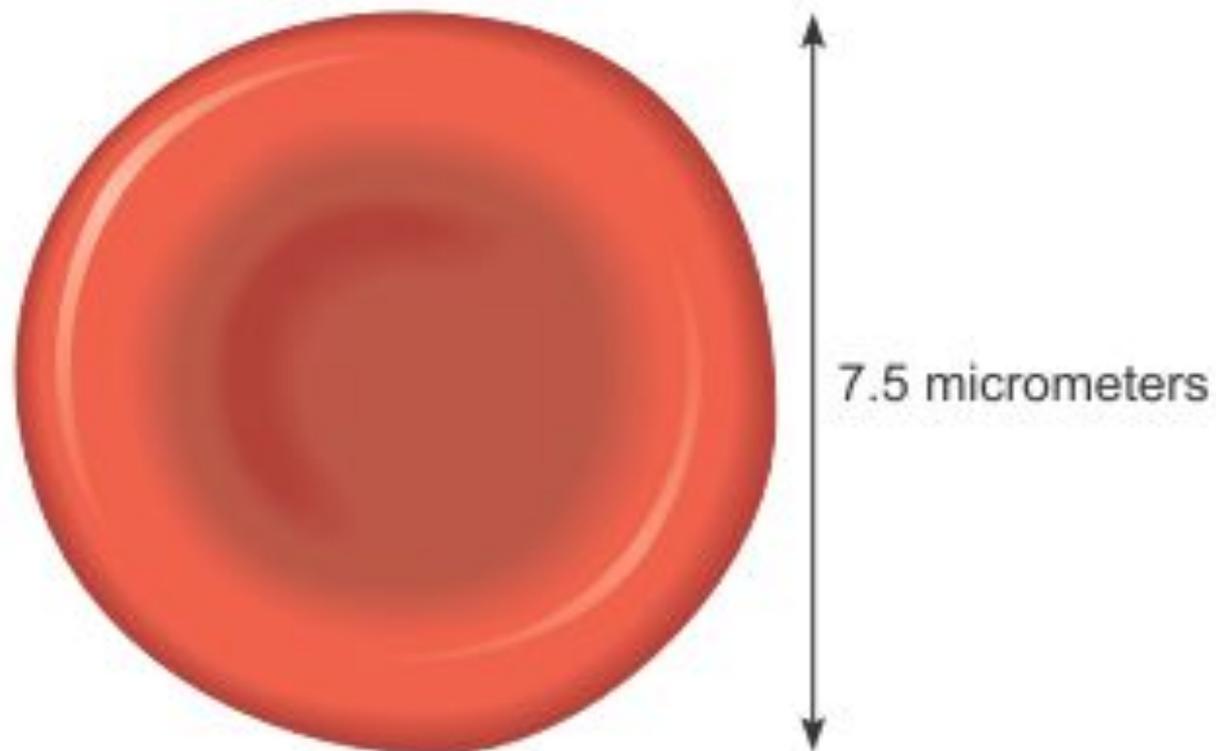


a When viewed in a standard blood smear, RBCs appear as two-dimensional objects, because they are flattened against the surface of the slide.

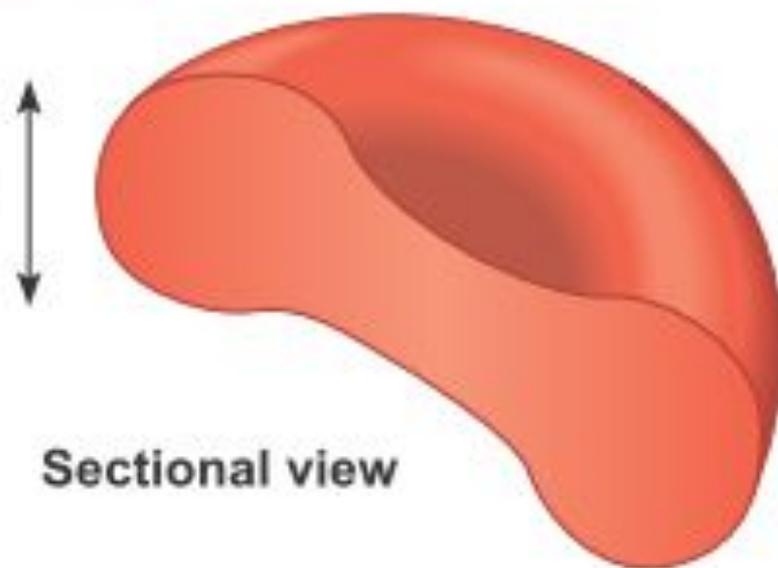
b The three-dimensional shape of RBCs

c A sectional view of a mature RBC, showing the normal ranges for its dimensions

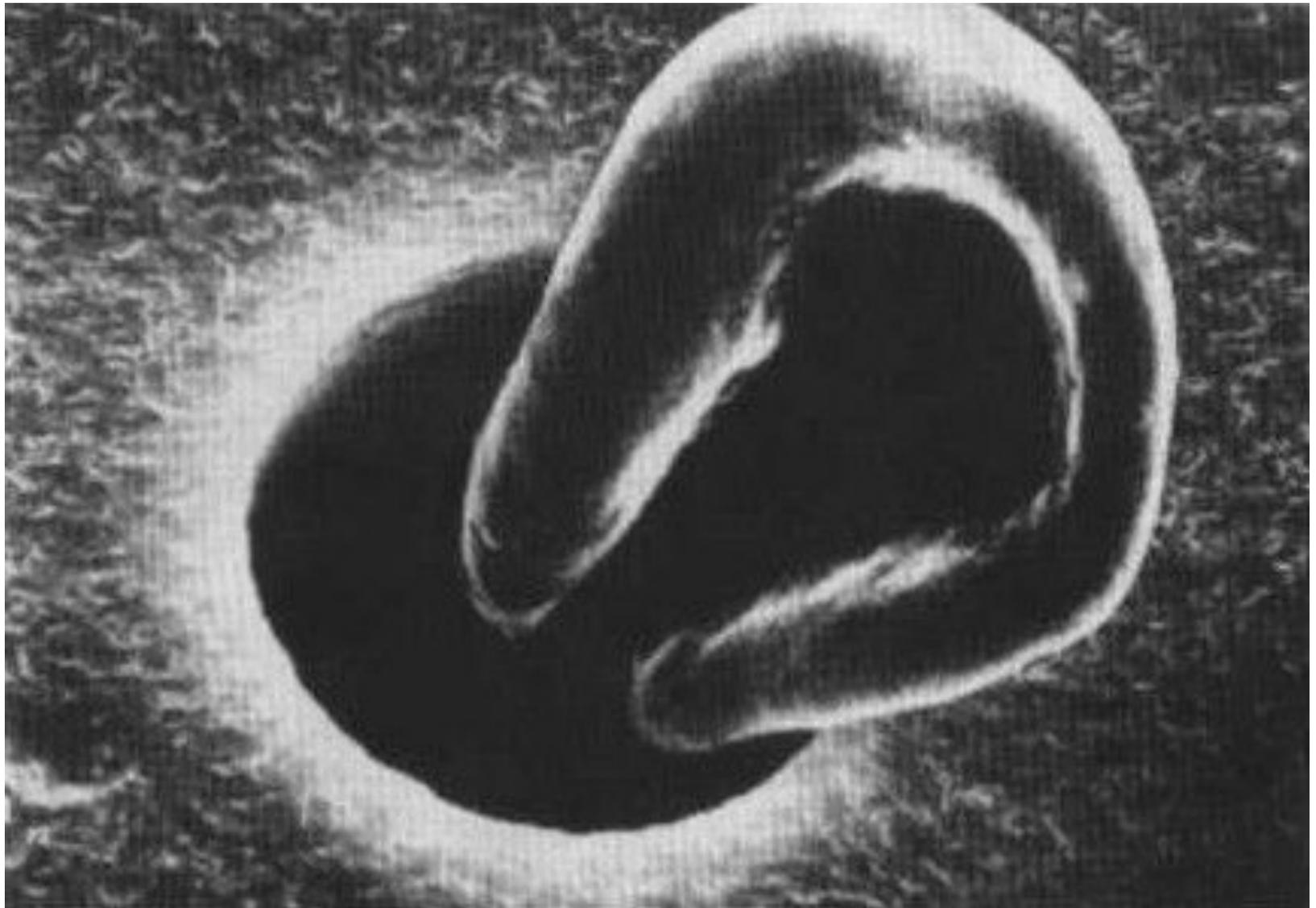
Top view

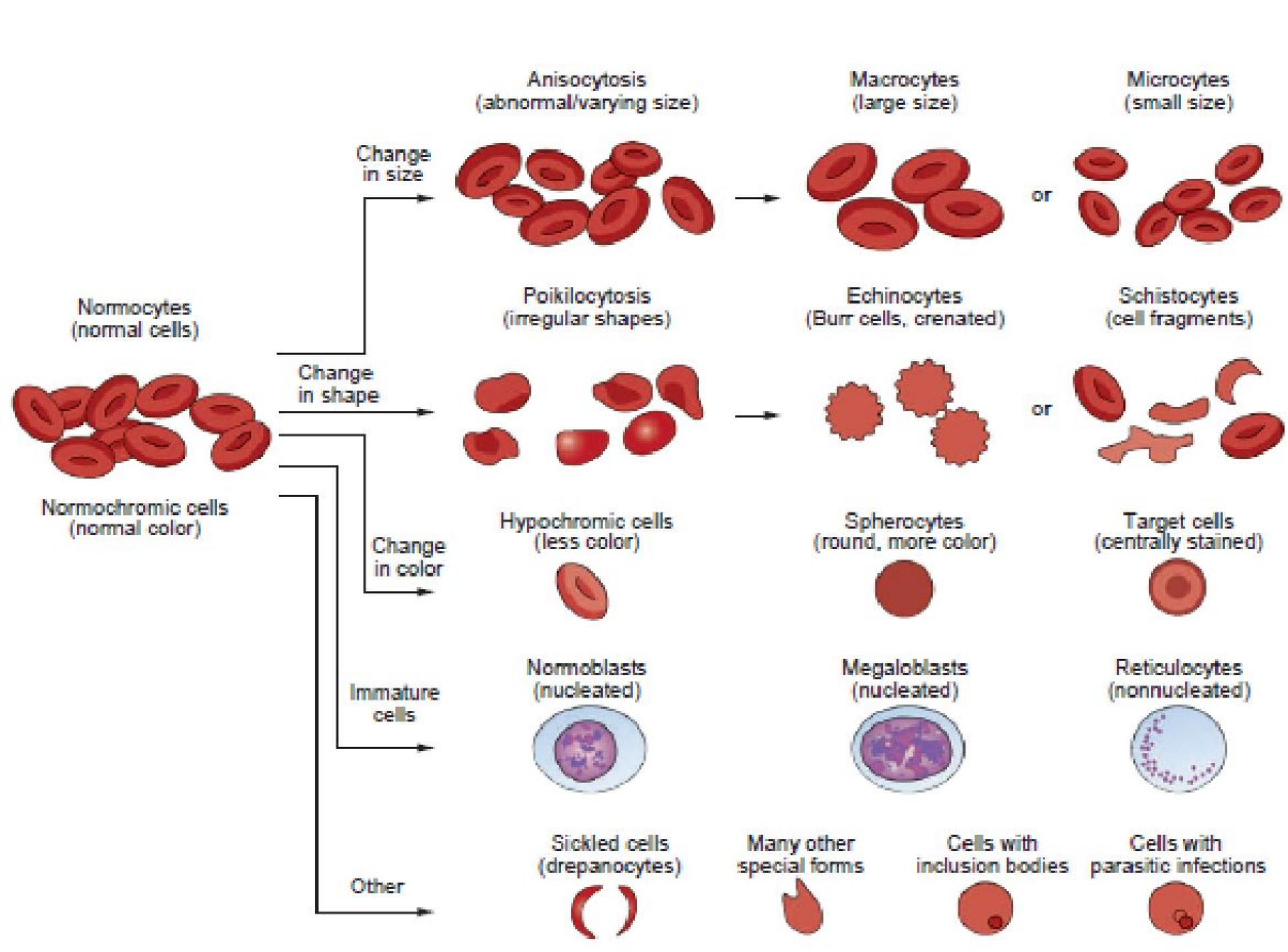


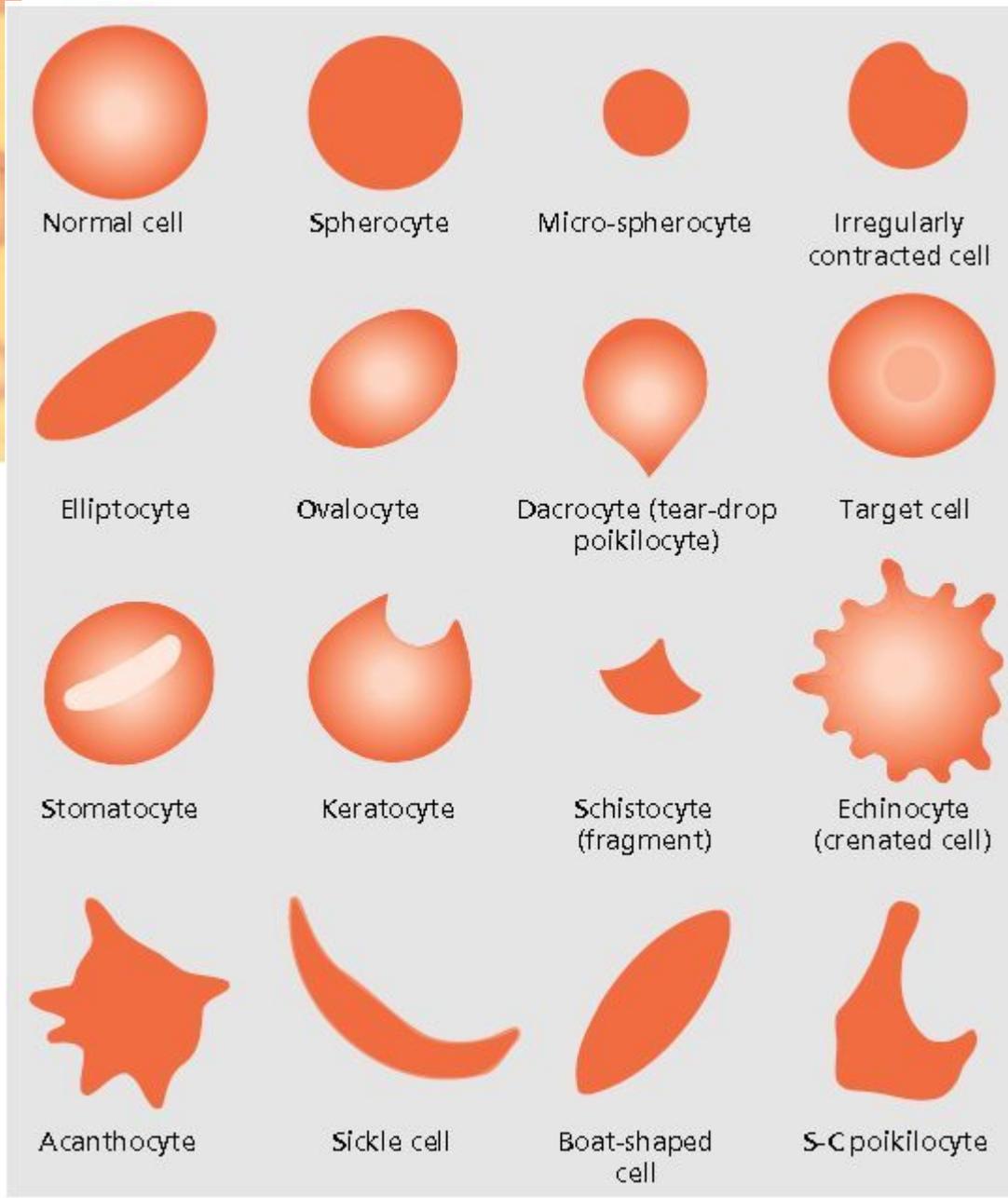
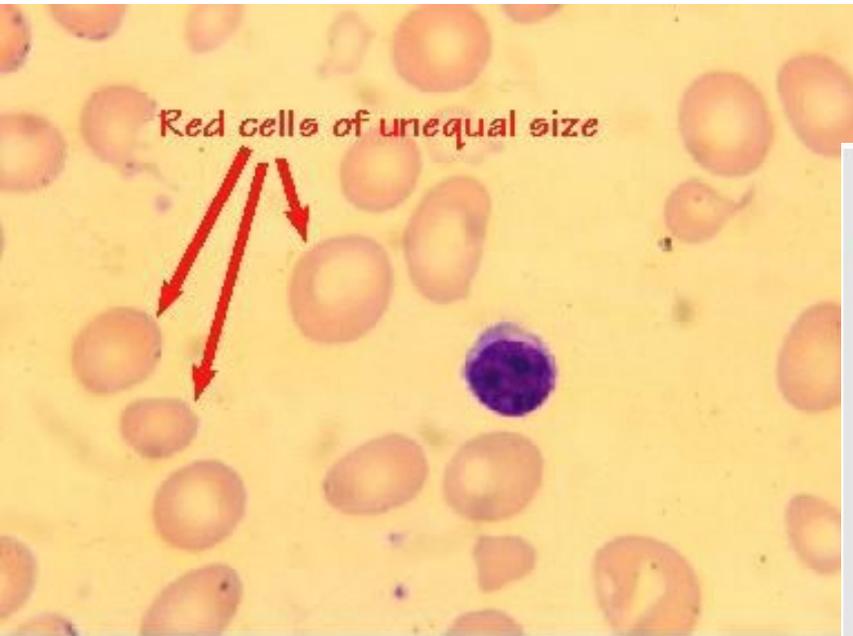
2.0 micrometers

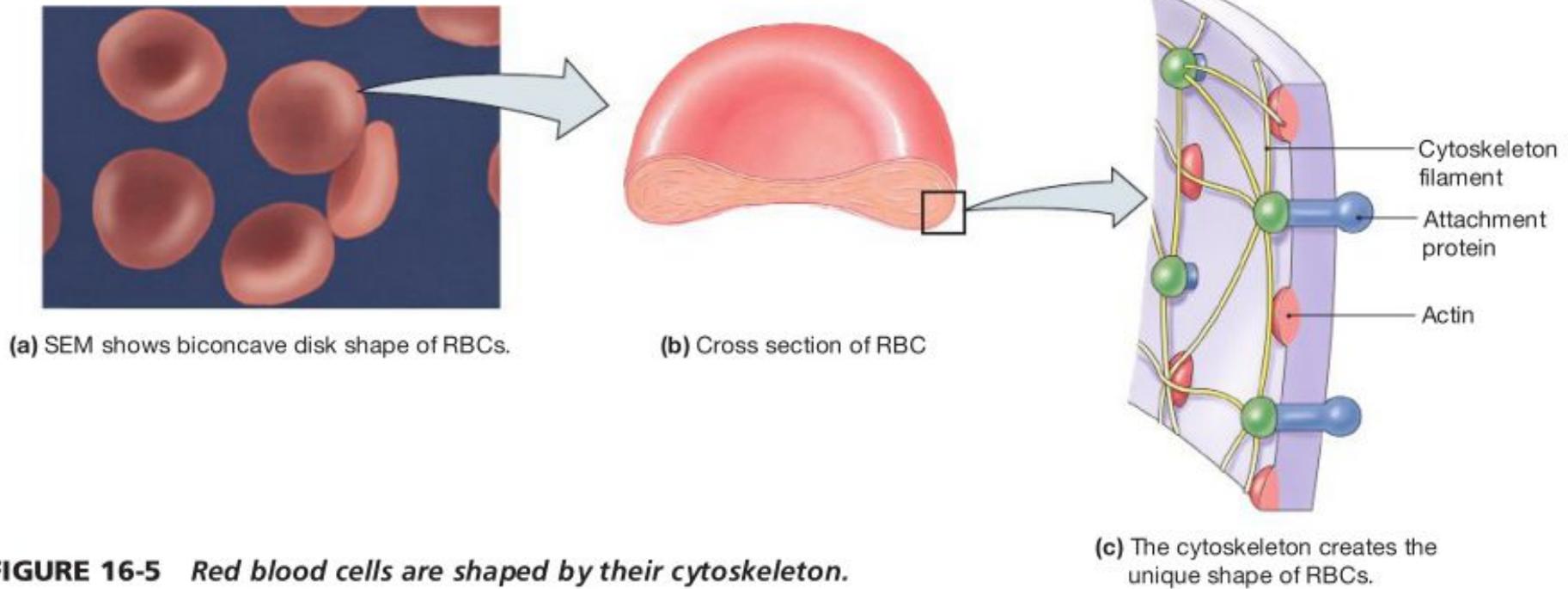


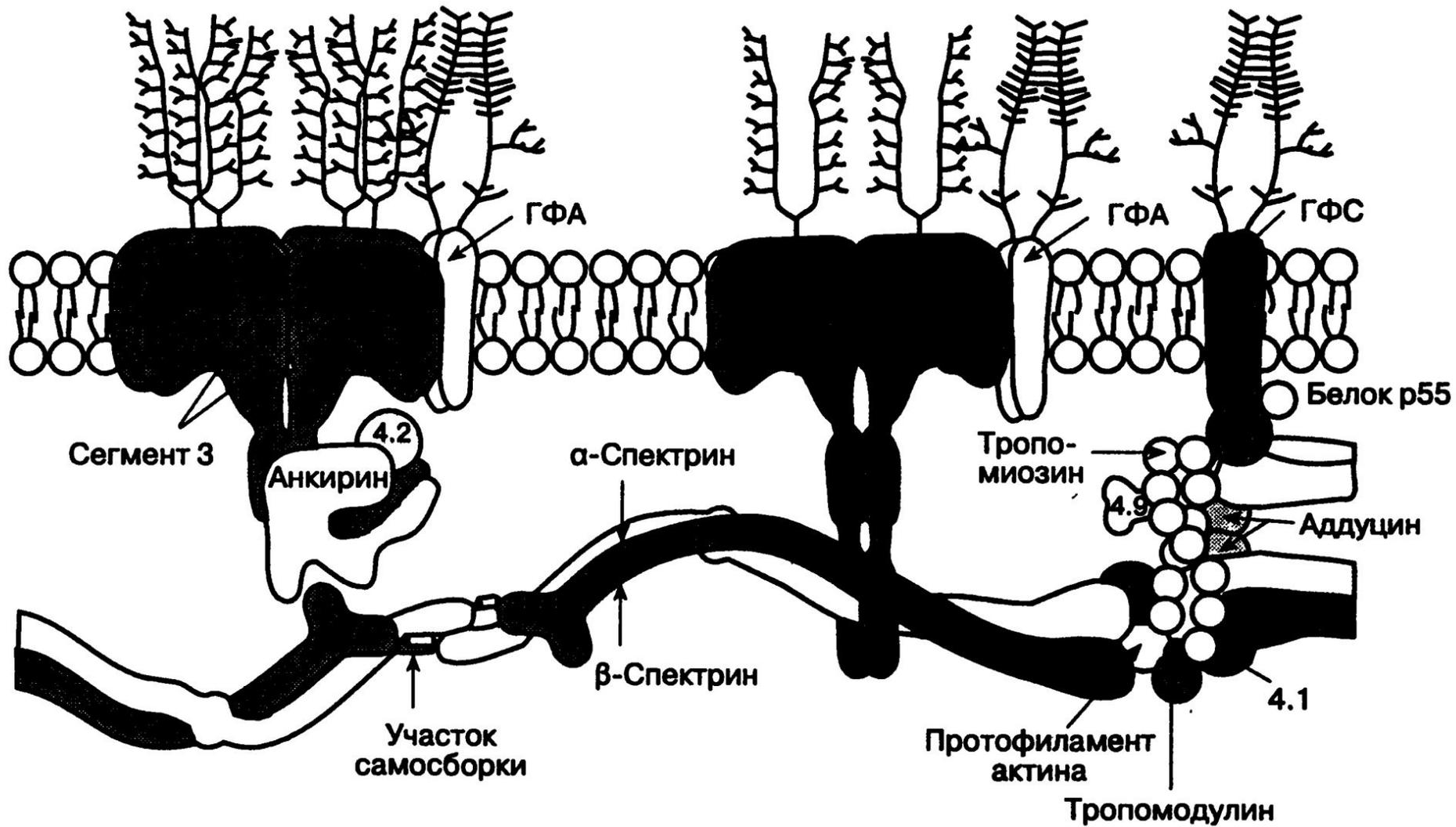
(a)

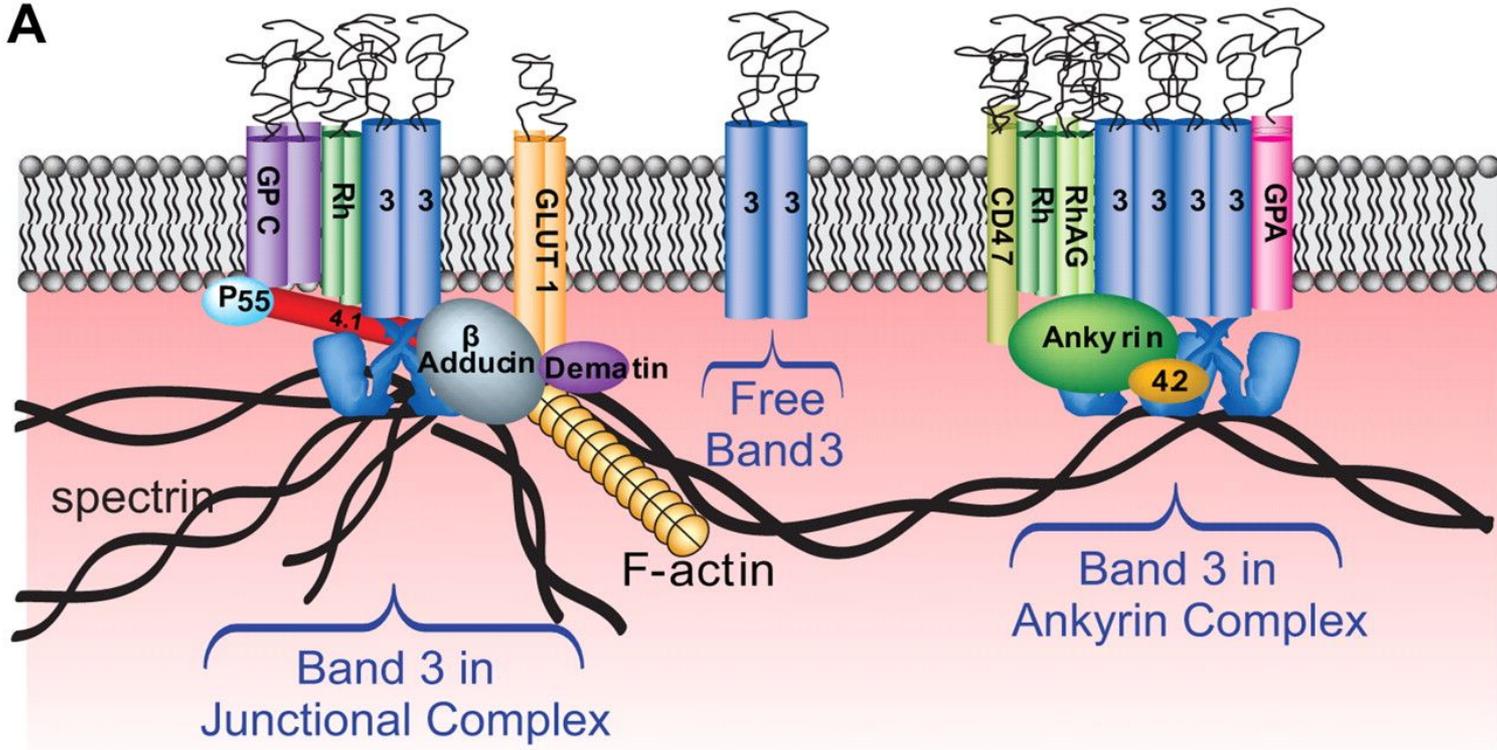
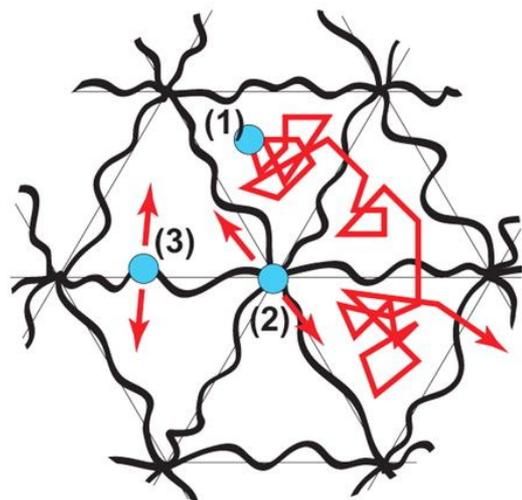


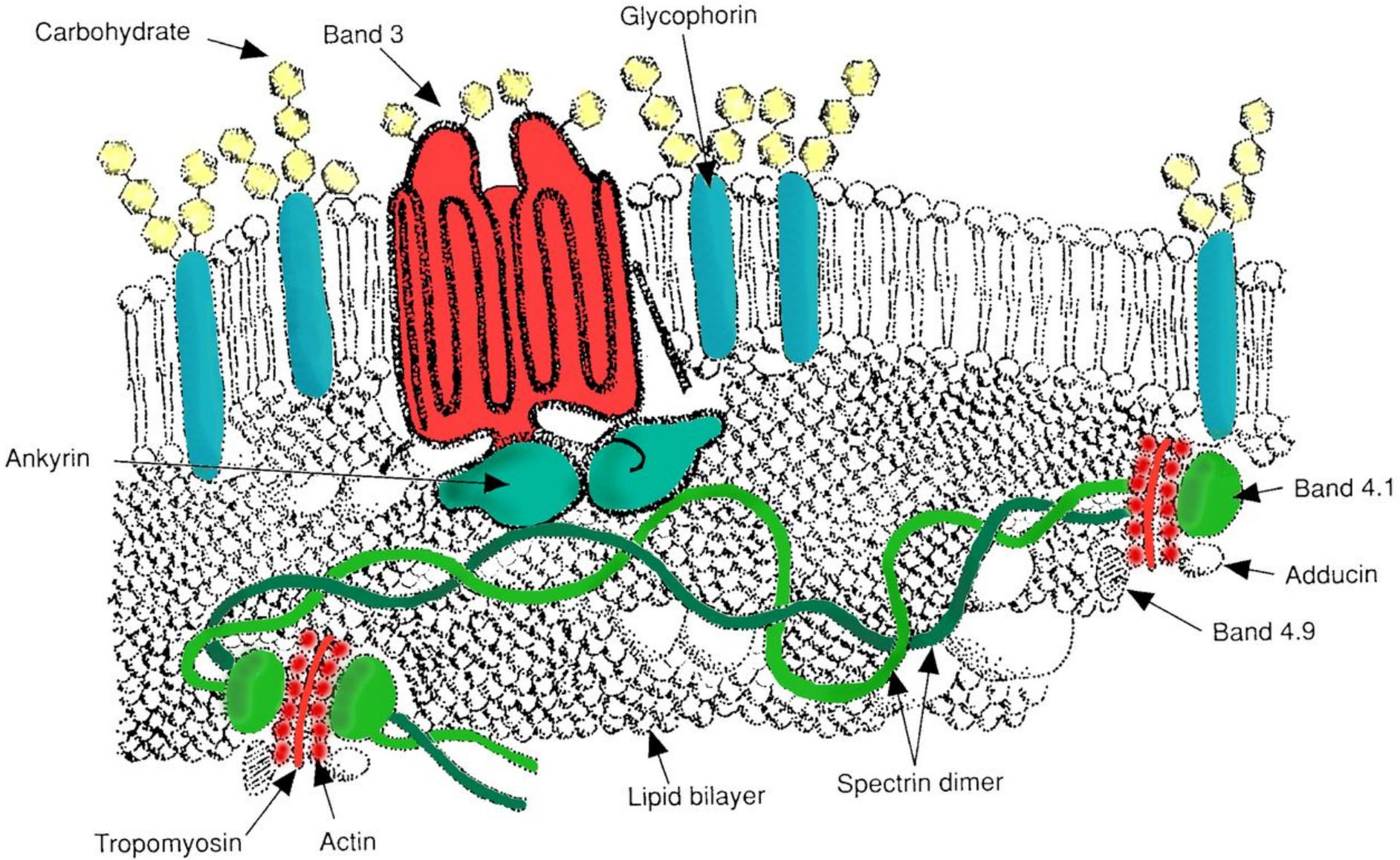






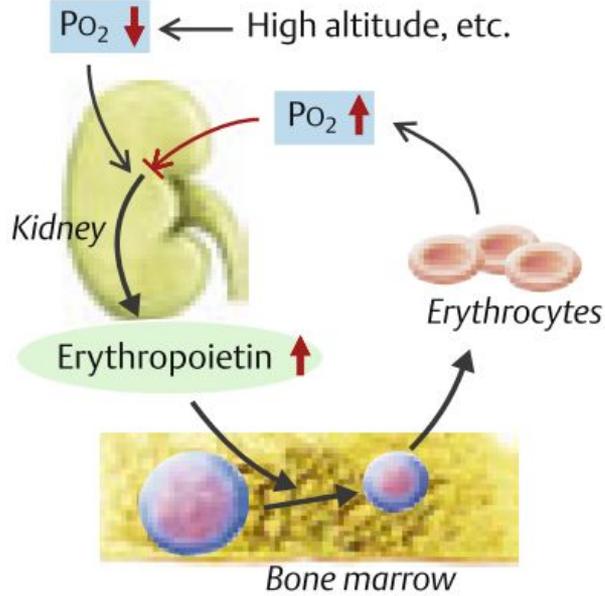


A**B**

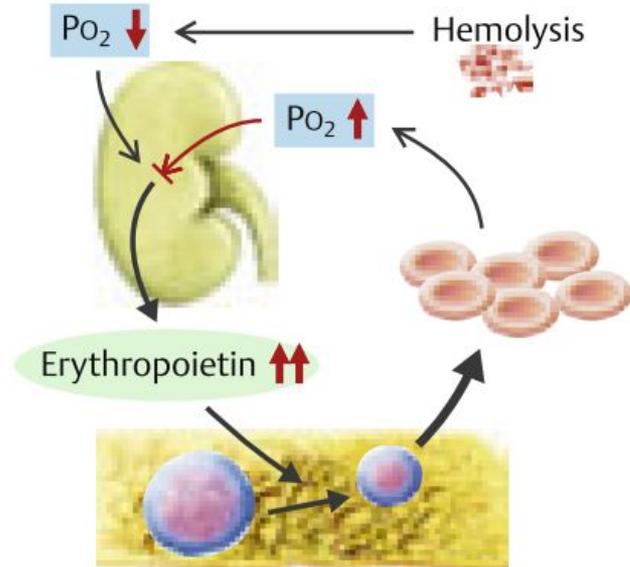


A. Regulation of RBC production

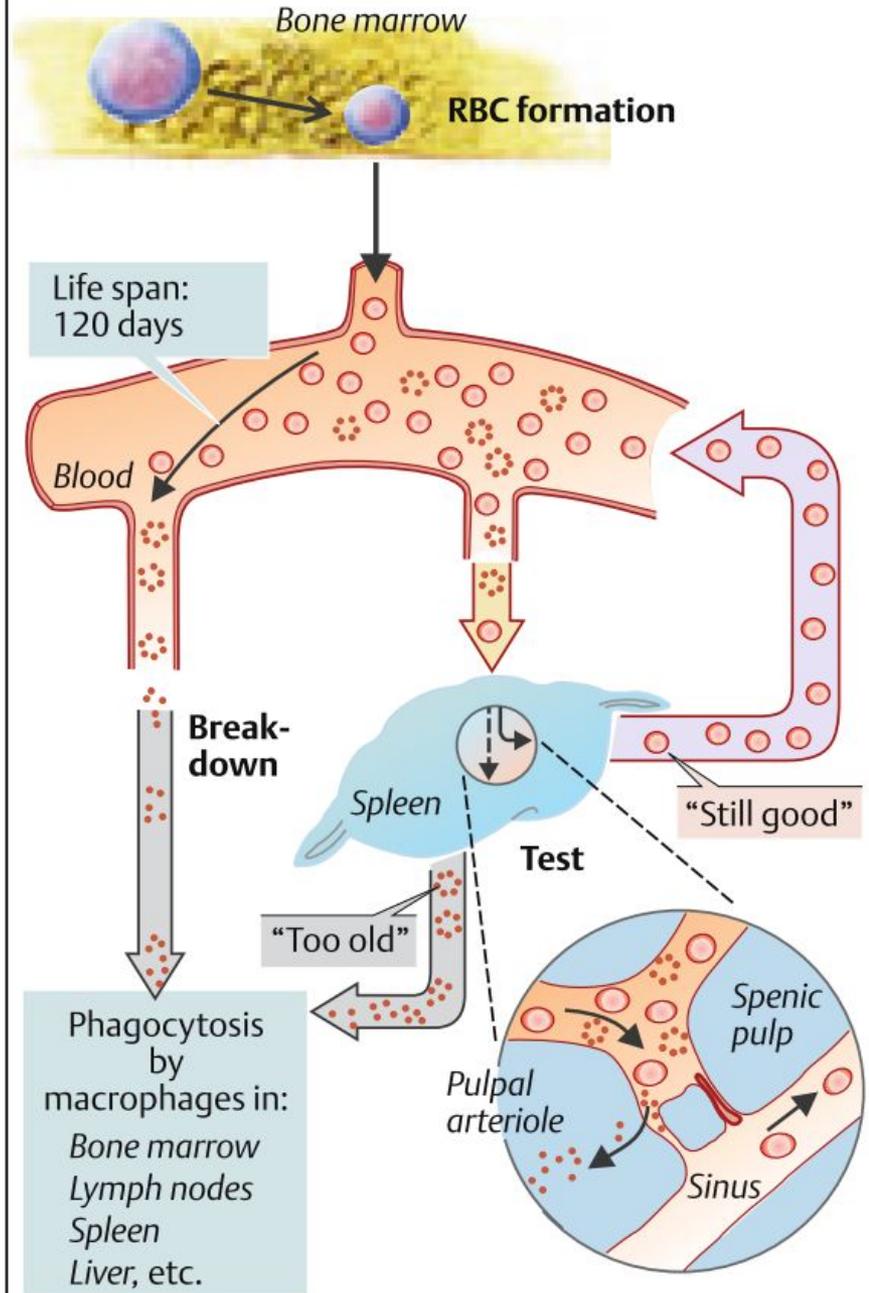
1 Hypoxia

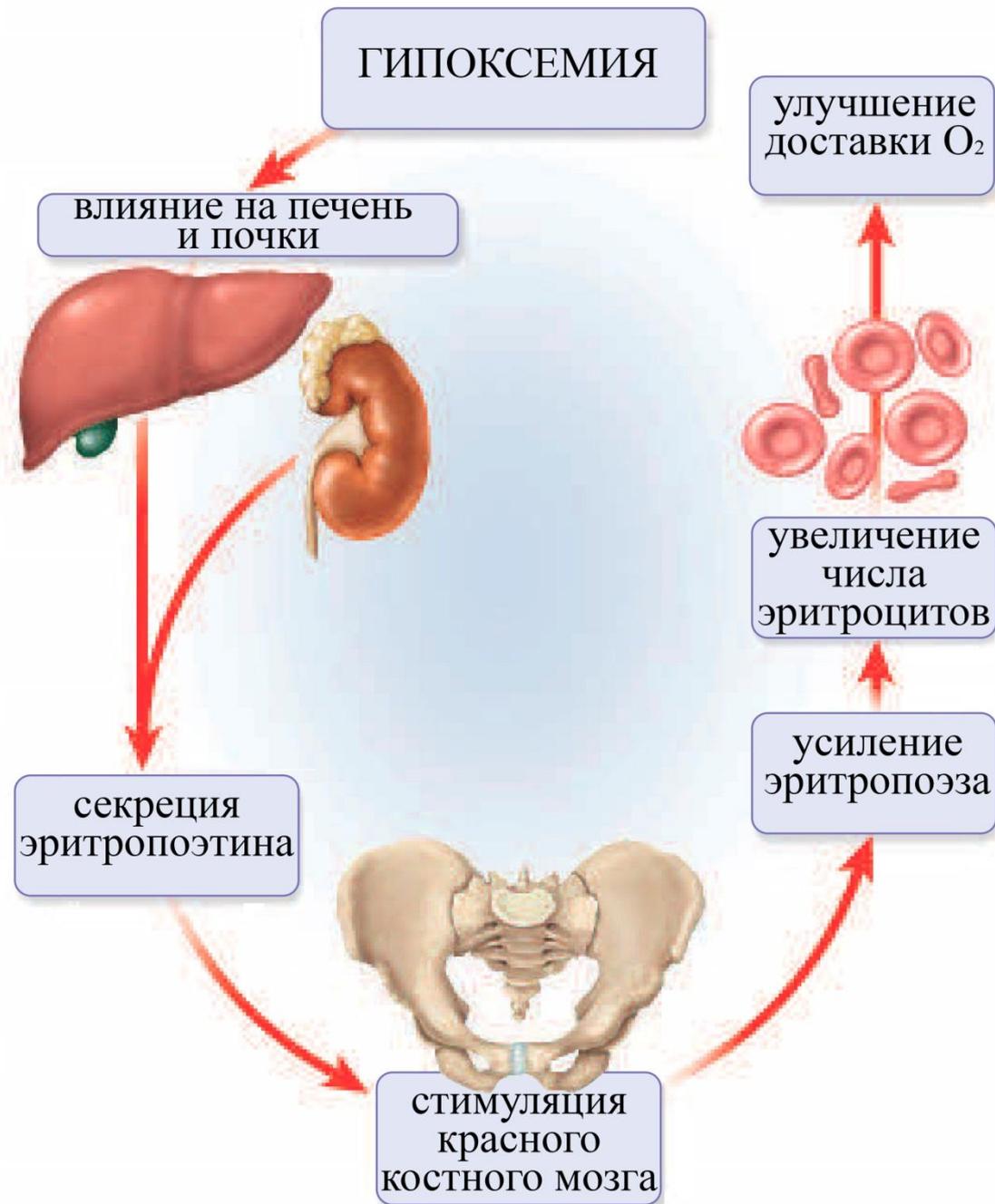


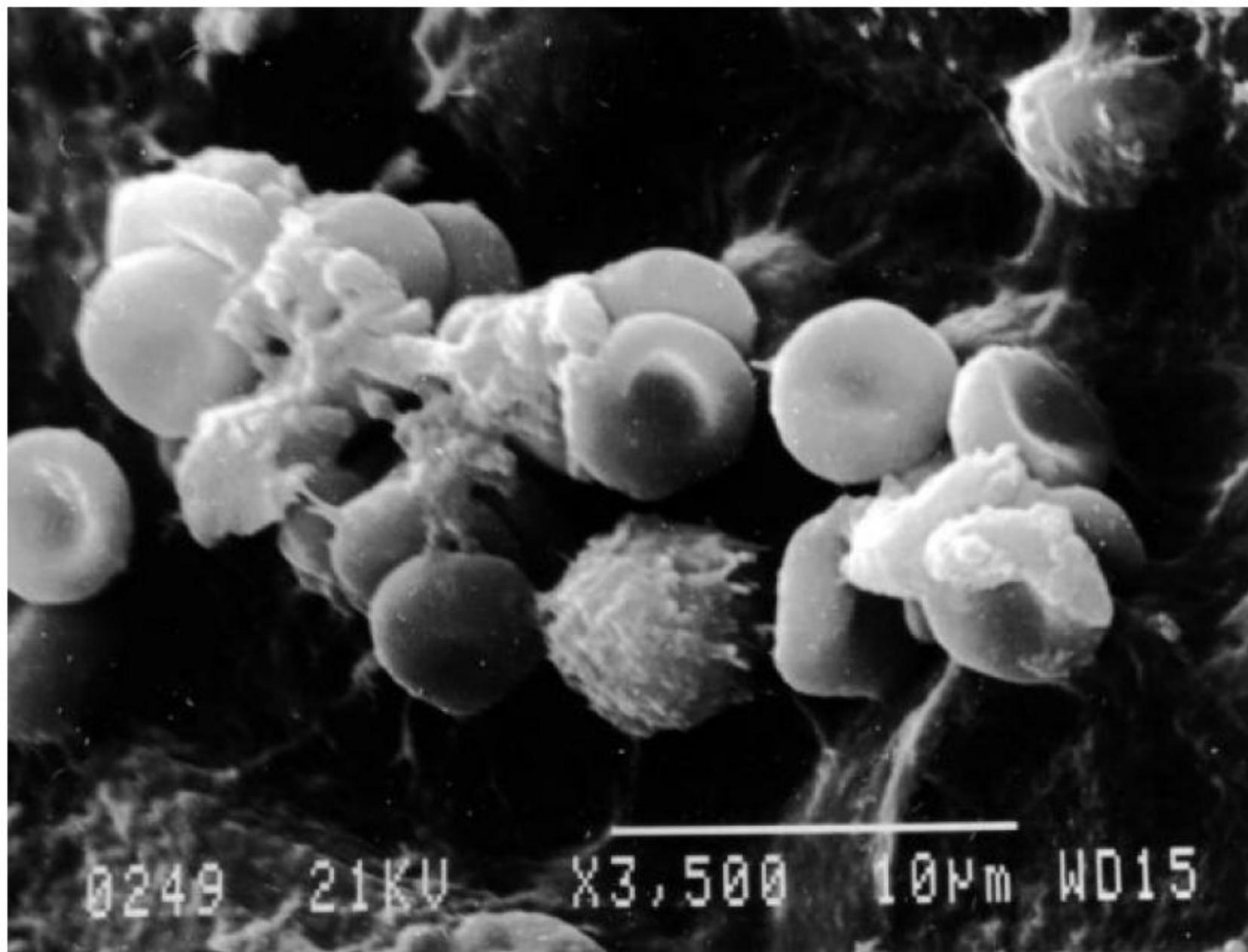
2 Hemolysis



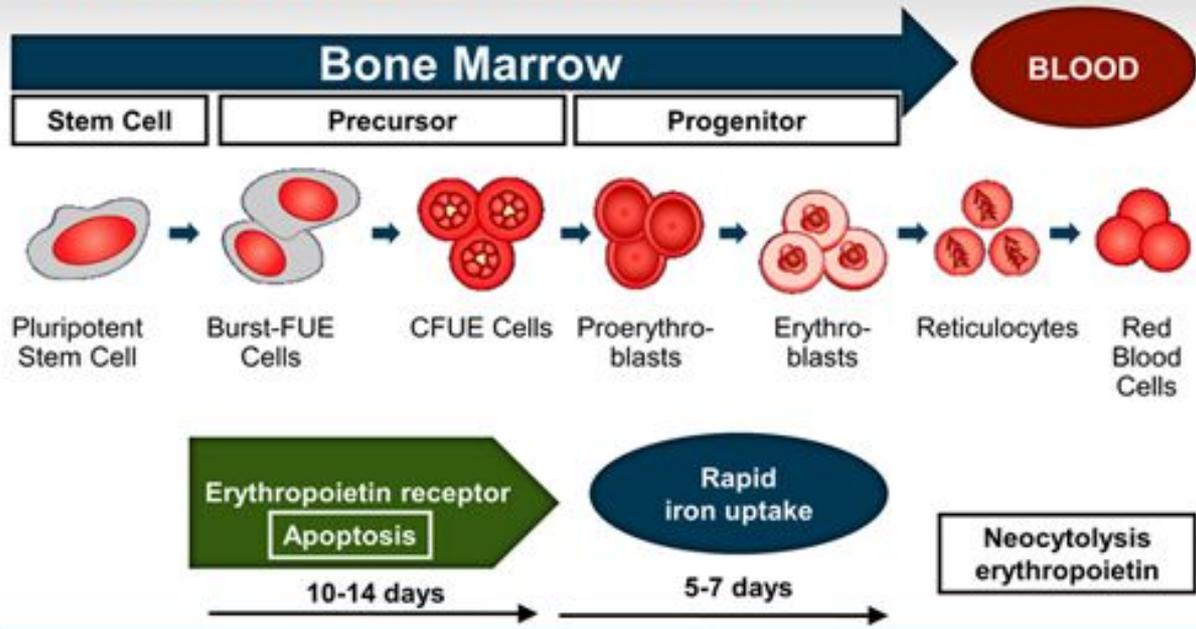
B. Life cycle of red blood cells



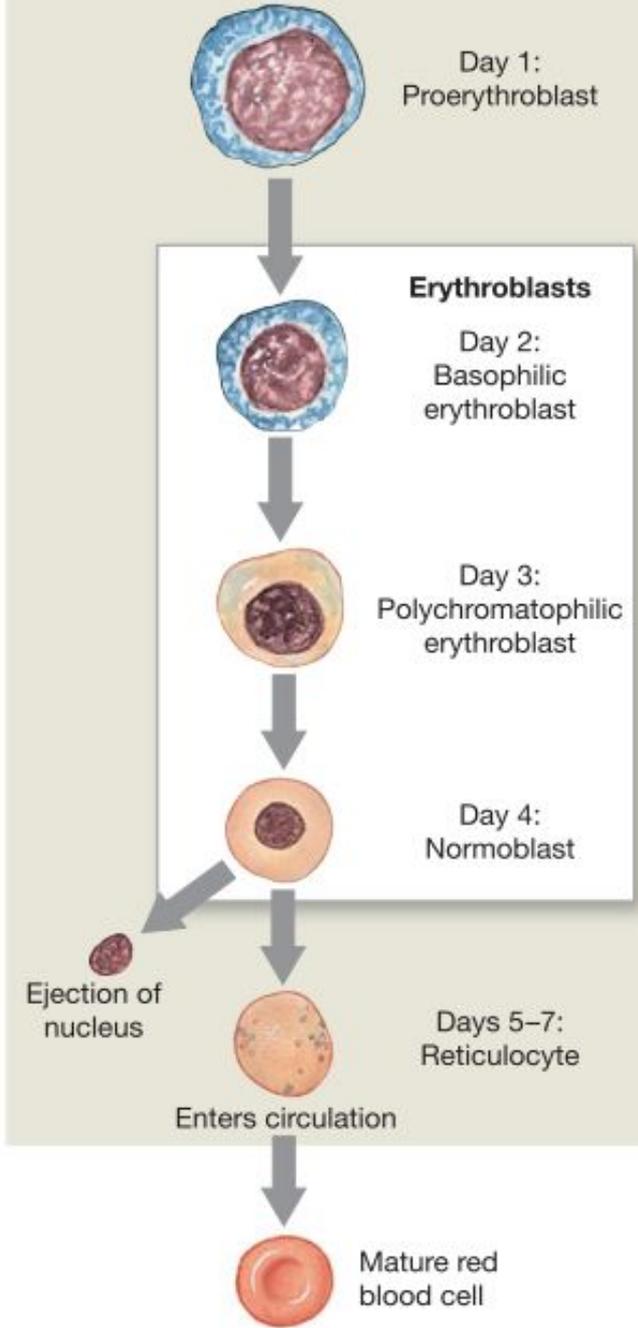




Red Blood Cell Maturation

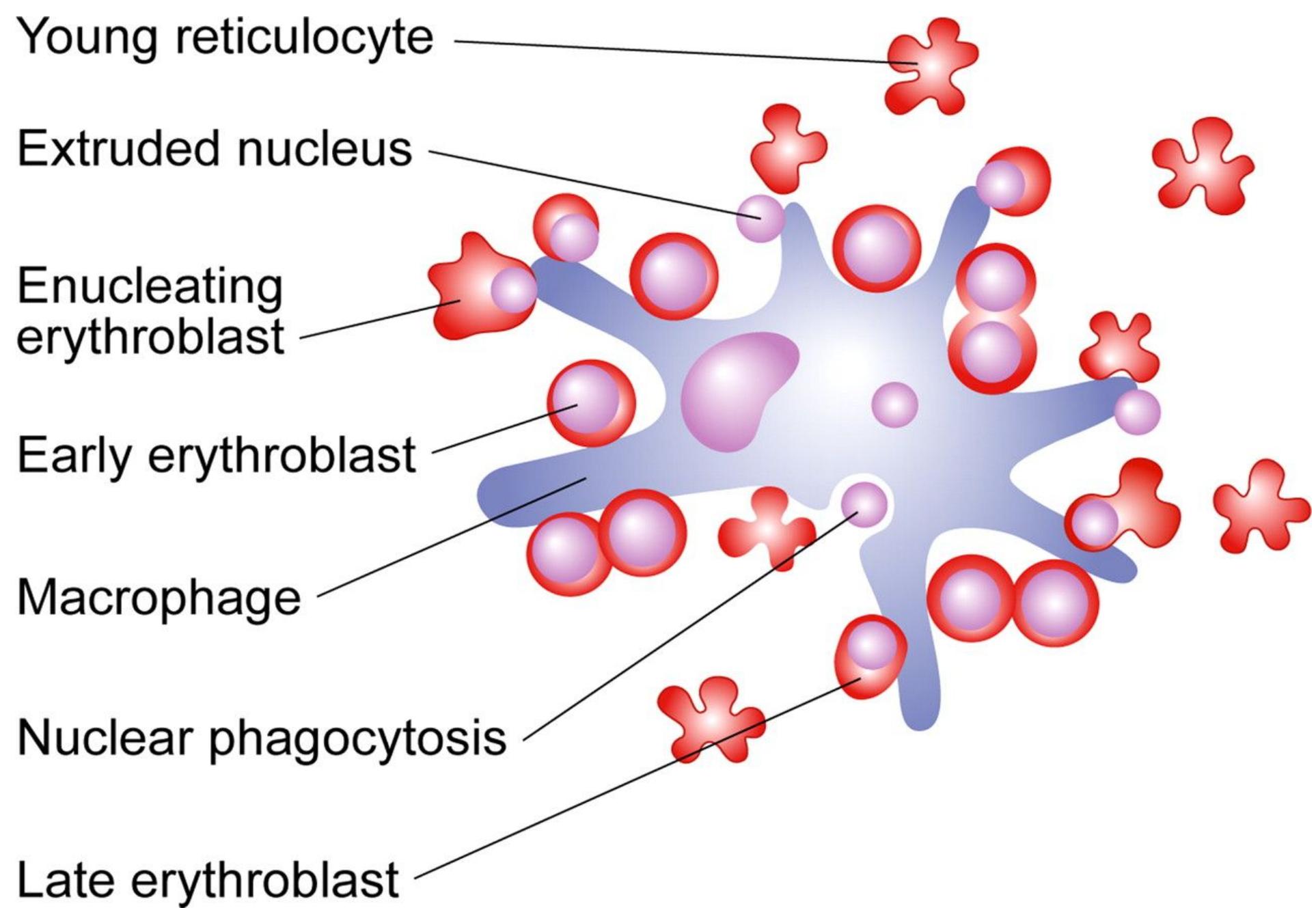


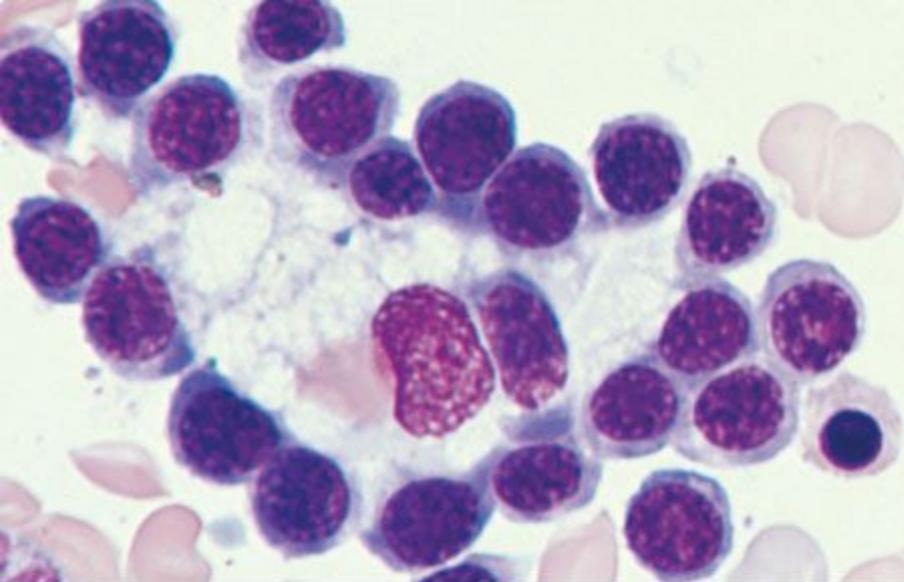
RED BONE MARROW



Requires on average a 3-week cycle for red blood cell maturation

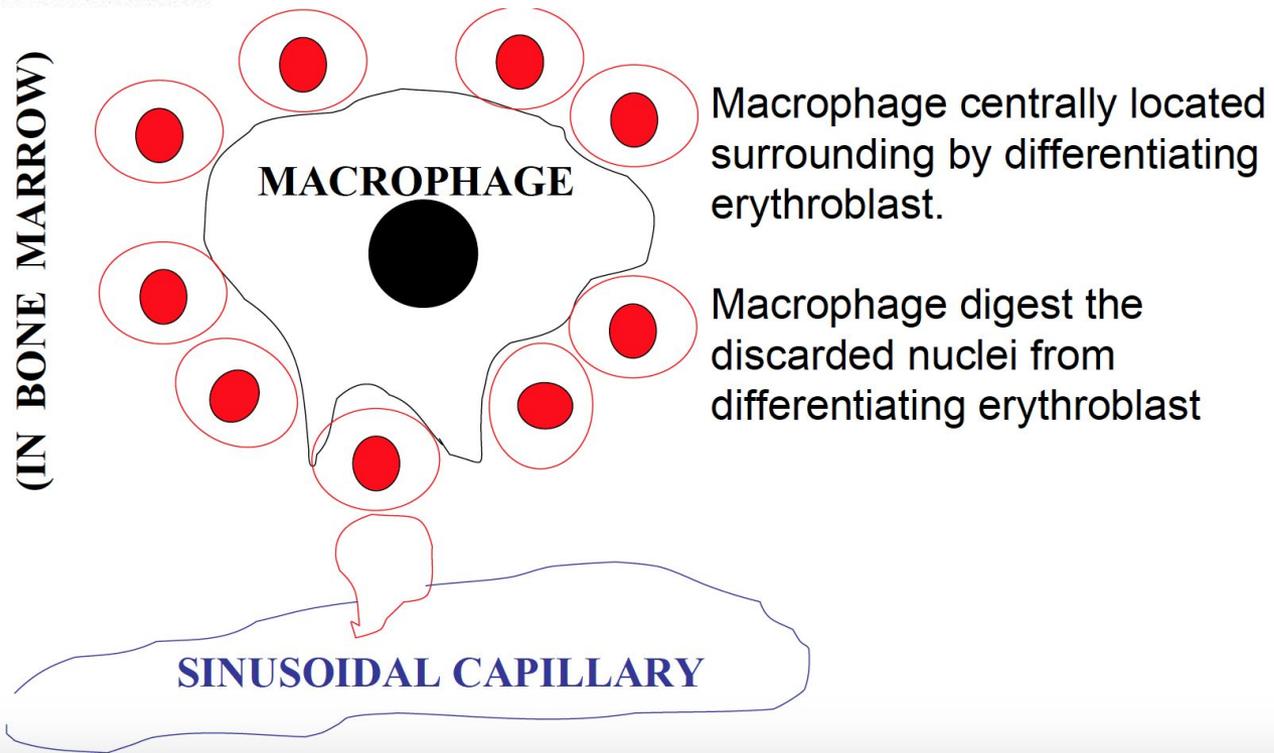
Reprinted from Lankhorst CE, Wish JB. Anemia in renal disease: diagnosis and management. *Blood Rev.* 2010;24:39-47, with permission from Elsevier.



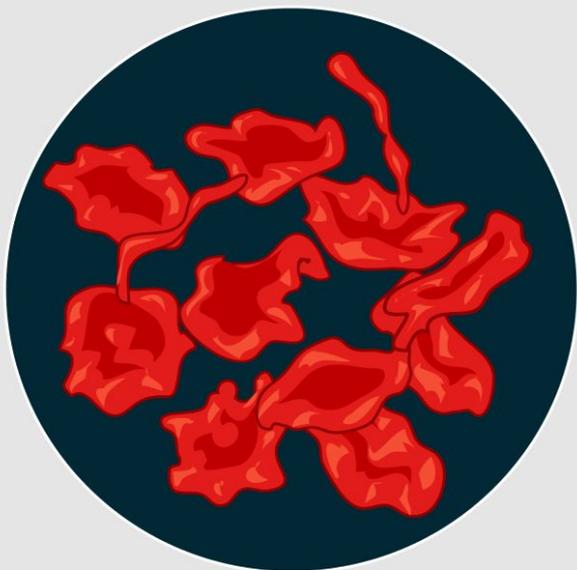


Source: Lichtman MA, Beutler E, Kipps TJ, Seligsohn U, Kaushansky K, Prchal JT: *Williams Hematology*, 7th Edition: <http://www.accessmedicine.com>

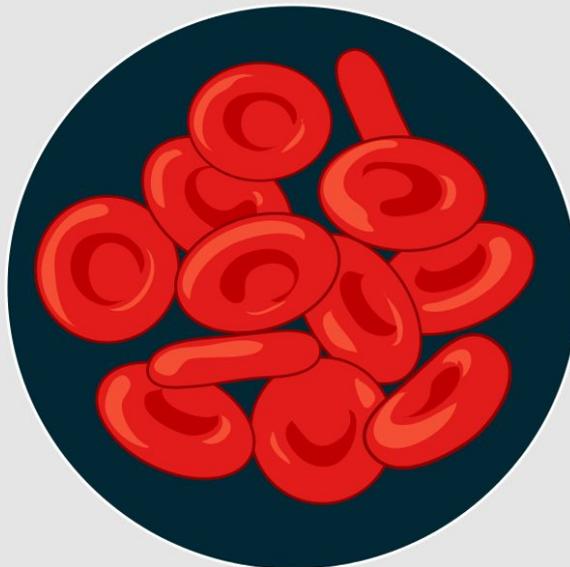
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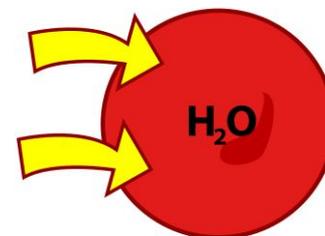
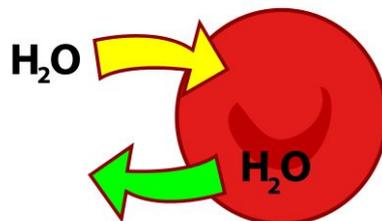
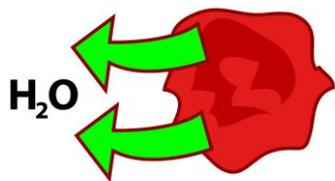
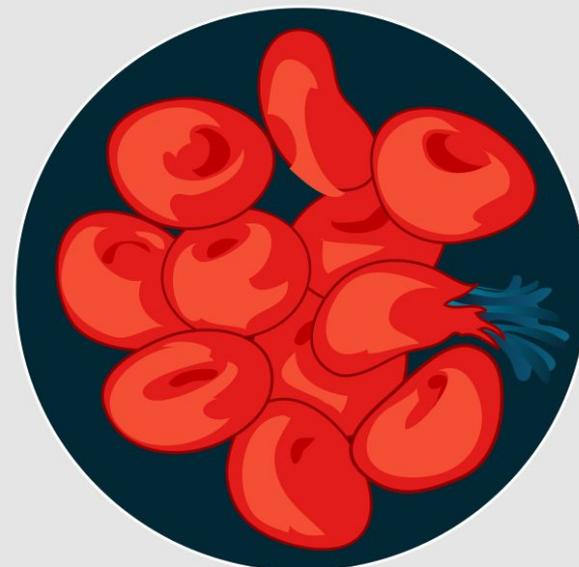
Гипертонический

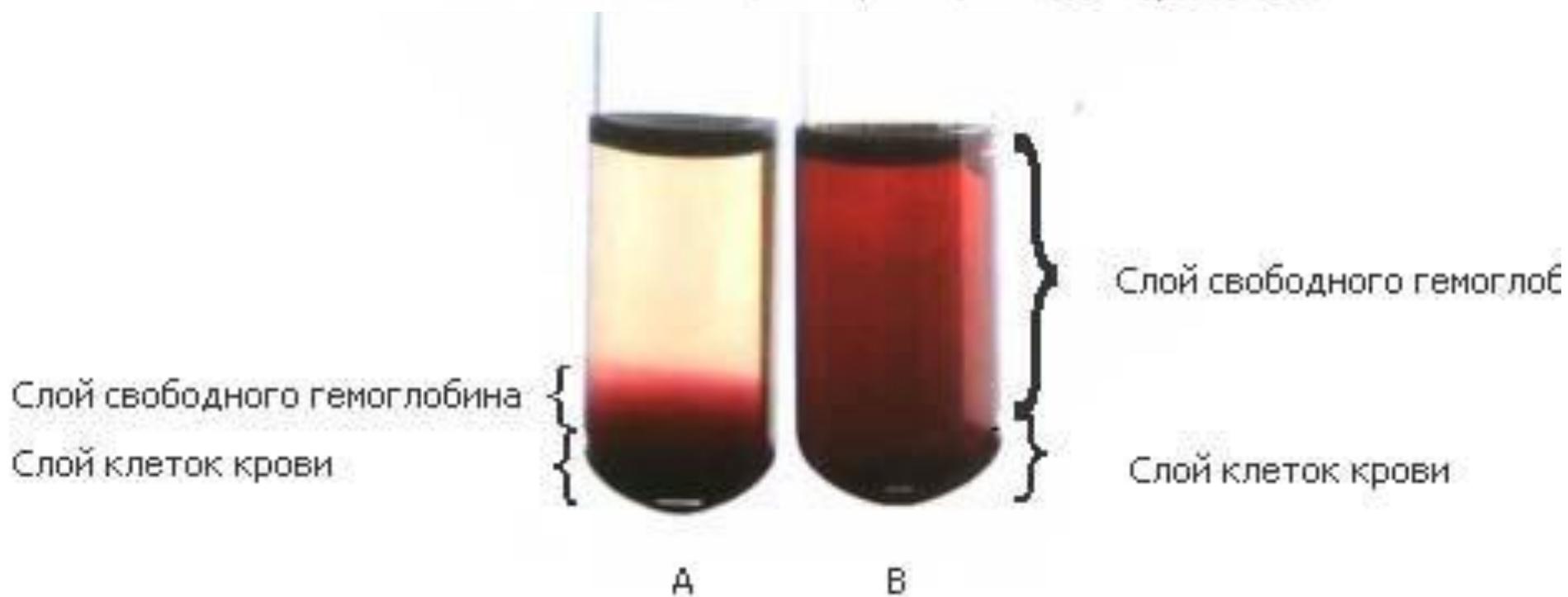
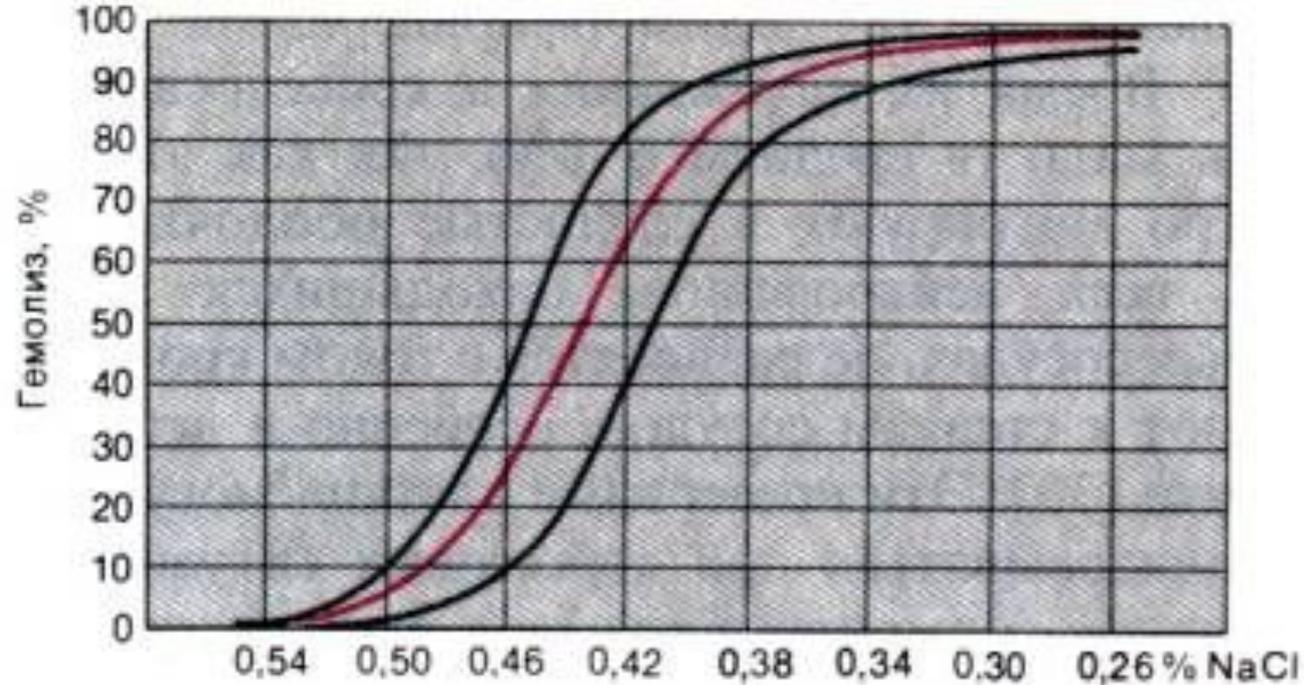


Изотонический



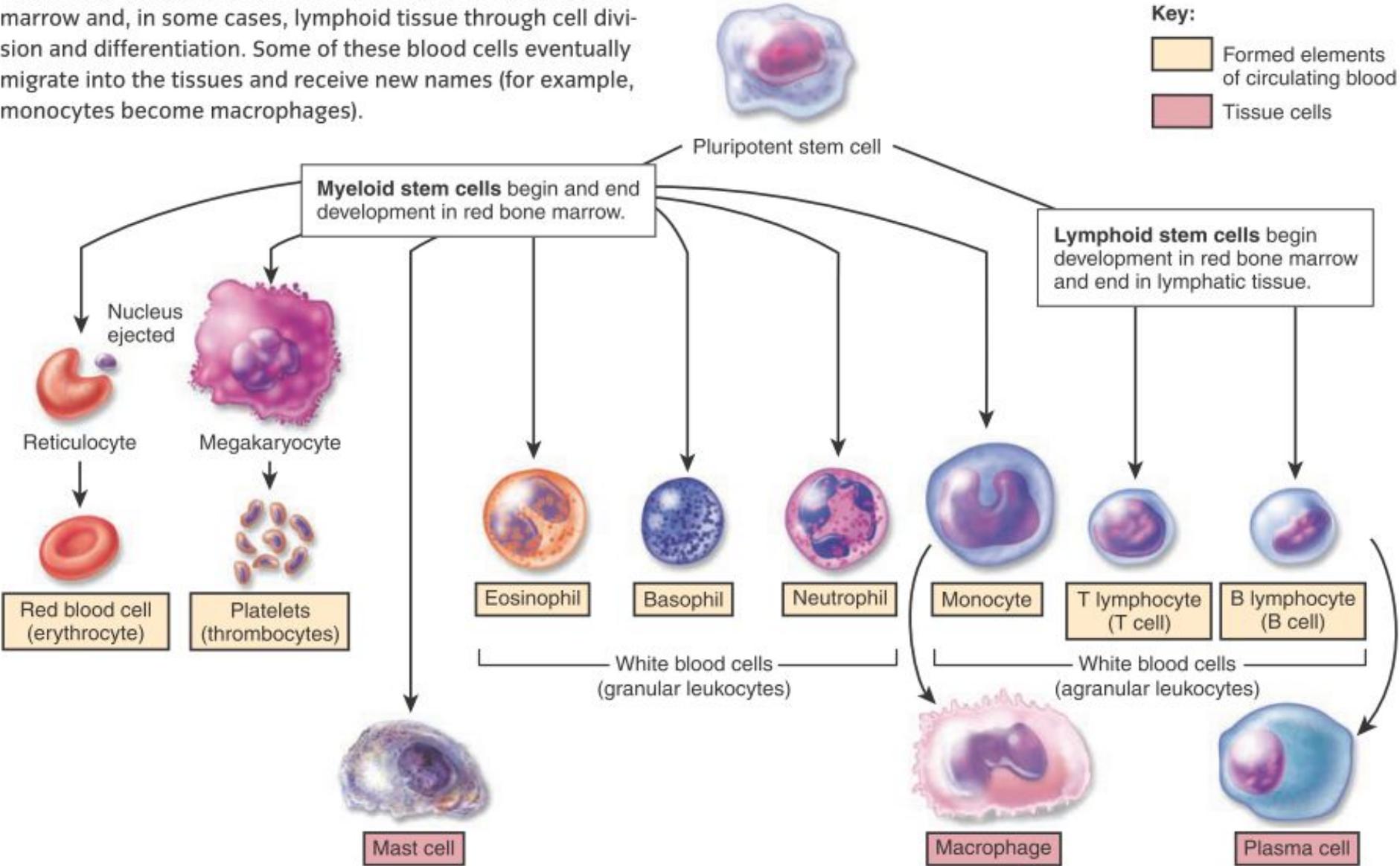
Гипотонический

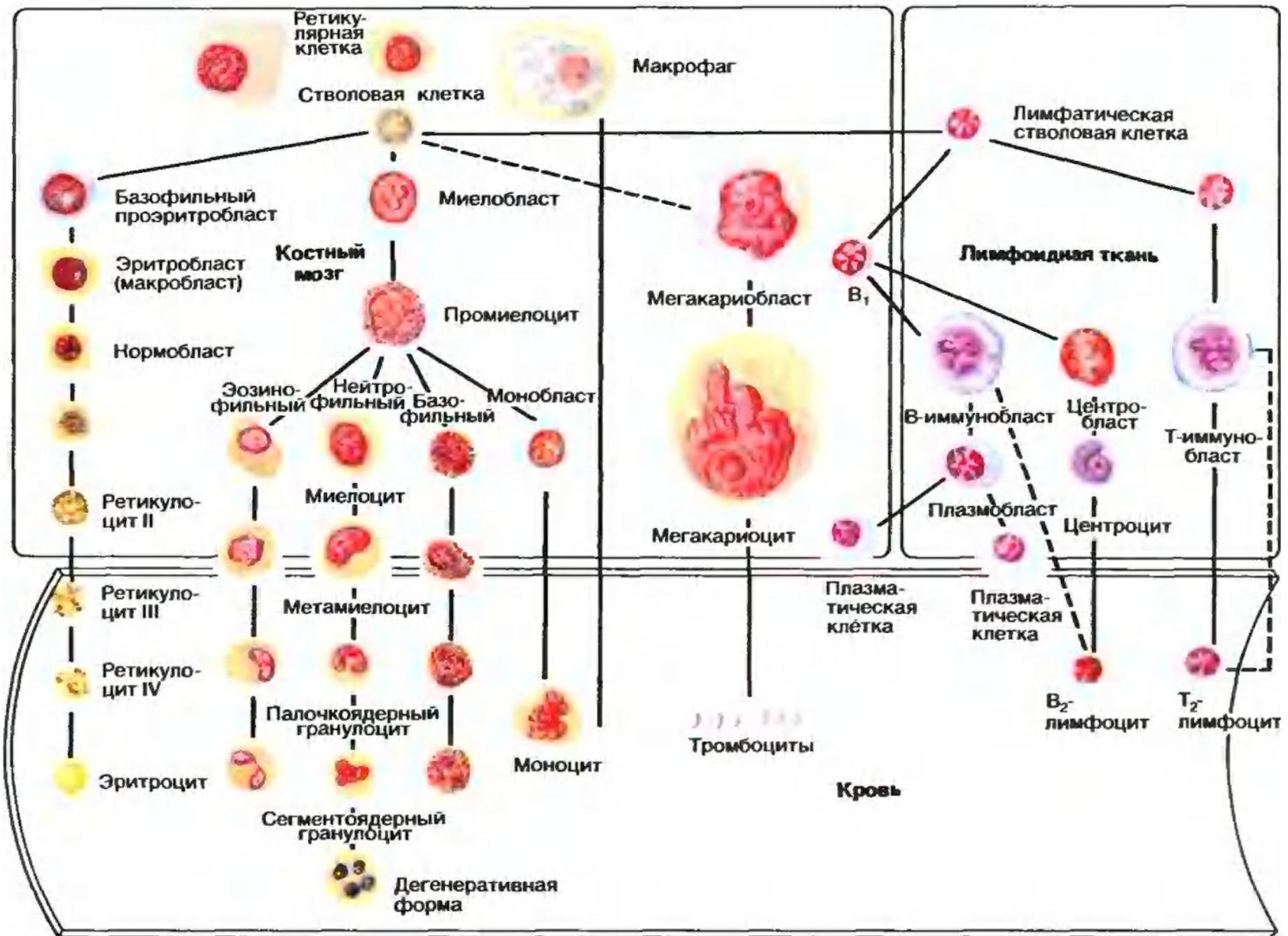




Origin and development of blood cells • Figure 10.4

The various blood cells form from stem cells in the red bone marrow and, in some cases, lymphoid tissue through cell division and differentiation. Some of these blood cells eventually migrate into the tissues and receive new names (for example, monocytes become macrophages).



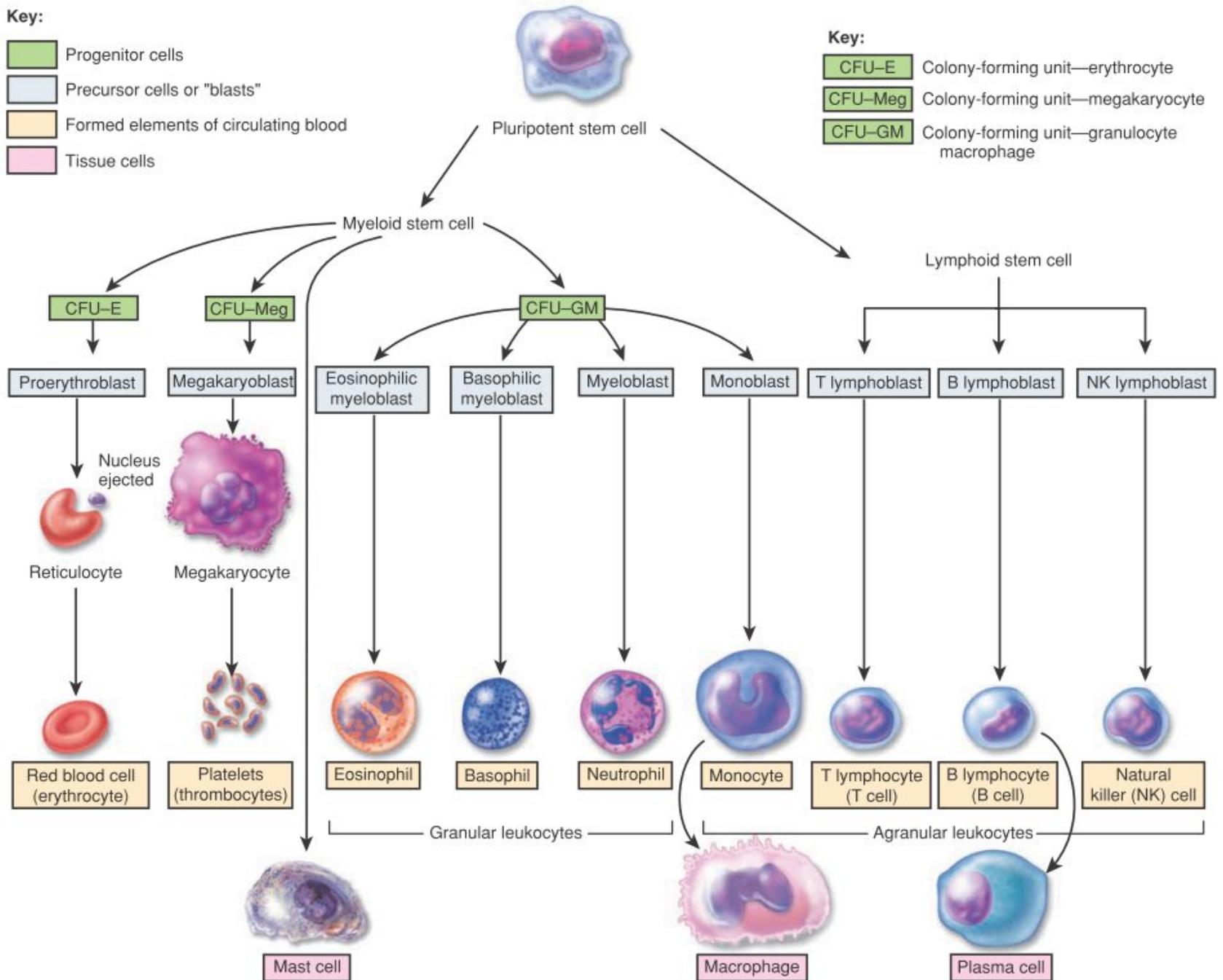


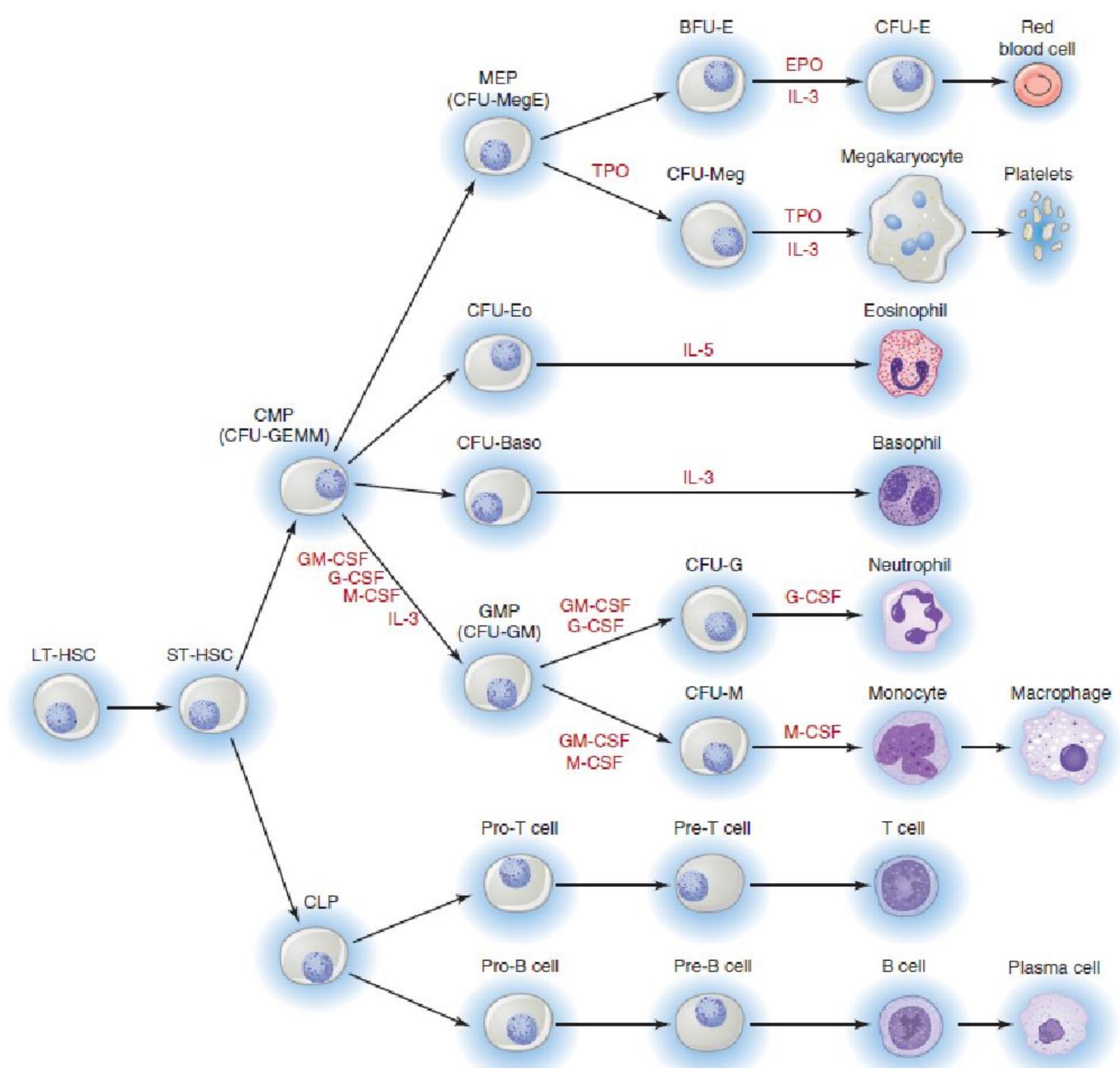
Key:

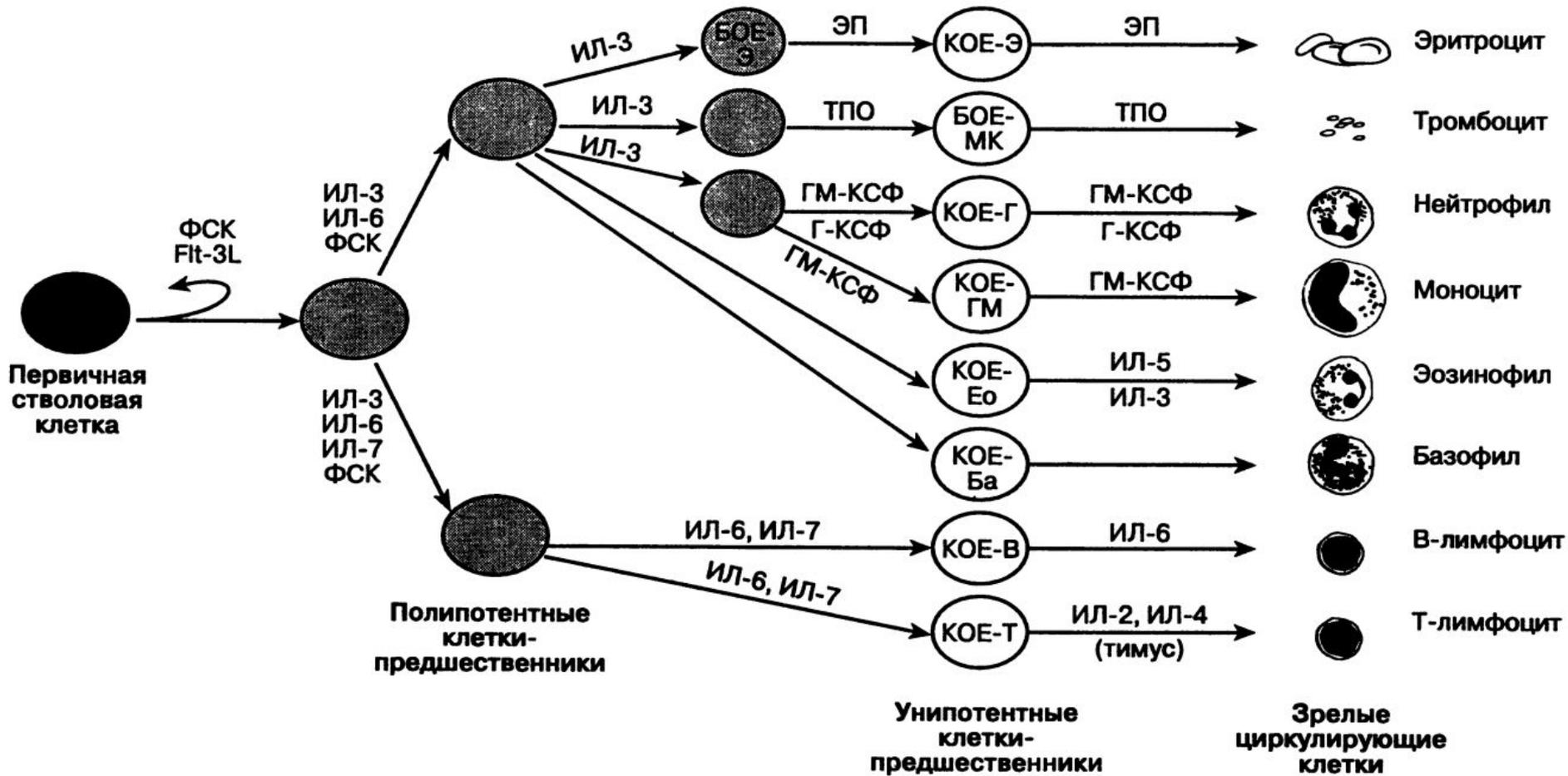
- Progenitor cells
- Precursor cells or "blasts"
- Formed elements of circulating blood
- Tissue cells

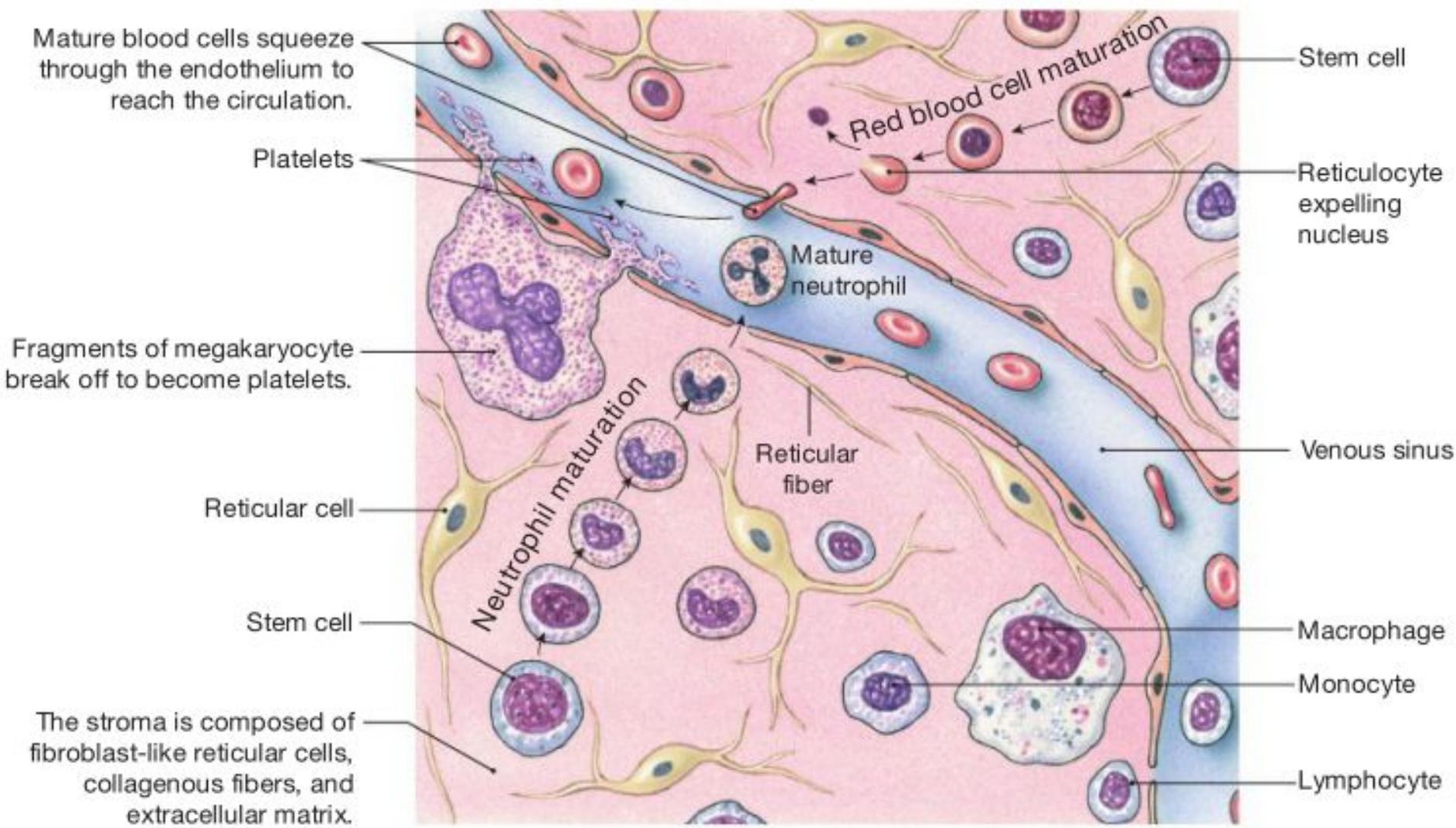
Key:

- CFU-E Colony-forming unit—erythrocyte
- CFU-Meg Colony-forming unit—megakaryocyte
- CFU-GM Colony-forming unit—granulocyte macrophage

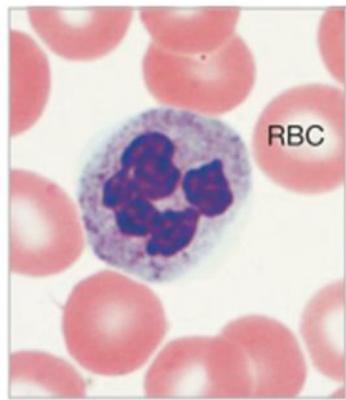




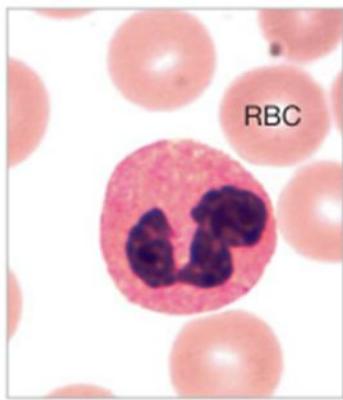




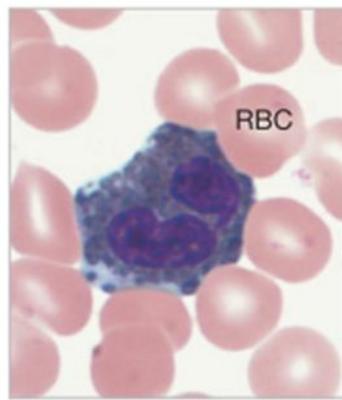
(c) Bone marrow consists of blood cells in different stages of development and supporting tissue known as the **stroma** [mattress].



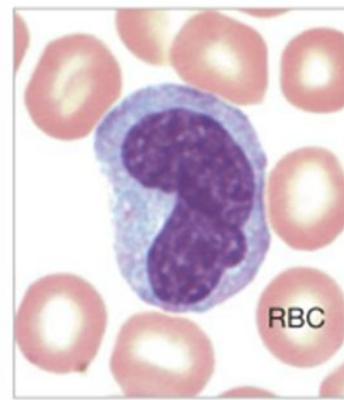
a Neutrophil LM \times 1500



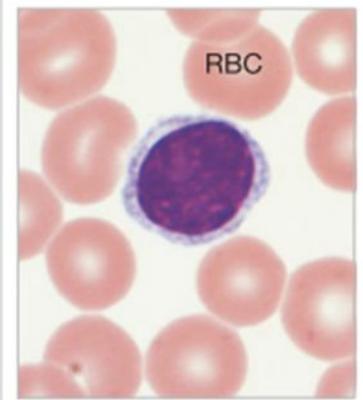
b Eosinophil LM \times 1500



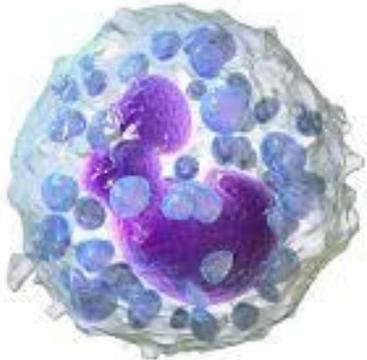
c Basophil LM \times 1500



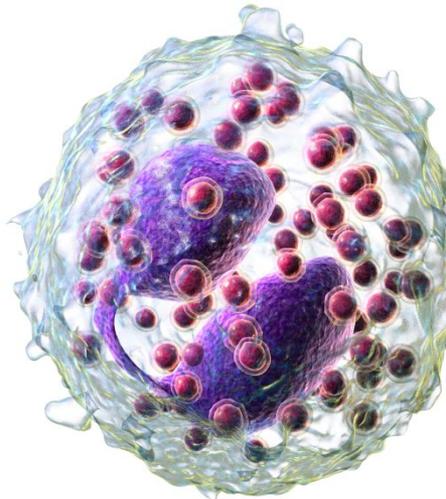
d Monocyte LM \times 1500



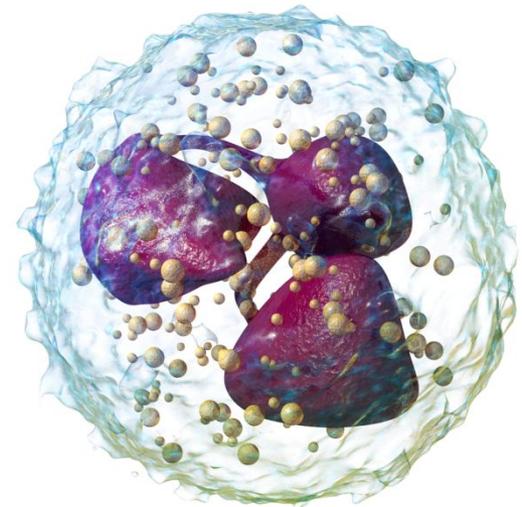
e Lymphocyte LM \times 1500



Basophil



Eosinophil



Neutrophil

Лейкоцитарная формула здорового человека (в %)

Гранулоциты

Агранулоциты

Нейтрофилы

юные Палочко- Сегменто-
ядерные ядерные

Базофилы

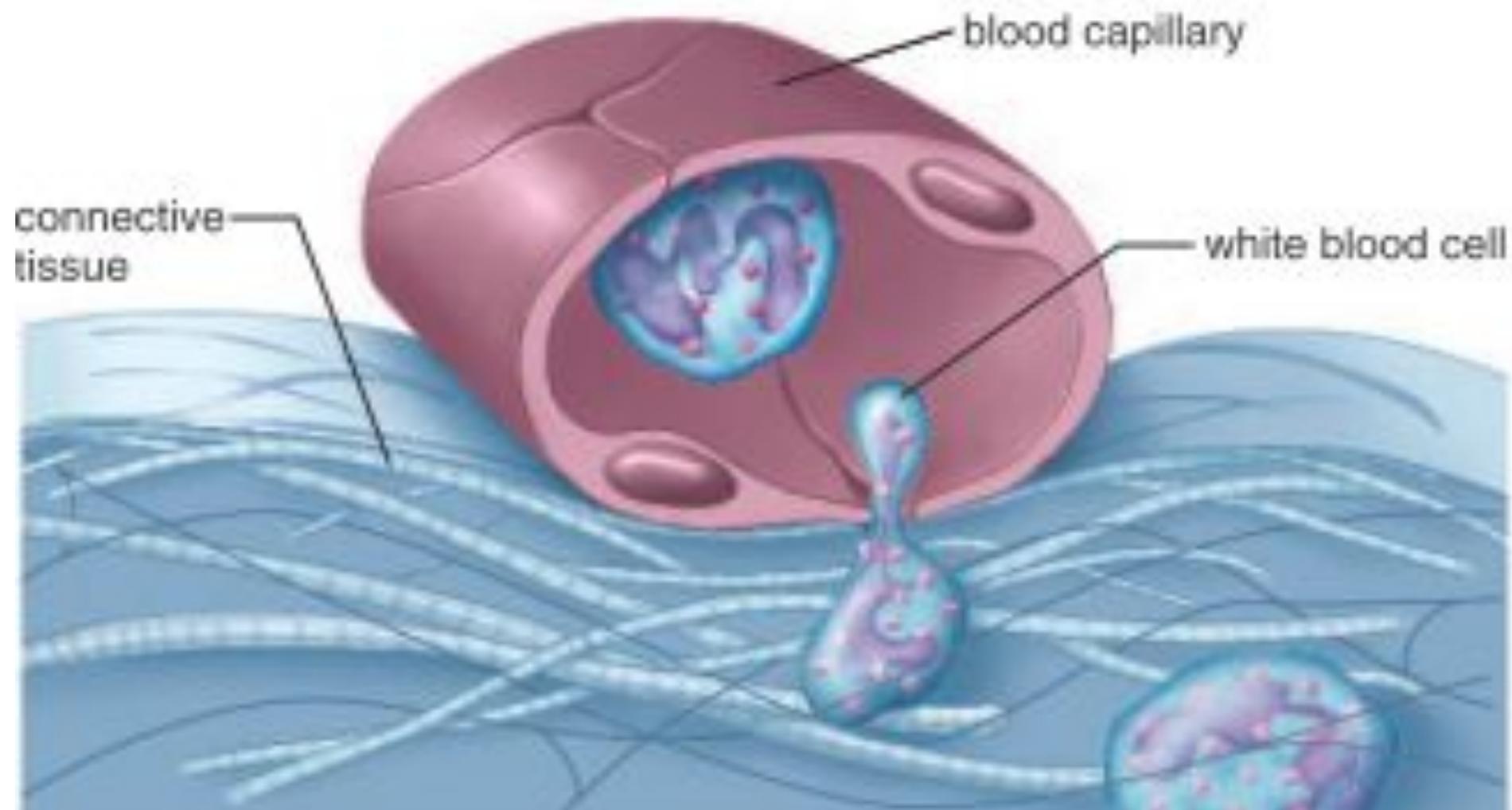
Эозинофилы

Лимфоциты

Моноциты

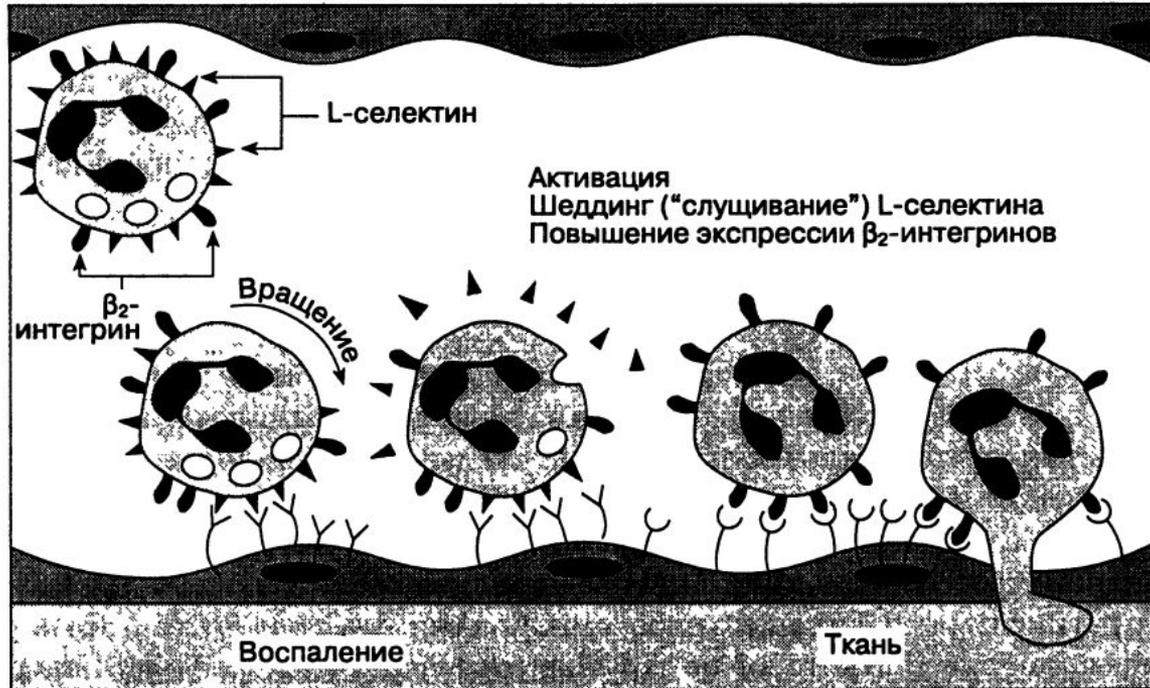
0 – 1 1 – 5 45 – 65 0 – 1 1 – 5 25 – 40 2 - 8



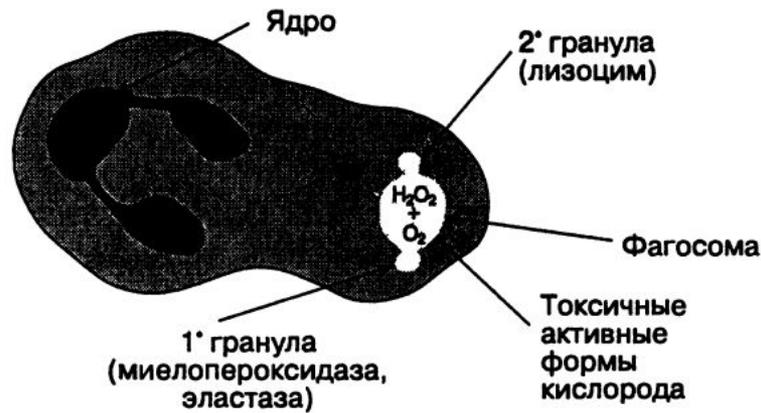


Селектинзависимая стадия

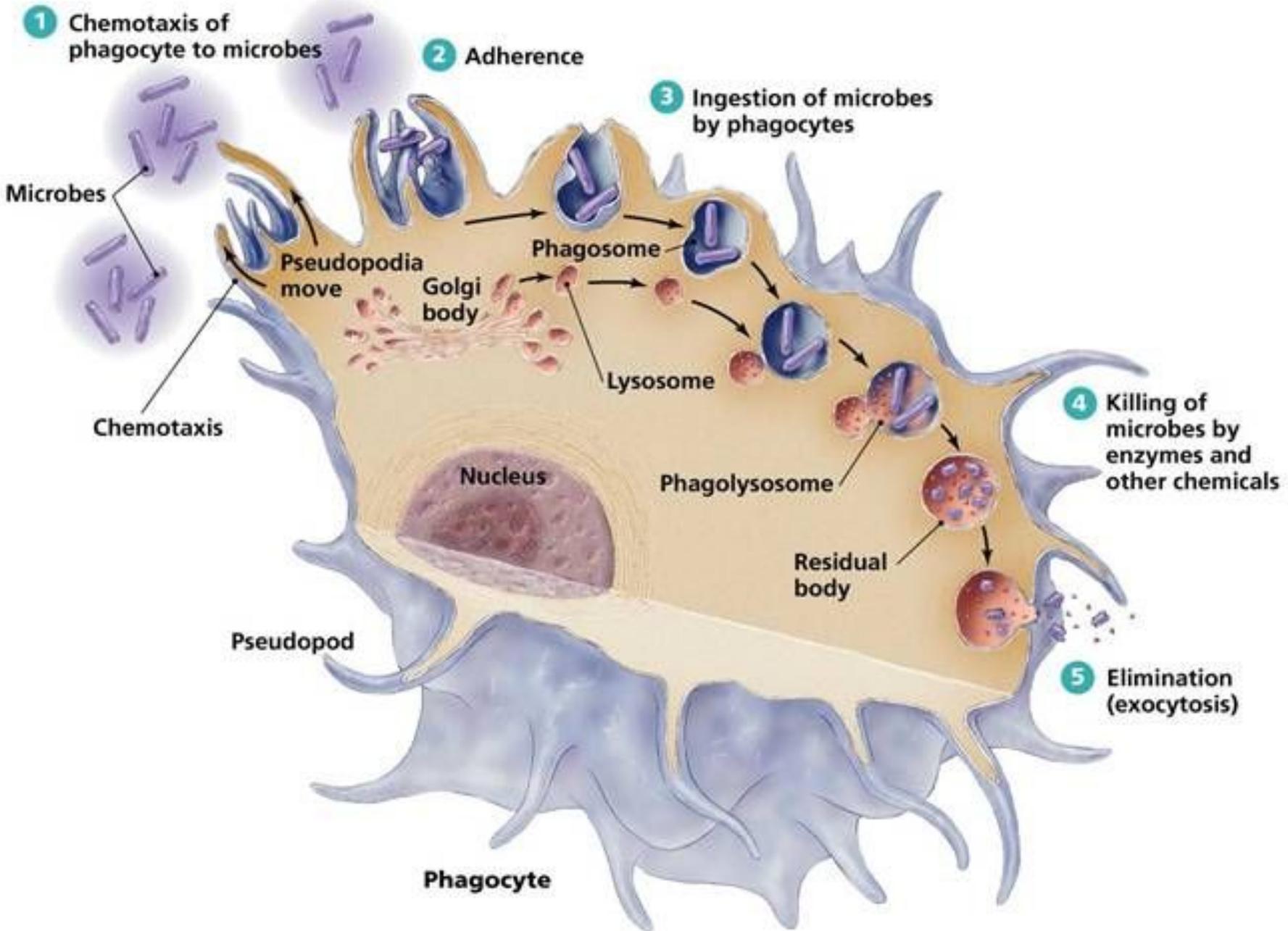
Интегринзависимая стадия

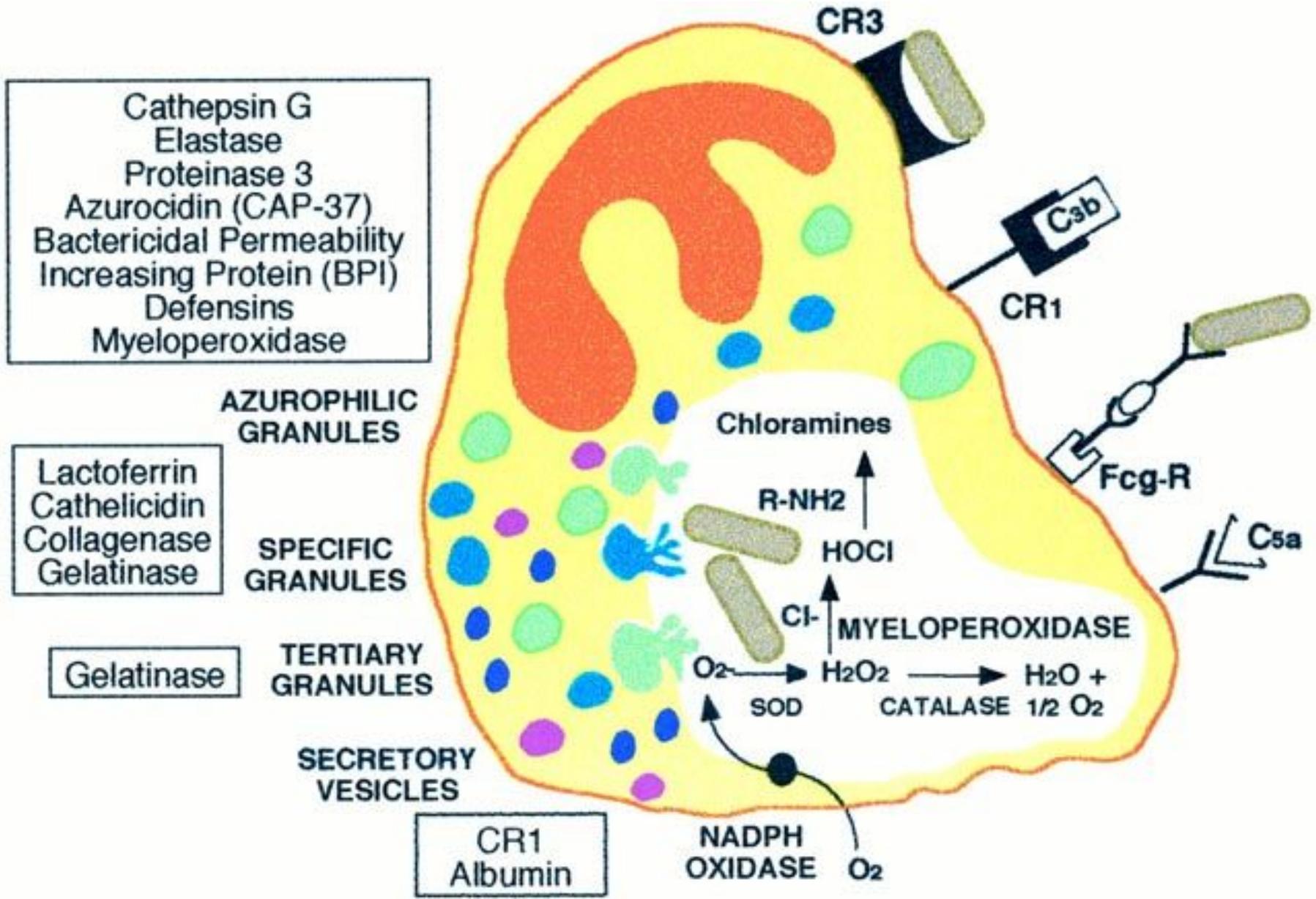


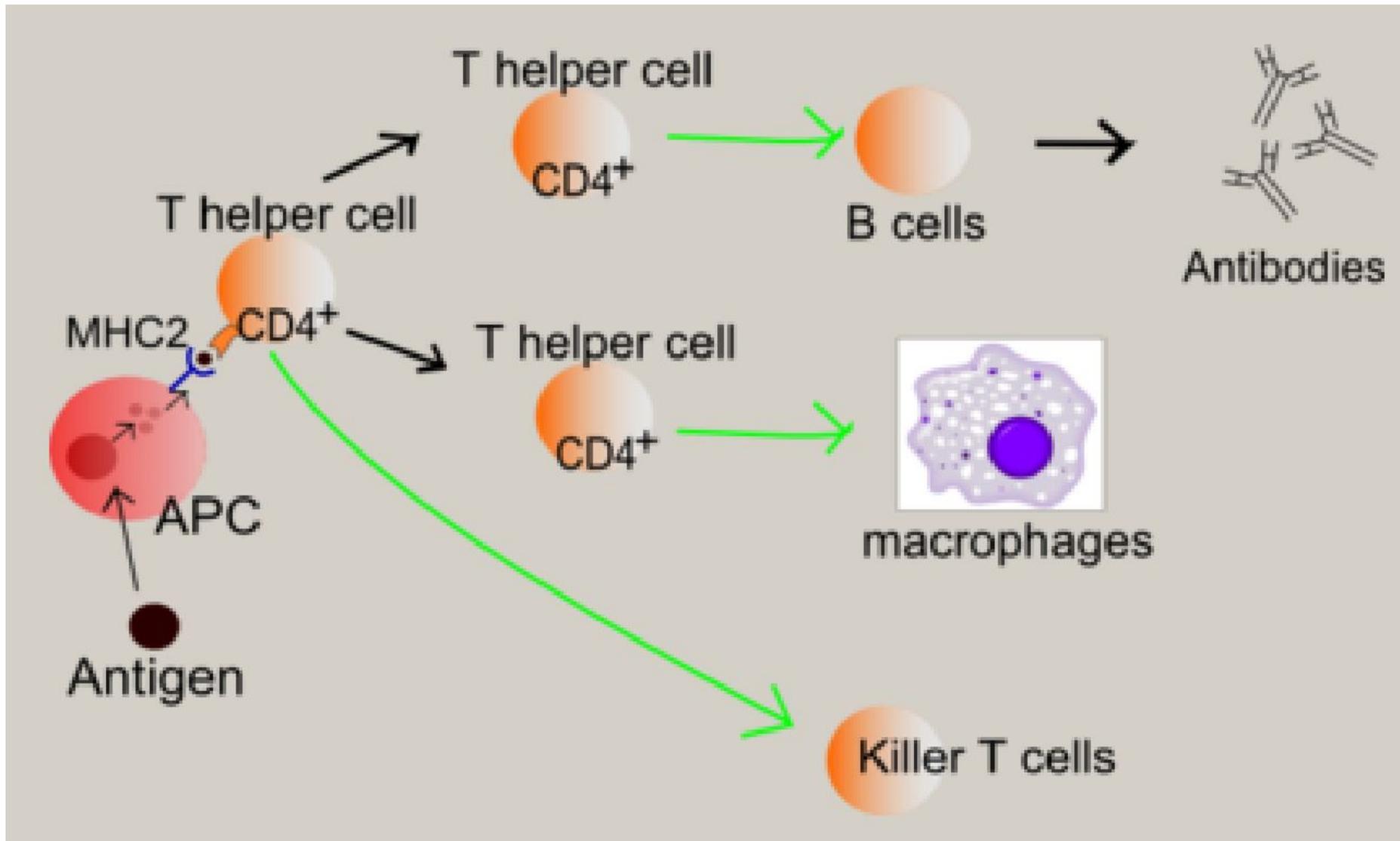
А



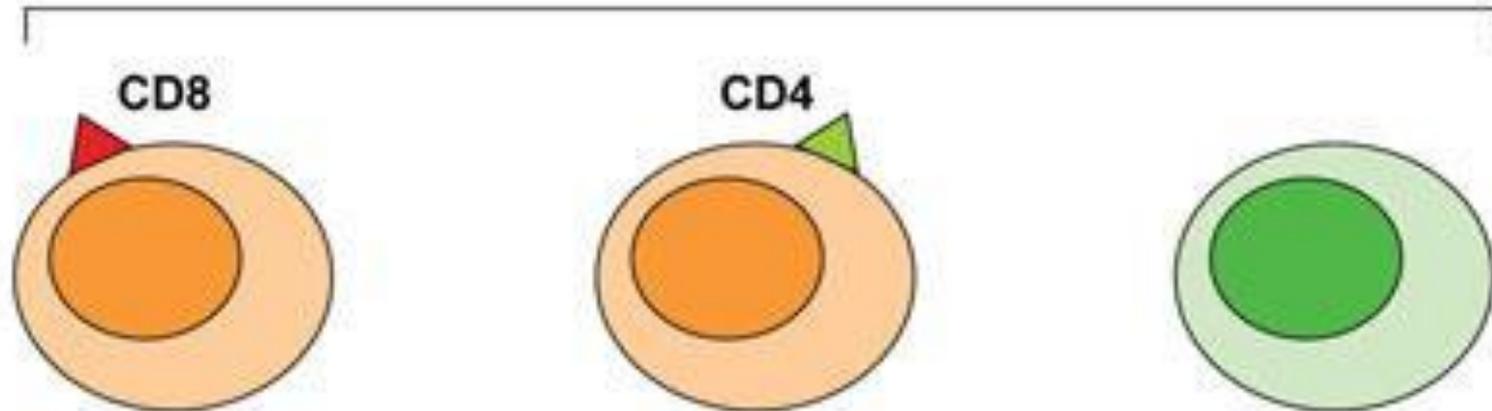
Б



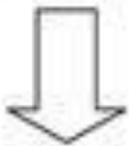




Lymphocytes

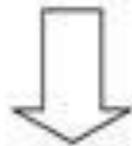


CD8
cytotoxic T cells



Kill virus-infected
and damaged cells

CD4
helper T cells

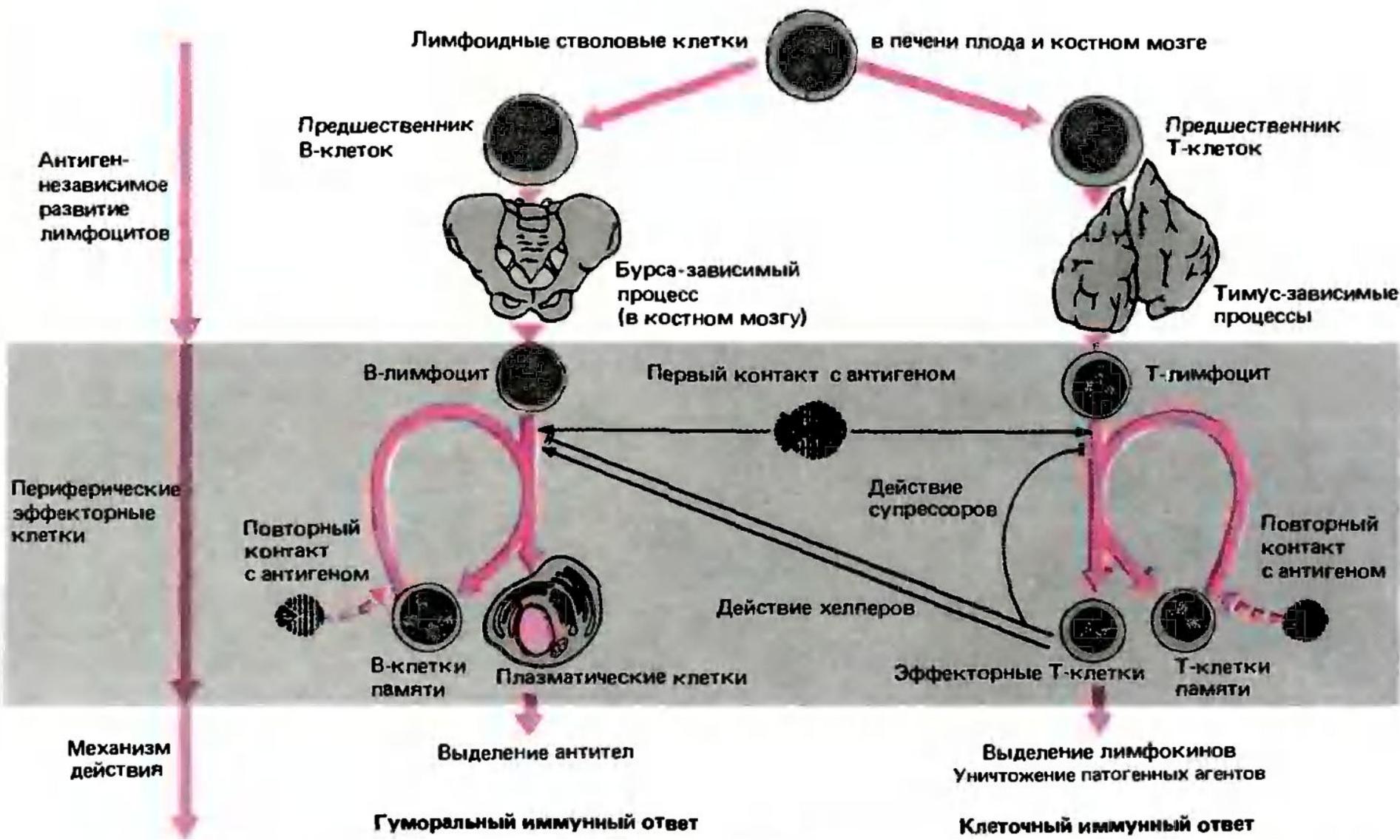


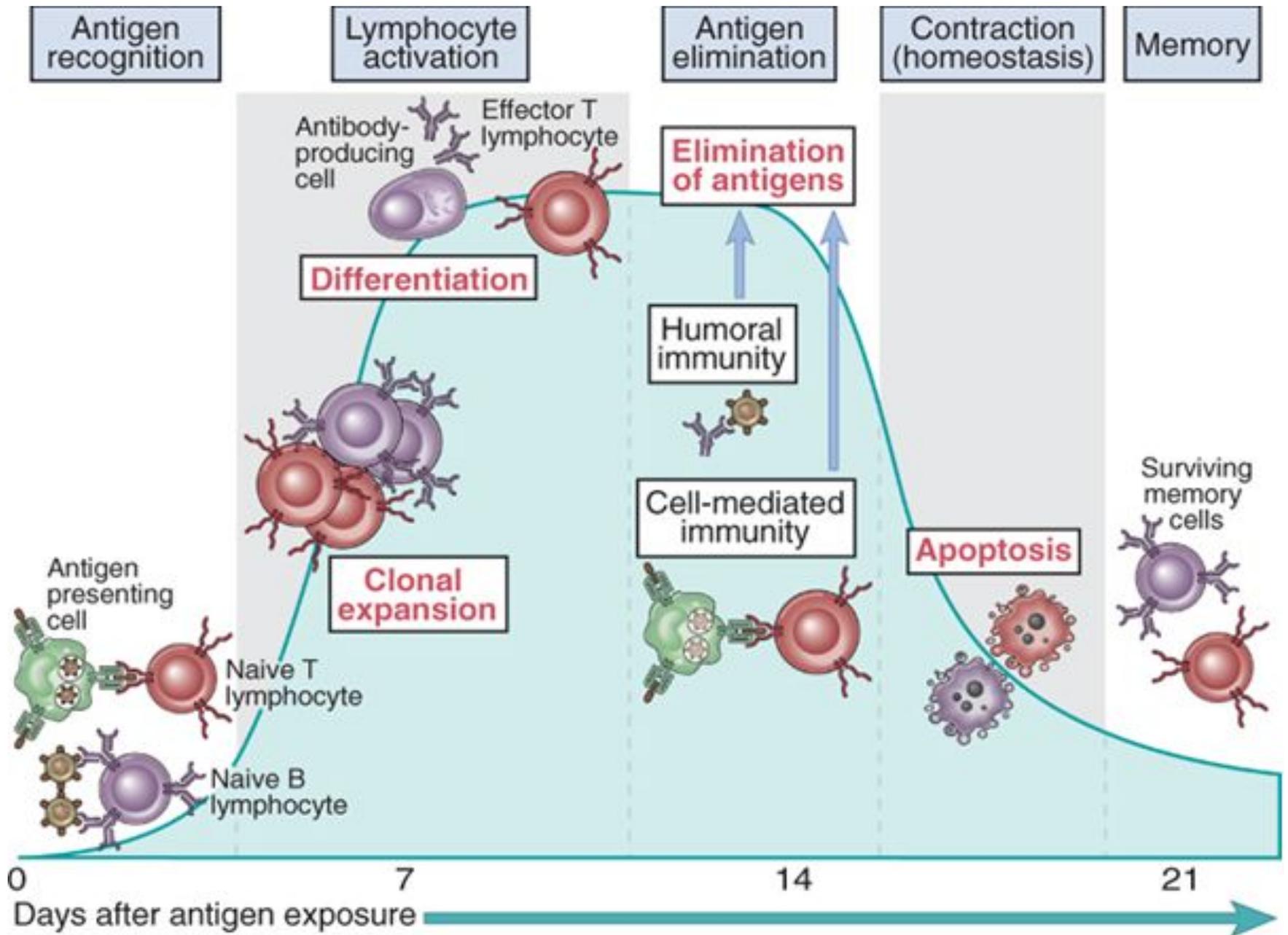
Help cytotoxic T cells
and B cells in their
immune functions

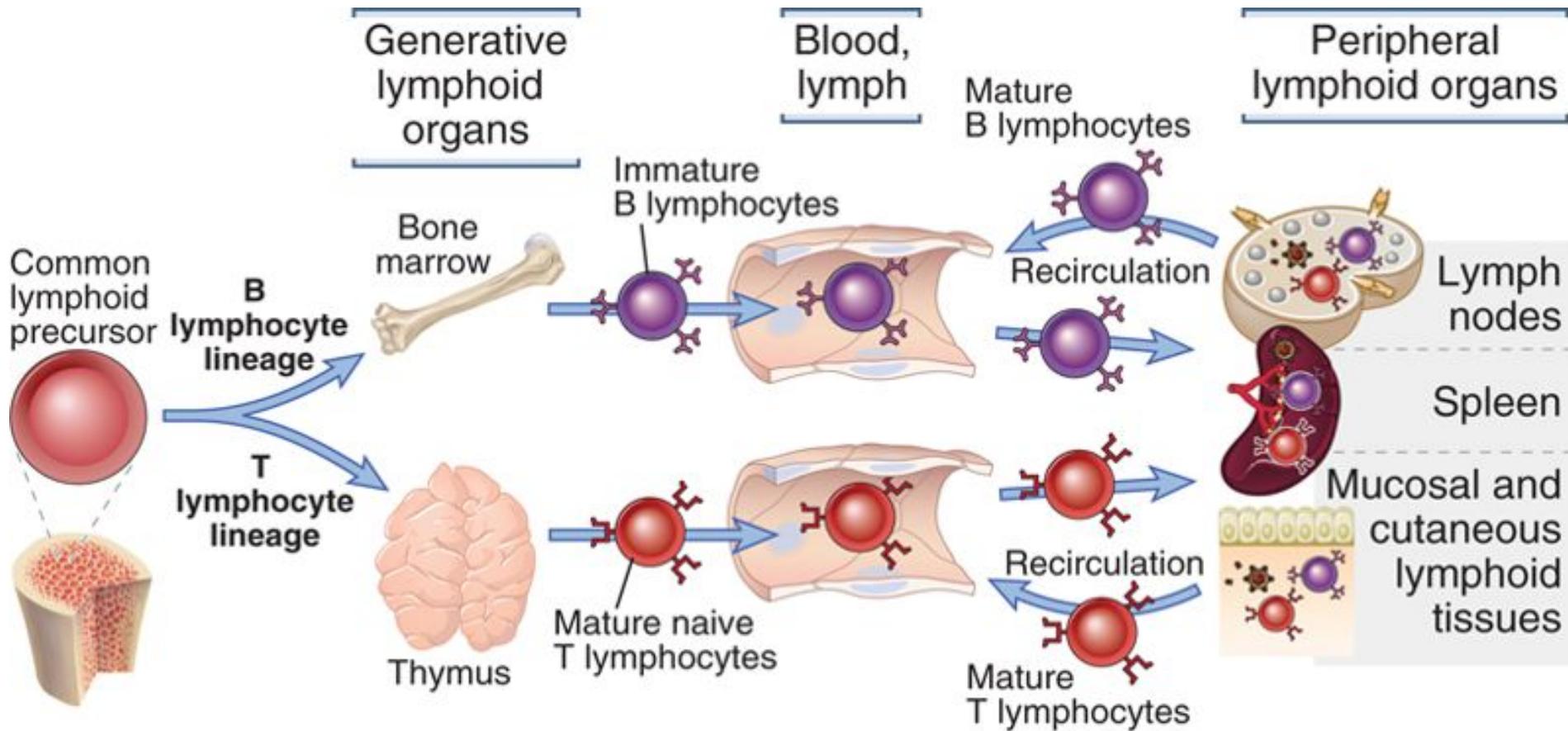
B cells

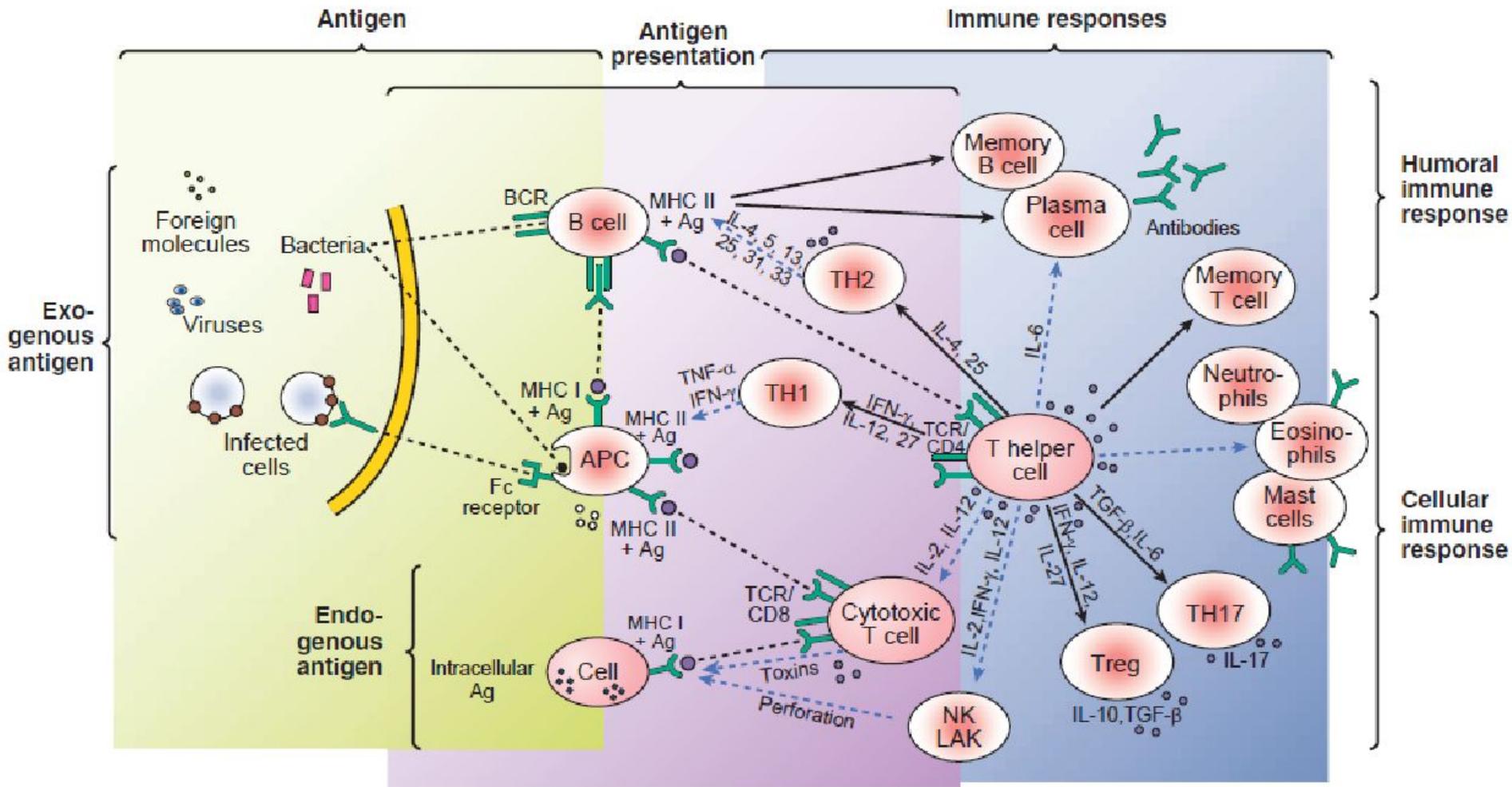


Produce antibodies



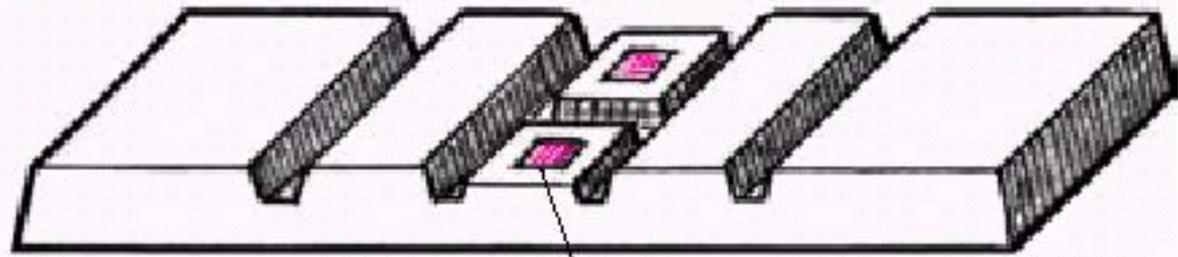






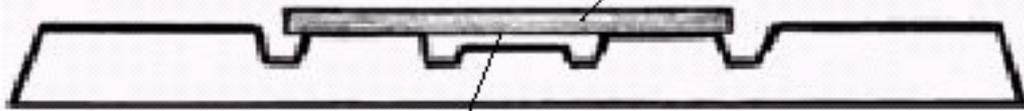
..... Receptor binding
 ← Differentiation
 ←····· Activation

Abbreviation	Test	Reference Range	Standardized International Reference	Significance (Examples)
RBC	Red blood cells			
	Men	4.3–5.9 × 10 ⁶ /μL	4.3–5.9 × 10 ¹² /L	
	Women	3.5–5.5 × 10 ⁶ /μL	3.5–5.5 × 10 ¹² /L	
Hgb or Hb	Hemoglobin			↓: anemia, severe bleeding
	Men	13.5–17.5 g/dL	2.09–2.71 mmol/L	↑: too many made, fluid loss, polycythemia
	Women	12–16 g/dL	1.86–2.48 mmol/L	
Hct or Ht	Hematocrit			
	Men	41%–53%	0.41–0.53	
	Women	36%–46%	0.36–0.46	
MCV	Mean cell volume	80–100 μm ³	80–100 fL	↓: iron deficiency, thalassemia
MCH	Mean cell hemoglobin	25.4–34.6 pg/cell	0.39–0.54 fmol/cell	↑: B12 and folate deficiency (MCH variable)
MCHC	Mean cell hemoglobin concentration	31%–36% Hb/cell	4.81–5.58 mmol Hb/L	↓: deficient Hgb synthesis ↑: spherocytosis
RDW	RBC distribution width	11.7%–14.2%	0.12–0.14	↑: mixed population, immature cells
WBC	White blood cells	4,500–11,000/μL	4.5–11 × 10 ³ /L	↓: some medication, autoimmune diseases, bone marrow diseases, severe infections
Neutrophil	Neutrophils (54%–62%)	4,000–7,000/μL	4–7 × 10 ³ /L	↑: infection (abscess, meningitis, pneumonia, appendicitis, tonsillitis), inflammation, leukemia, stress, dead tissue (burns, heart attack, gangrene)
Lymph	Lymphocytes (25%–33%)	2,500–5,000/μL	2.5–5 × 10 ³ /L	
Mono	Monocytes (3%–7%)	100–1,000/μL	0.1–1 × 10 ³ /L	
Eos	Eosinophils (1%–3%)	0–500/μL	0–0.5 × 10 ³ /L	
Baso	Basophils (0%–1%)	0–100/μL	0–0.1 × 10 ³ /L	
Pit	Platelet count	0.15–0.4 × 10 ⁶ /μL	0.15–0.4 × 10 ¹¹ /L	↓: not enough made, bleeding, systemic lupus erythematosus, pernicious anemia, hypersplenism, leukemia, chemotherapy
MPV	Mean platelet volume	7.5–11.5 μm ³	7.5–11.5 fL	↑: too many made, young cells



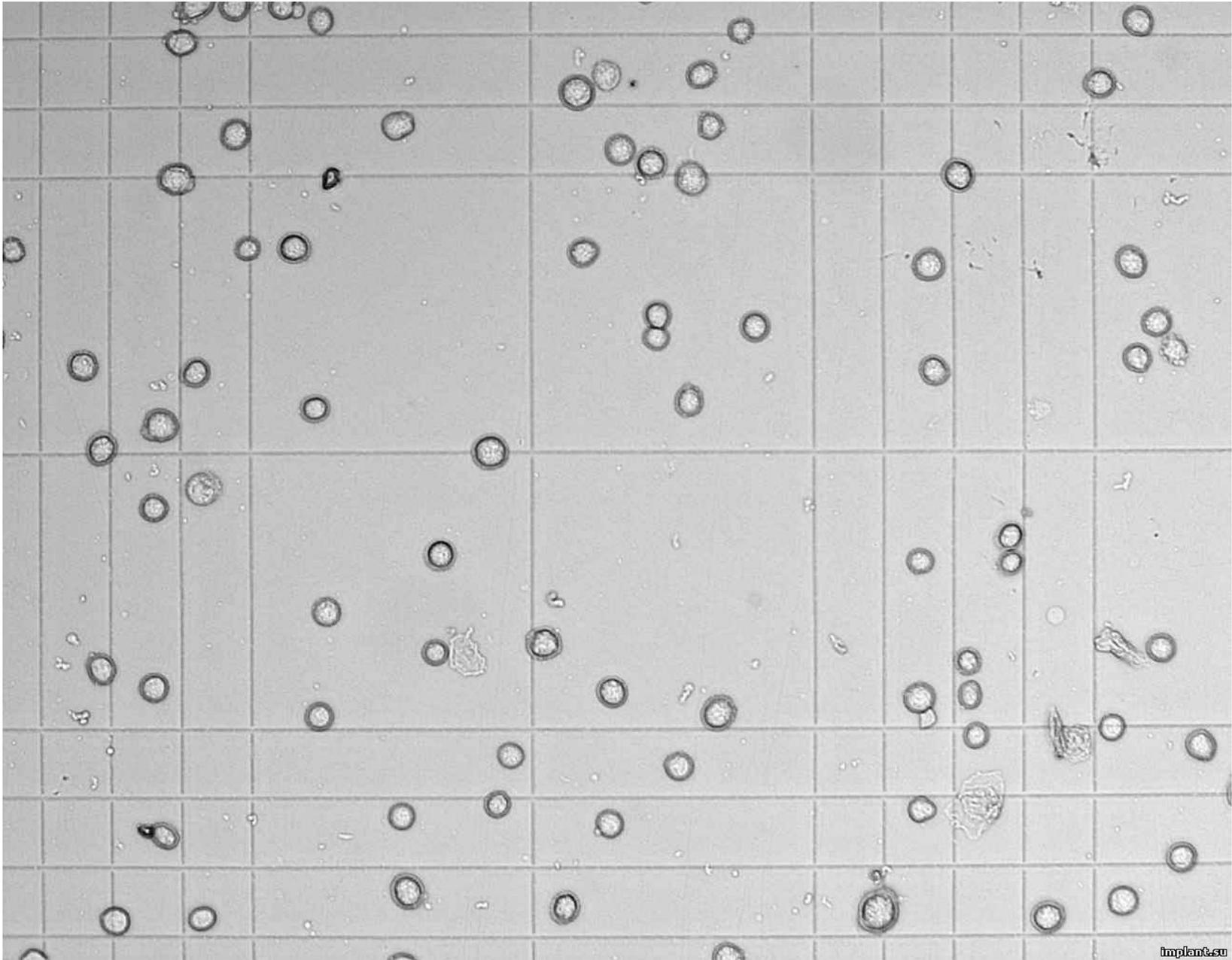
Сетка Горяева

Шлифованное покровное стекло



Глубина камеры – 0,1 мм





- Эритроциты

$$X = A \times 4000 \times 200 / 80$$

- Лейкоциты

$$X = B \times 4000 \times 20 / 400$$