

Fig. 18.1

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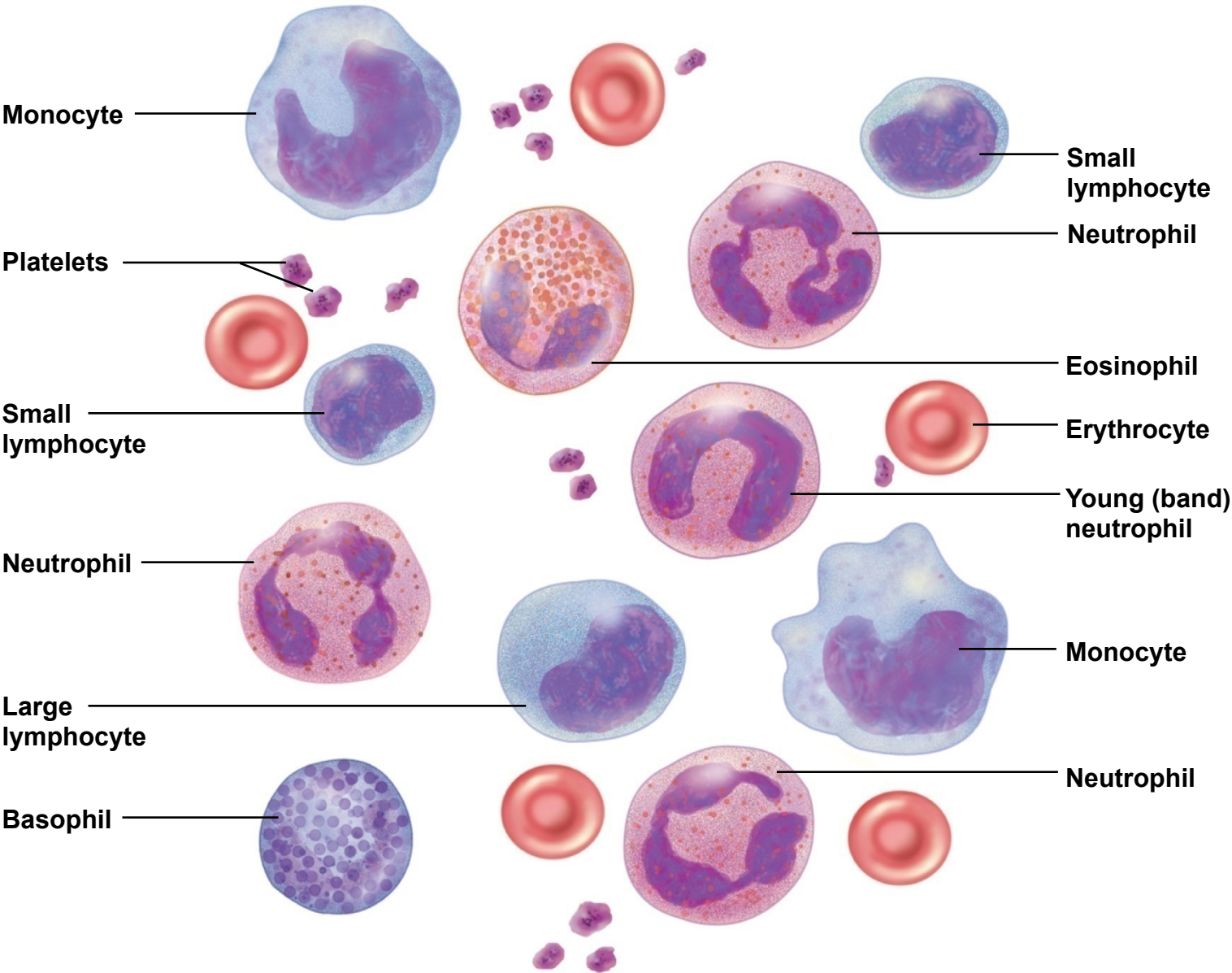


Fig. 18.2

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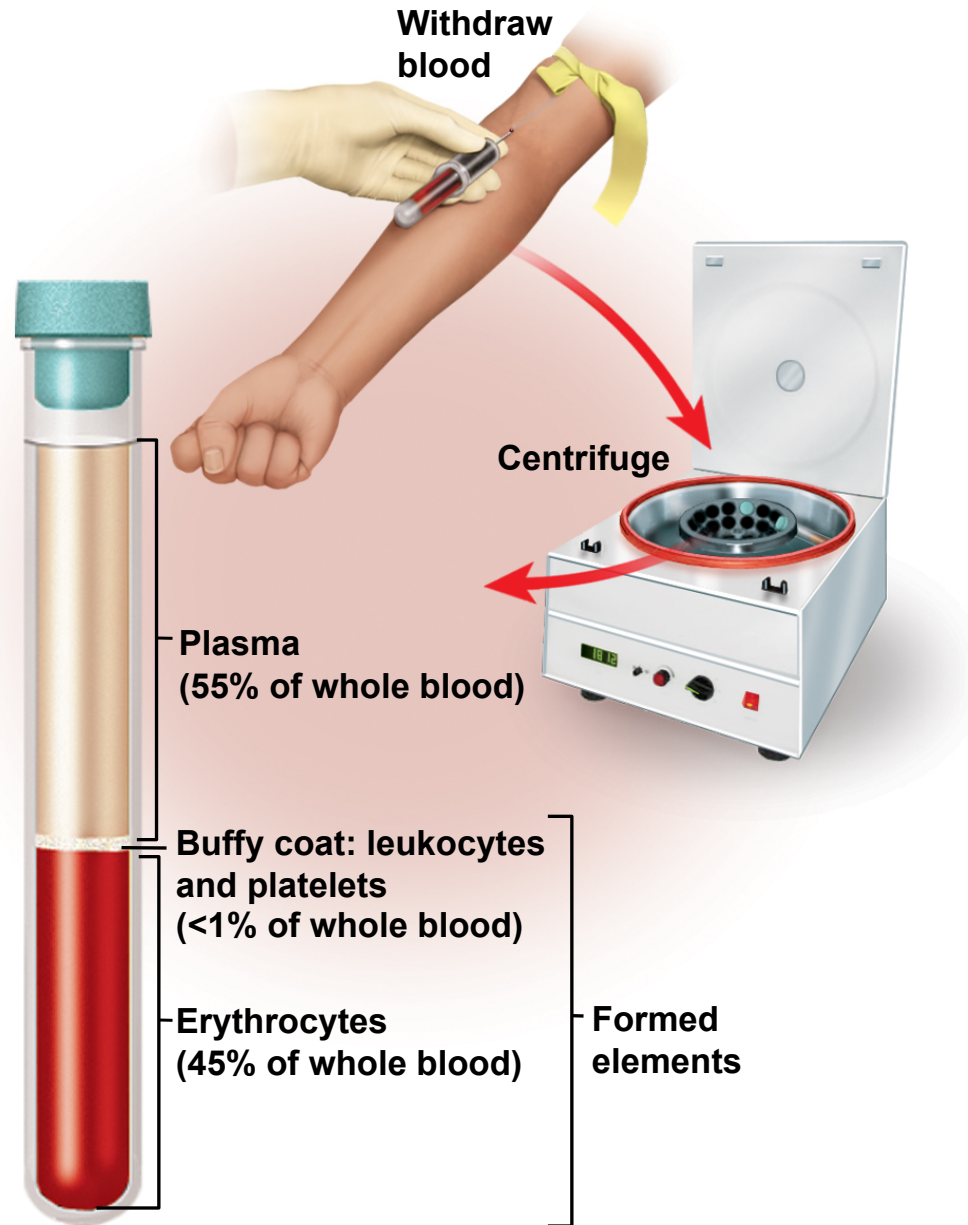


Table 18.2

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TABLE 18.2	Composition of Blood Plasma
Blood Component*	Typical Values for Healthy Adults
<i>Water</i>	92% by weight
<i>Proteins</i>	Total 6–9 g/dL
Albumin	60% of total protein, 3.2–5.5 g/dL
Globulins	36% of total protein, 2.3–3.5 g/dL
Fibrinogen	4% of total protein, 0.2–0.3 g/dL
Nutrients	
Glucose (dextrose)	70–110 mg/dL
Amino acids	33–51 mg/dL
Lactic acid	6–16 mg/dL
Total lipid	450–850 mg/dL
Cholesterol	120–220 mg/dL
Fatty acids	190–420 mg/dL
High-density lipoprotein (HDL)	30–80 mg/dL
Low-density lipoprotein (LDL)	62–185 mg/dL
Triglycerides (neutral fats)	40–150 mg/dL
Phospholipids	6–12 mg/dL
Iron	50–150 µg/dL
Trace elements	Traces
Vitamins	Traces
Electrolytes	
Sodium (Na ⁺)	135–145 mEq/L
Calcium (Ca ²⁺)	9.2–10.4 mEq/L
Potassium (K ⁺)	3.5–5.0 mEq/L
Magnesium (Mg ²⁺)	1.3–2.1 mEq/L
Chloride (Cl ⁻)	100–106 mEq/L
Bicarbonate (HCO ₃ ⁻)	23.1–26.7 mEq/L
Phosphate (HPO ₄ ²⁻)	1.4–2.7 mEq/L
Sulfate (SO ₄ ²⁻)	0.6–1.2 mEq/L
Nitrogenous wastes	
Urea	10–20 mg/dL
Uric acid	1.5–8.0 mg/dL
Creatinine	0.6–1.5 mg/dL
Creatine	0.2–0.8 mg/dL
Ammonia	0.02–0.09 mg/dL
Bilirubin	0–1.0 mg/dL
Other components	
Dissolved CO ₂	2.62 mL/dL
Dissolved O ₂	0.29 mL/dL
Dissolved N ₂	0.98 mL/dL
Enzymes of diagnostic value	—
Hormones	—

*This table is limited to substances of greatest relevance to this and later chapters. Concentrations refer to plasma only, not to whole blood.

Table 18.3

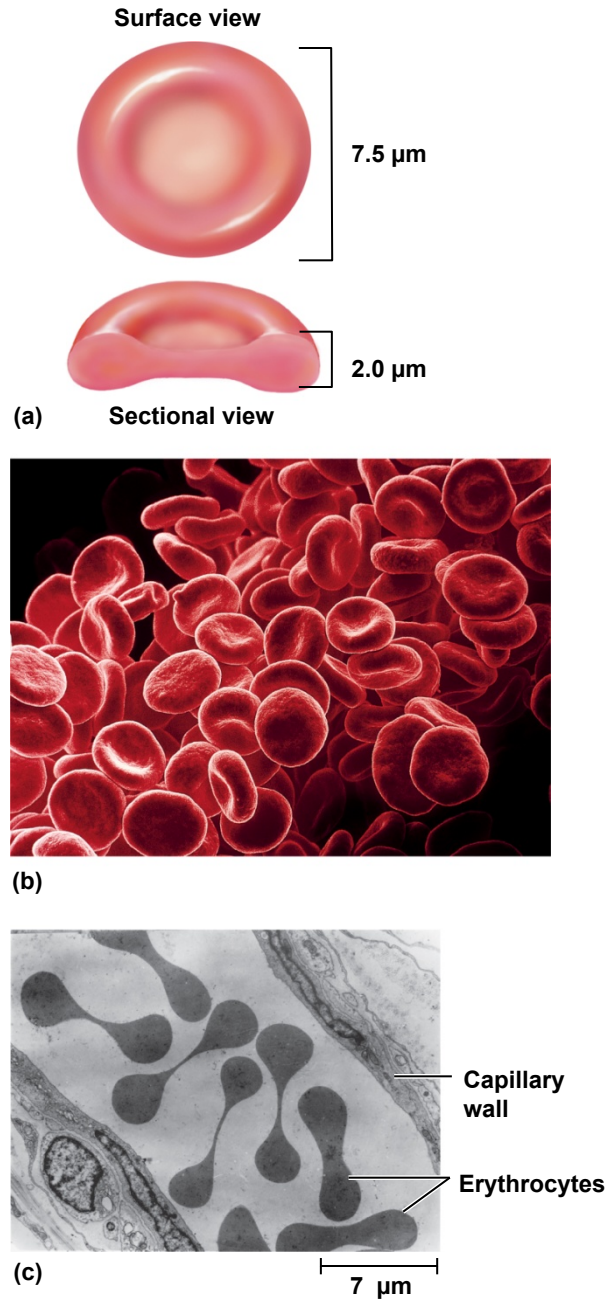
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TABLE 18.3	Major Proteins of the Blood Plasma
Proteins	Functions
<i>Albumin (60%)*</i>	Responsible for colloid osmotic pressure; major contributor to blood viscosity; transports lipids, hormones, calcium, and other solutes; buffers blood pH
<i>Globulins (36%)*</i>	
Alpha (α) globulins	
Haptoglobin	Transports hemoglobin released by dead erythrocytes
Ceruloplasmin	Transports copper
Prothrombin	Promotes blood clotting
Others	Transport lipids, fat-soluble vitamins, and hormones
Beta (β) globulins	
Transferrin	Transports iron
Complement proteins	Aid in destruction of toxins and microorganisms
Others	Transport lipids
Gamma (γ) globulins	Antibodies; combat pathogens
<i>Fibrinogen (4%)*</i>	Becomes fibrin, the major component of blood clots

*Mean percentage of the total plasma protein by weight

Fig. 18.4

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b: ©Susumu Nishinaga/Getty Images; c: ©Dr. Don W. Fawcett/Visuals Unlimited

Fig. 18.5

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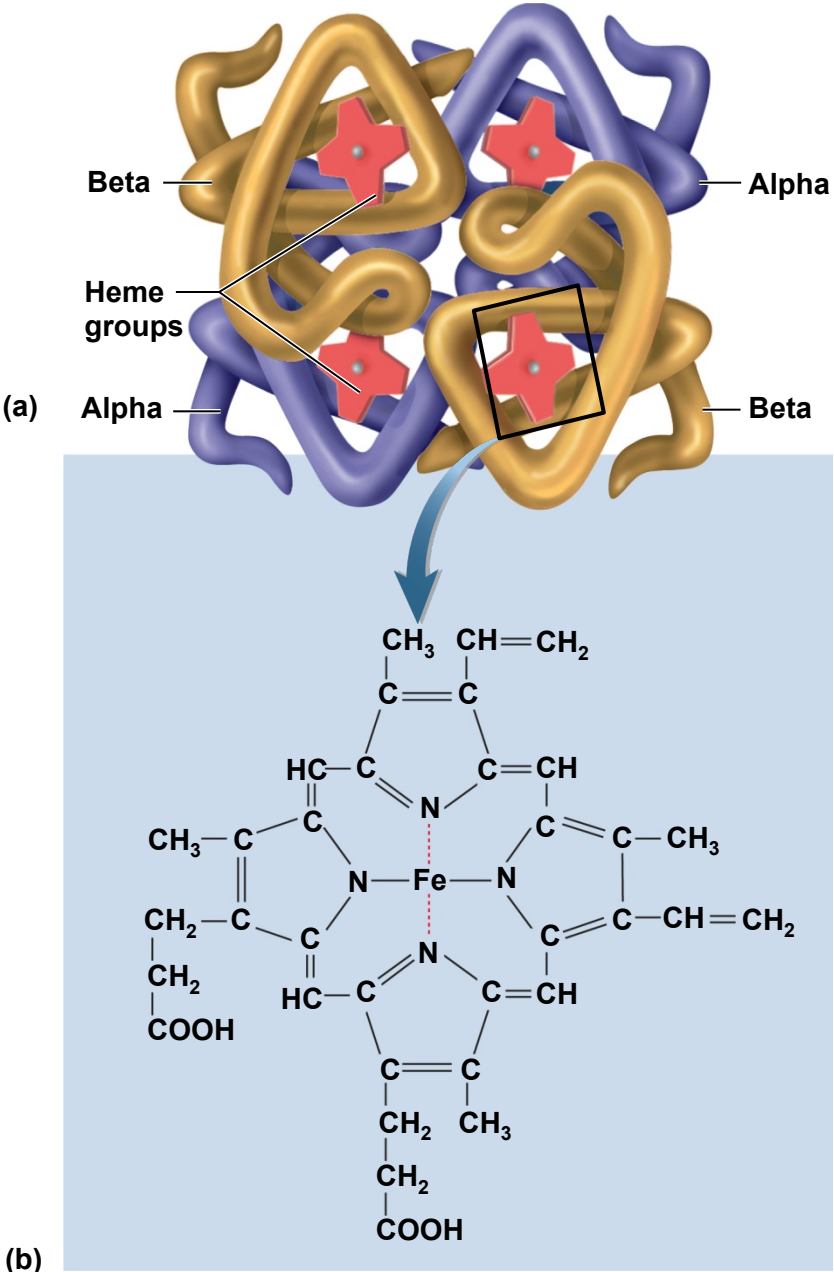


Fig. 18.6

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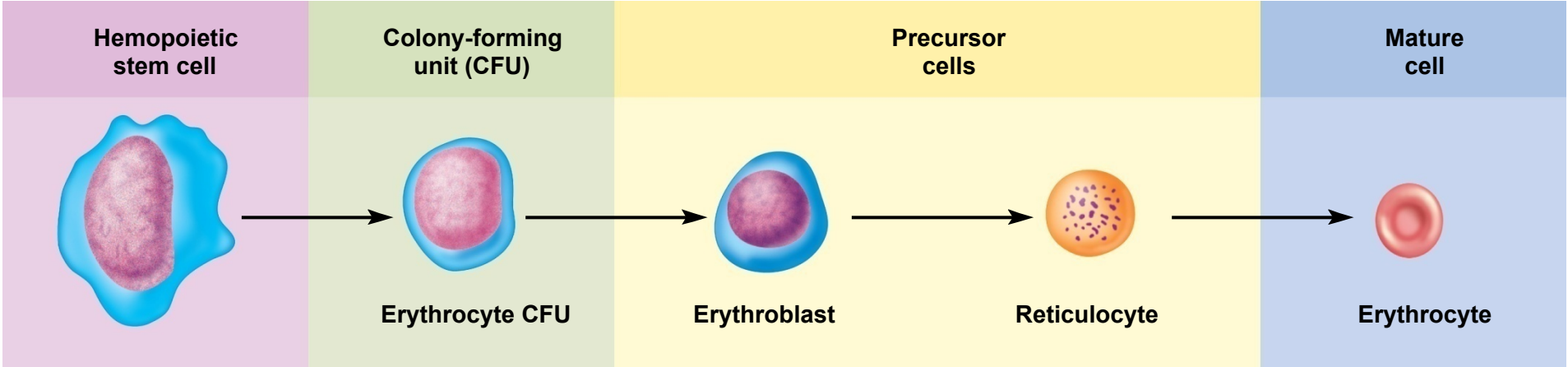


Fig. 18.7

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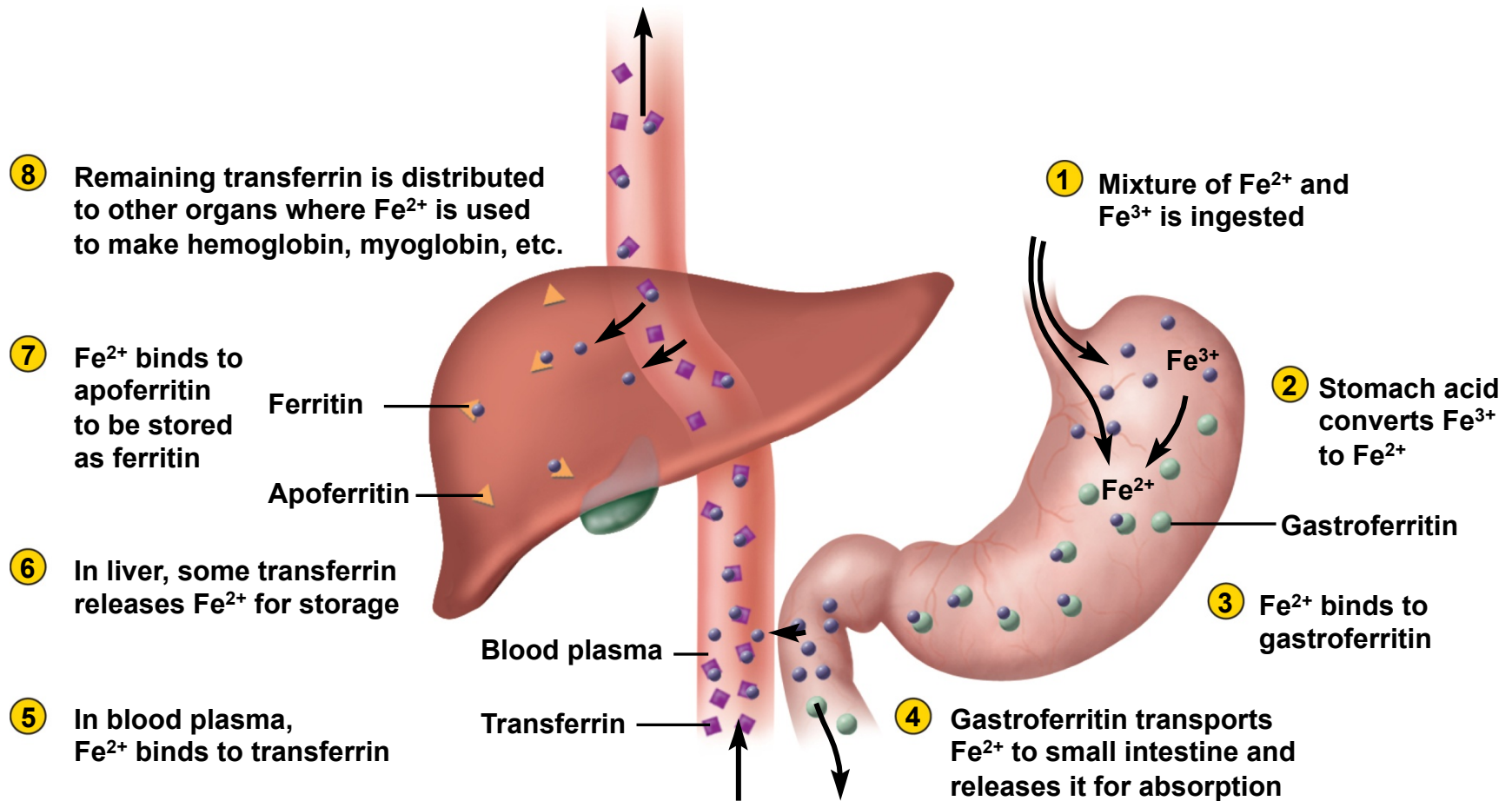


Fig. 18.8

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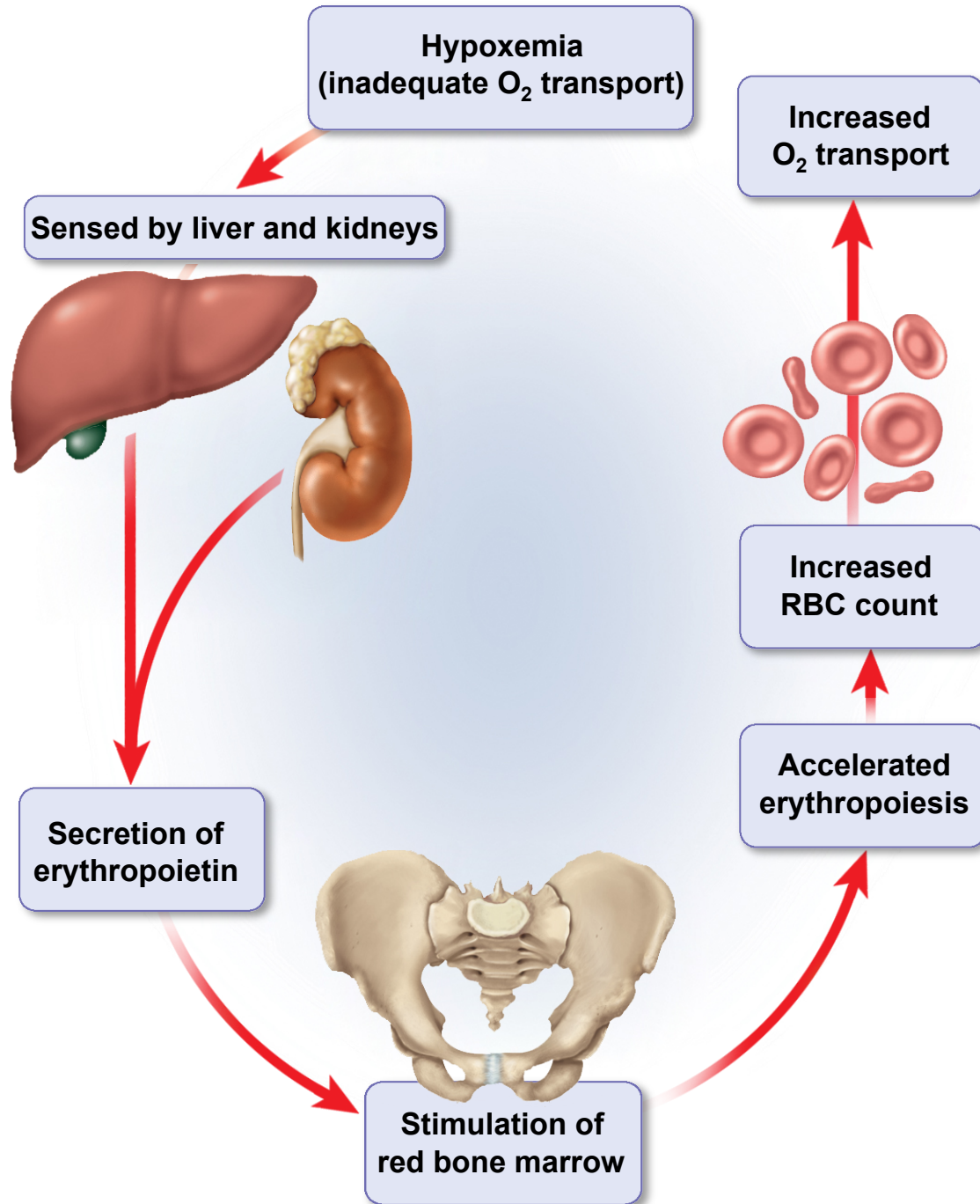


Fig. 18.9

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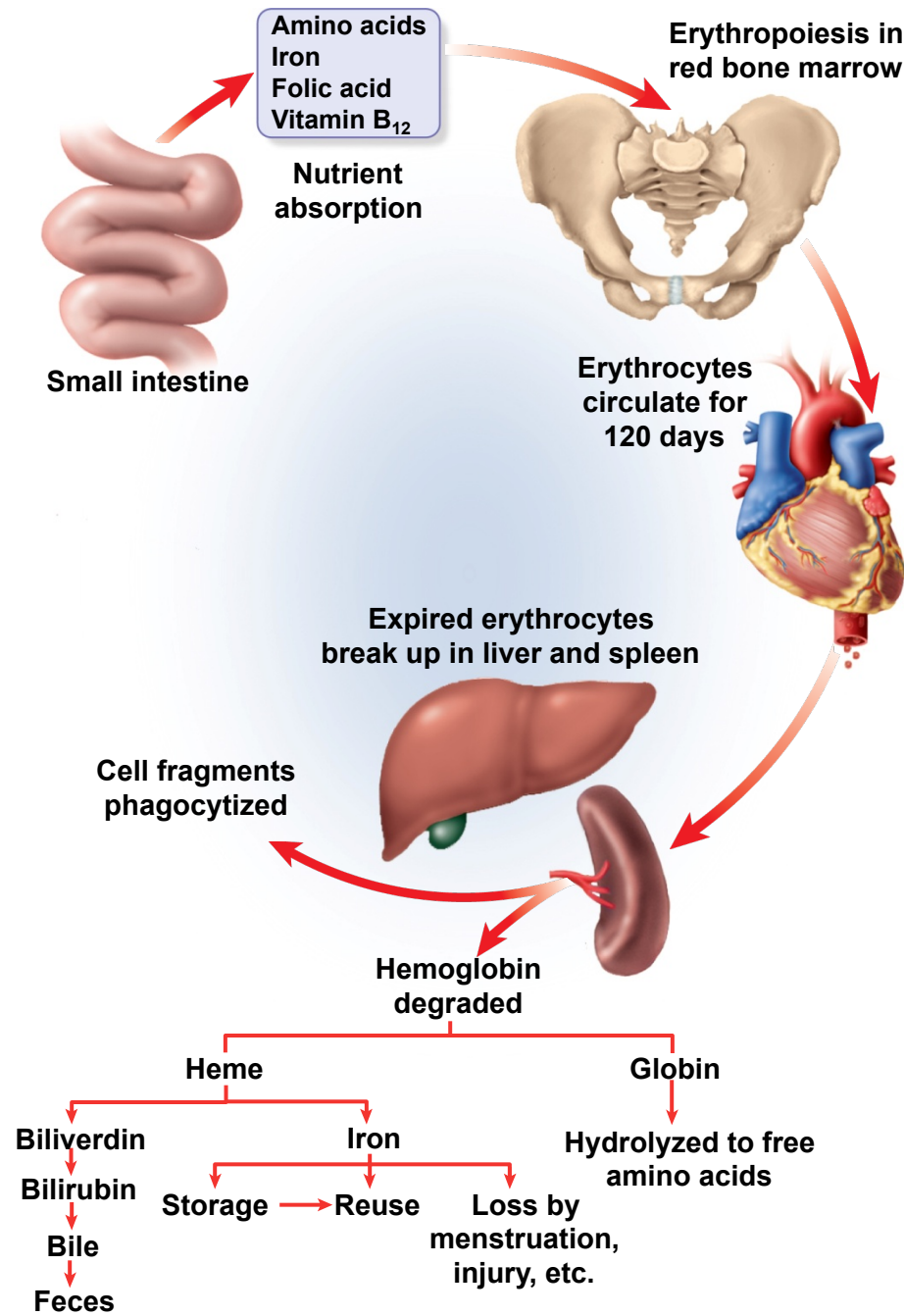


Table 18.5

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TABLE 18.5	The ABO Blood Group			
Characteristics	ABO Blood Type			
	Type O	Type A	Type B	Type AB
Possible genotypes*	<i>ii</i>	<i>I^A I^A or I^A i</i>	<i>I^B I^B or I^B i</i>	<i>I^A I^B</i>
RBC antigen	None	A	B	A, B
Plasma antibody	Anti-A, anti-B	Anti-B	Anti-A	None
May safely receive RBCs of type	O	O, A	O, B	O, A, B, AB
May safely donate RBCs to	O, A, B, AB	A, AB	B, AB	AB
Frequency in U.S. population				
White	45%	40%	11%	4%
Black	49%	27%	20%	4%
Hispanic	63%	14%	20%	3%
Japanese	31%	38%	22%	9%
Native American	79%	16%	4%	< 1%

* I^A is the dominant allele for agglutinin A; I^B is the dominant allele for agglutinin B; and allele i is recessive to both of these.

Fig. 18.13

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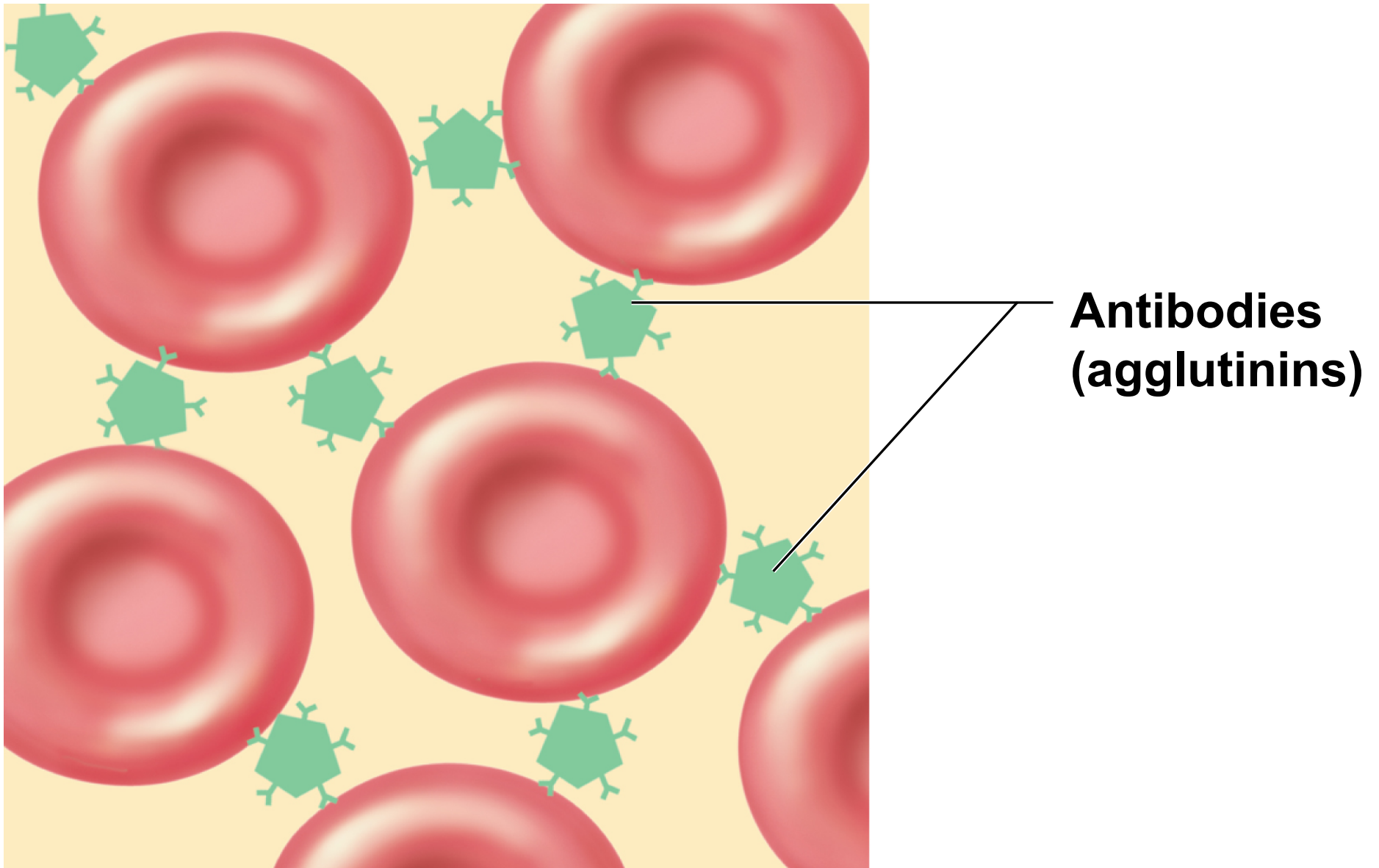


Fig. 18.16

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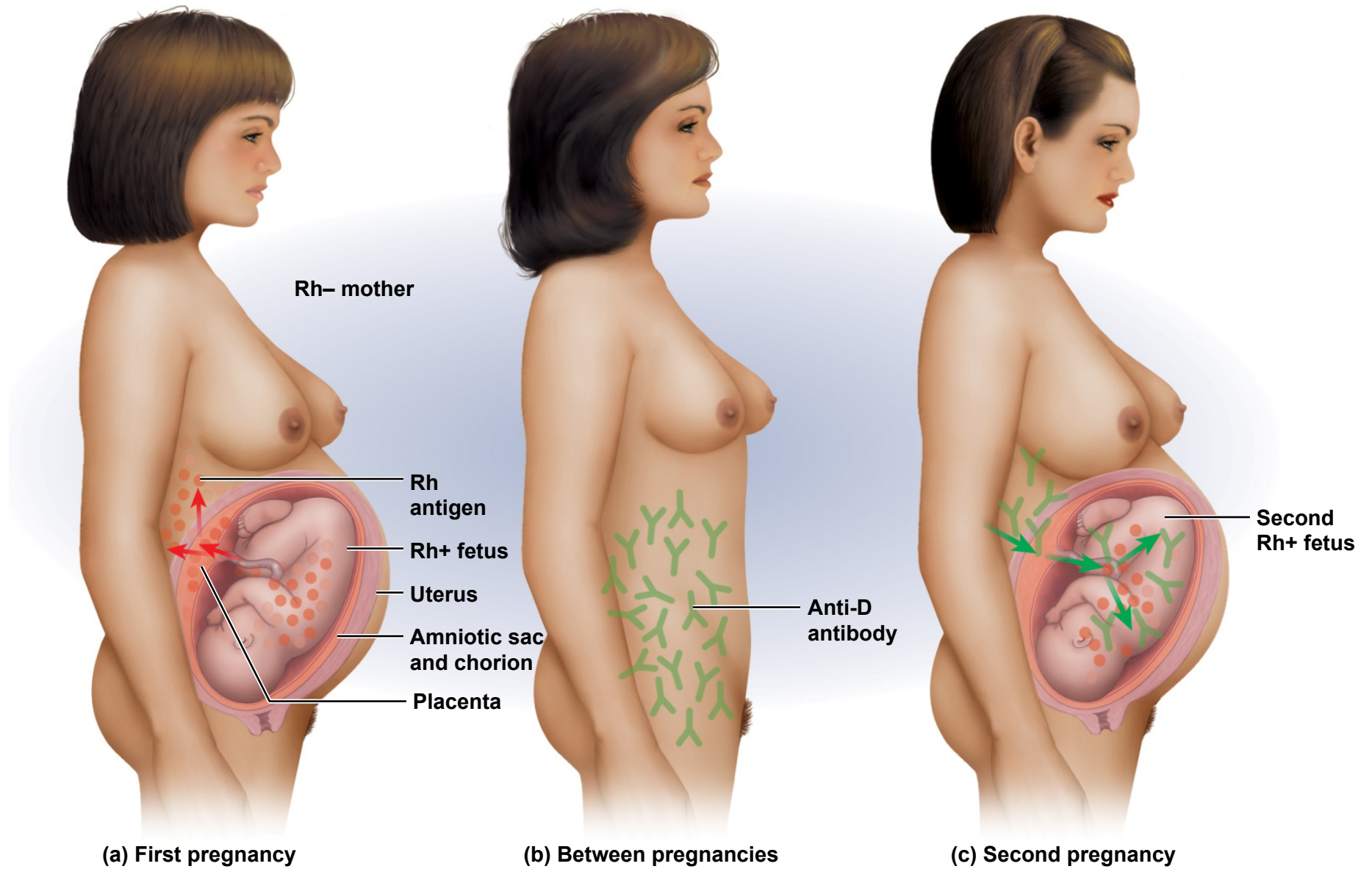
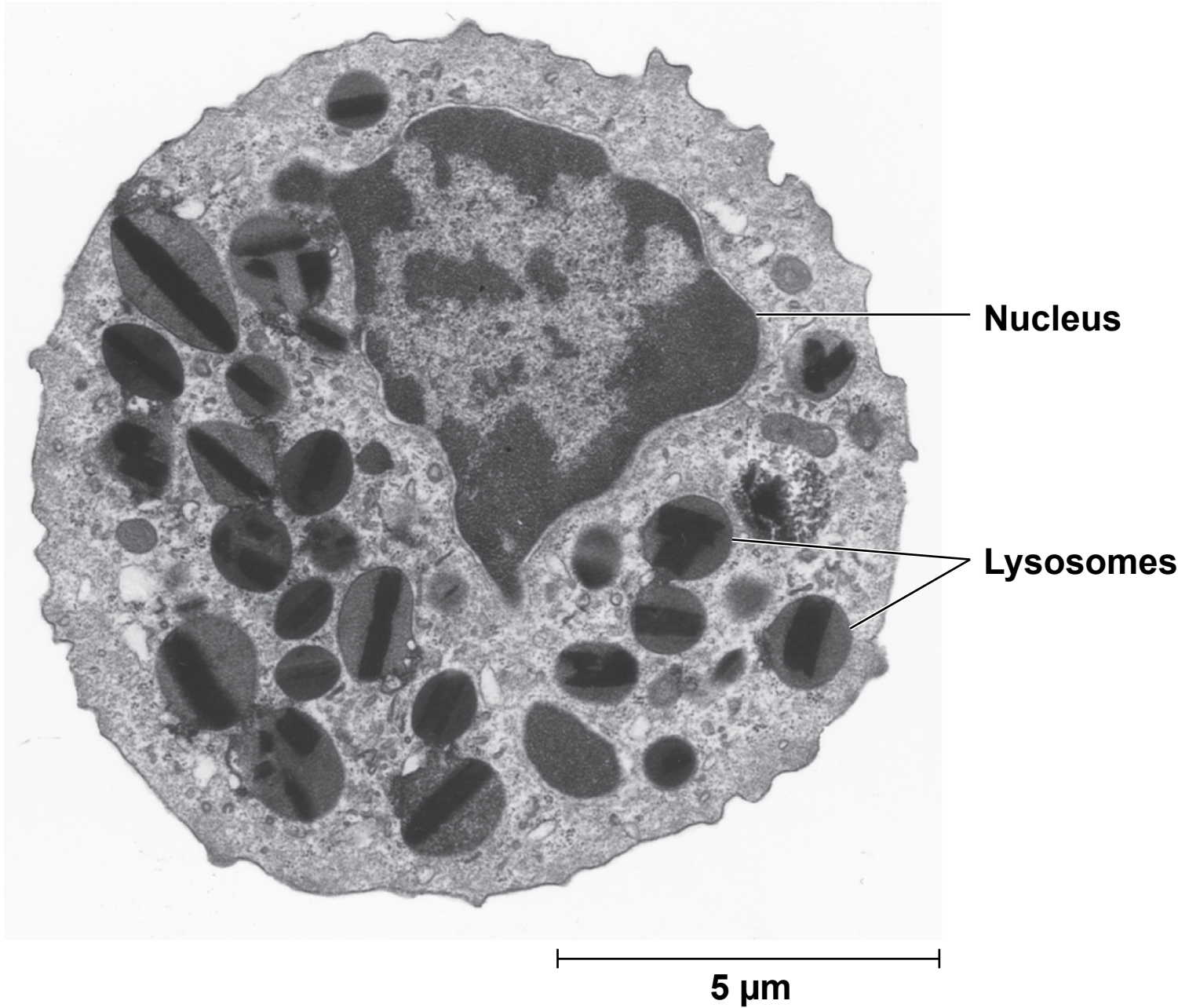


Fig. 18.17

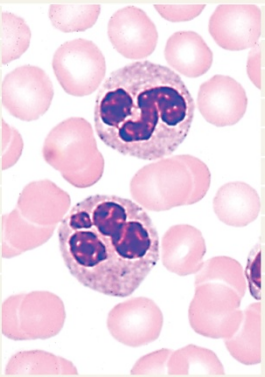
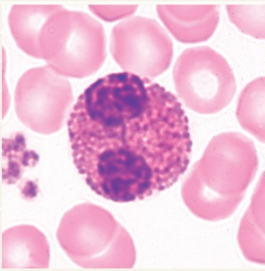
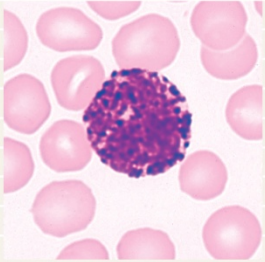
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Table 18.6a

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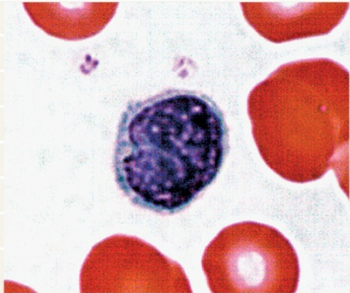
TABLE 18.6		The White Blood Cells (Leukocytes)
Neutrophils		 <p>Neutrophils</p> <p>10 μm</p>
Percentage of WBCs	60% to 70%	
Mean count	4,150 cells/ μ L	
Diameter	9–12 μ m	
<i>Appearance*</i>		
	<ul style="list-style-type: none"> Nucleus usually with 3–5 lobes in S- or C-shaped array Fine reddish to violet specific granules in cytoplasm 	
<i>Differential count</i>		
	<ul style="list-style-type: none"> Increases in bacterial infections 	
<i>Functions</i>		
	<ul style="list-style-type: none"> Phagocytize bacteria Release antimicrobial chemicals 	
Eosinophils		 <p>Eosinophil</p> <p>10 μm</p>
Percentage of WBCs	2% to 4%	
Mean count	165 cells/ μ L	
Diameter	10–14 μ m	
<i>Appearance*</i>		
	<ul style="list-style-type: none"> Nucleus usually has two large lobes connected by thin strand Large orange-pink specific granules in cytoplasm 	
<i>Differential count</i>		
	<ul style="list-style-type: none"> Fluctuates greatly from day to night, seasonally, and with phase of menstrual cycle Increases in parasitic infections, allergies, collagen diseases, and diseases of spleen and central nervous system 	
<i>Functions</i>		
	<ul style="list-style-type: none"> Phagocytize antigen–antibody complexes, allergens, and inflammatory chemicals Release enzymes that weaken or destroy parasites such as worms 	
Basophils		 <p>Basophil</p> <p>10 μm</p>
Percentage of WBCs	< 0.5%	
Mean count	44 cells/ μ L	
Diameter	8–10 μ m	
<i>Appearance*</i>		
	<ul style="list-style-type: none"> Nucleus large and U- to S-shaped, but typically pale and obscured from view Coarse, abundant, dark violet specific granules in cytoplasm 	
<i>Differential count</i>		
	<ul style="list-style-type: none"> Relatively stable Increases in chickenpox, sinusitis, diabetes mellitus, myxedema, and polycythemia 	
<i>Functions</i>		
	<ul style="list-style-type: none"> Secrete histamine (a vasodilator), which increases blood flow to a tissue Secrete heparin (an anticoagulant), which promotes mobility of other WBCs by preventing clotting 	

(Neutrophils, Eosinophil, Basophil): ©Ed Reschke

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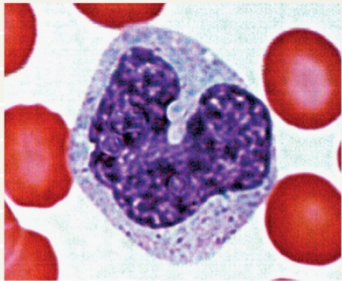
TABLE 18.6		The White Blood Cells (Leukocytes) (continued)	
Lymphocytes			
Percentage of WBCs	25% to 33%		
Mean count	2,185 cells/ μ L		
Diameter			
Small class	5–8 μ m		
Medium class	10–12 μ m		
Large class	14–17 μ m		
Appearance*			
<ul style="list-style-type: none">• Nucleus round, ovoid, or slightly dimpled on one side, of uniform or mottled dark violet color• In small lymphocytes, nucleus fills nearly all of the cell and leaves only a scanty rim of clear, light blue cytoplasm.• In larger lymphocytes, cytoplasm is more abundant; large lymphocytes may be hard to differentiate from monocytes.			
Differential count			
<ul style="list-style-type: none">• Increases in diverse infections and immune responses			
Functions			
<ul style="list-style-type: none">• Several functional classes usually indistinguishable by light microscopy• Destroy cancer cells, cells infected with viruses, and foreign cells• Present antigens to activate other cells of immune system• Coordinate actions of other immune cells• Secrete antibodies• Serve in immune memory			
Monocytes			
Percentage of WBCs	3% to 8%		
Mean count	456 cells/ μ L		
Diameter	12–15 μ m		
Appearance*			
<ul style="list-style-type: none">• Nucleus ovoid, kidney-shaped, or horseshoe-shaped; violet• Abundant cytoplasm with sparse, fine nonspecific granules• Sometimes very large with stellate or polygonal shapes			
Differential count			
<ul style="list-style-type: none">• Increases in viral infections and inflammation			
Functions			
<ul style="list-style-type: none">• Differentiate into macrophages (large phagocytic cells of the tissues)• Phagocytize pathogens, dead neutrophils, and debris of dead cells• Present antigens to activate other cells of immune system			



A light micrograph of a blood smear showing a central lymphocyte with a large, round, dark purple nucleus and a thin rim of light blue cytoplasm. Several red blood cells are visible in the background. A scale bar in the bottom right corner indicates 10 μ m.

Lymphocyte

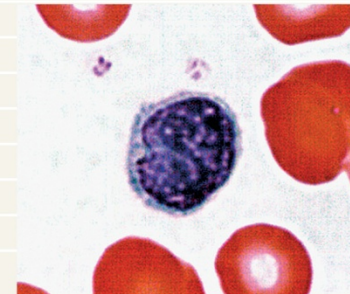
10 μ m



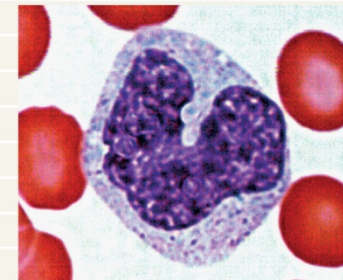
A light micrograph of a blood smear showing a central monocyte with a large, kidney-shaped or horseshoe-shaped dark purple nucleus and abundant, light blue granular cytoplasm. Several red blood cells are visible in the background. A scale bar in the bottom right corner indicates 10 μ m.

Monocyte

10 μ m



Lymphocyte

10 μ m

Monocyte

10 μ m

*Appearance pertains to blood films dyed with Wright's stain.

(Lymphocyte, Monocyte): ©Michael Ross/Science Source

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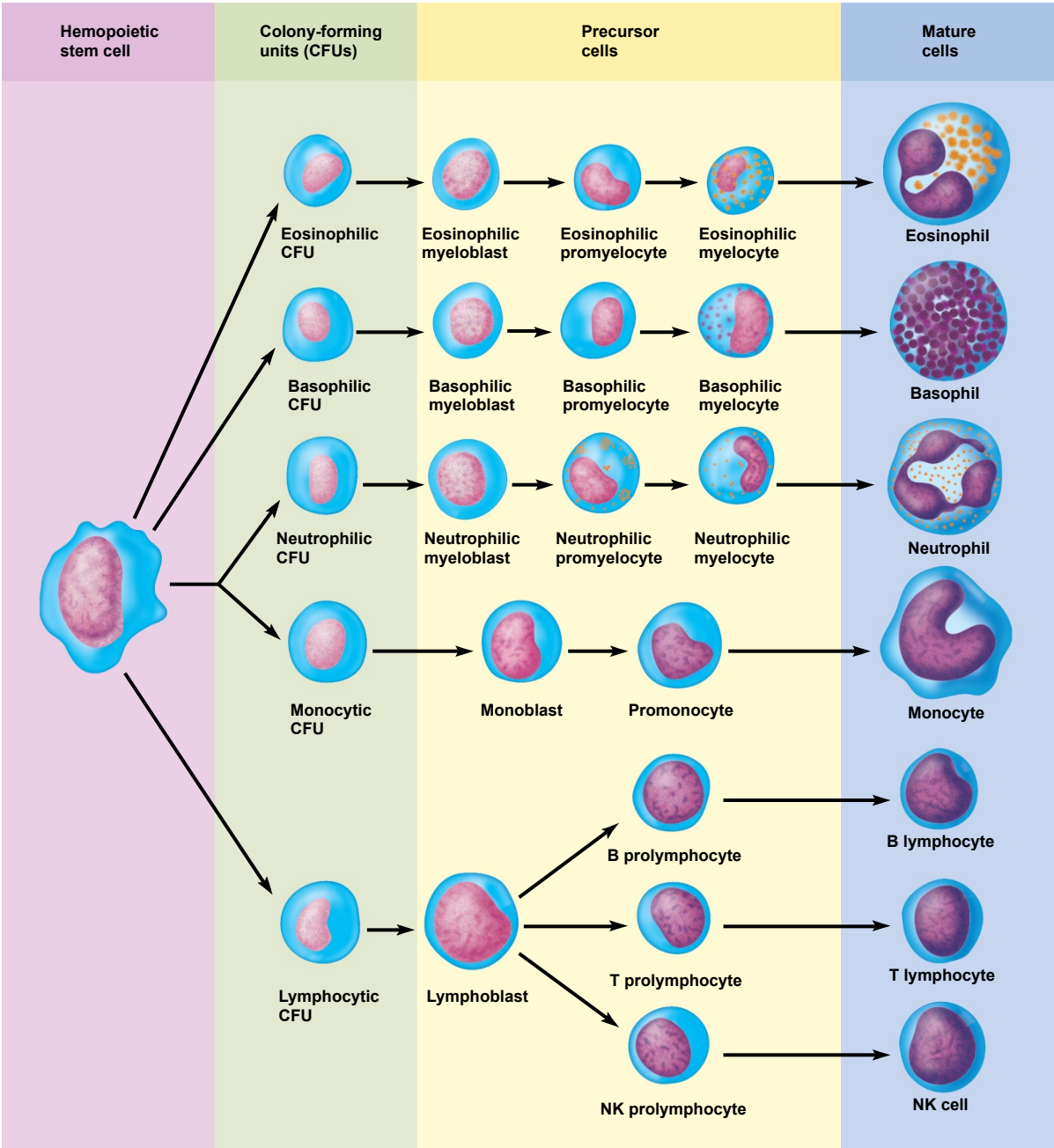
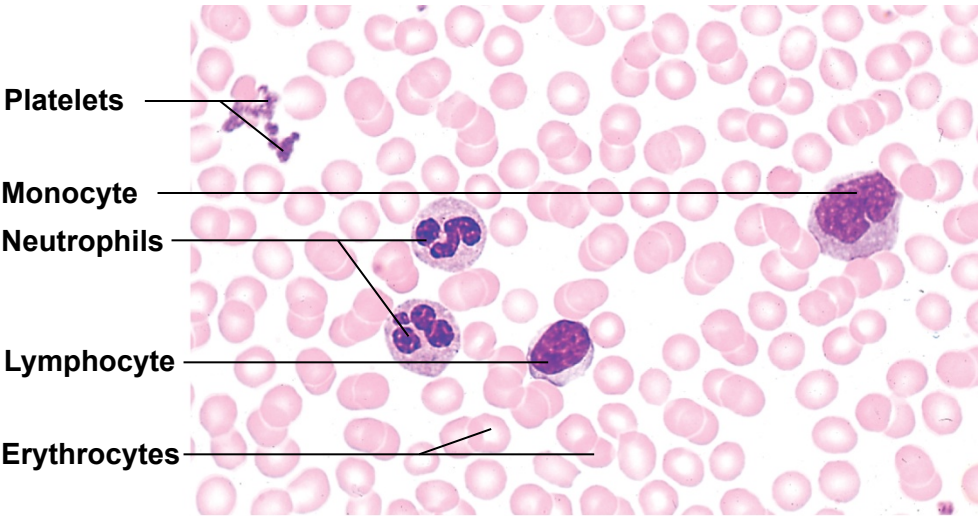
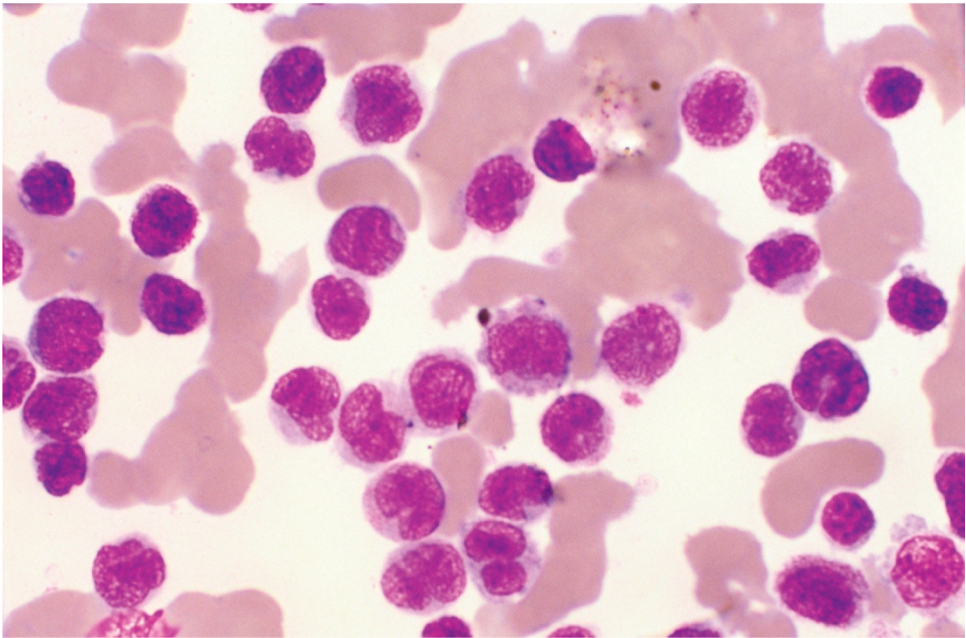


Fig. 18.19

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(a)



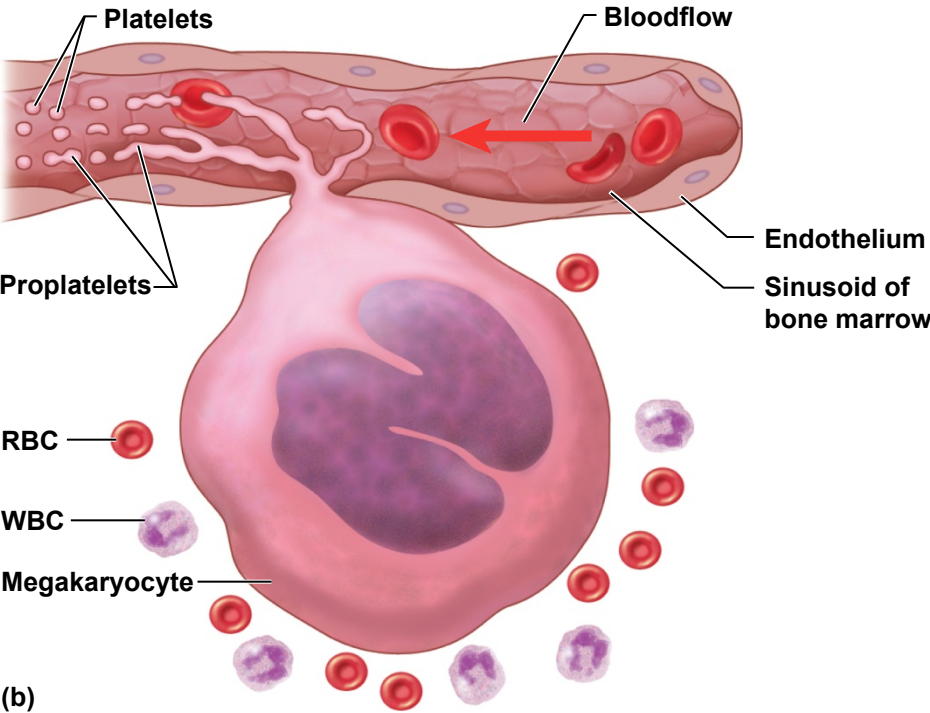
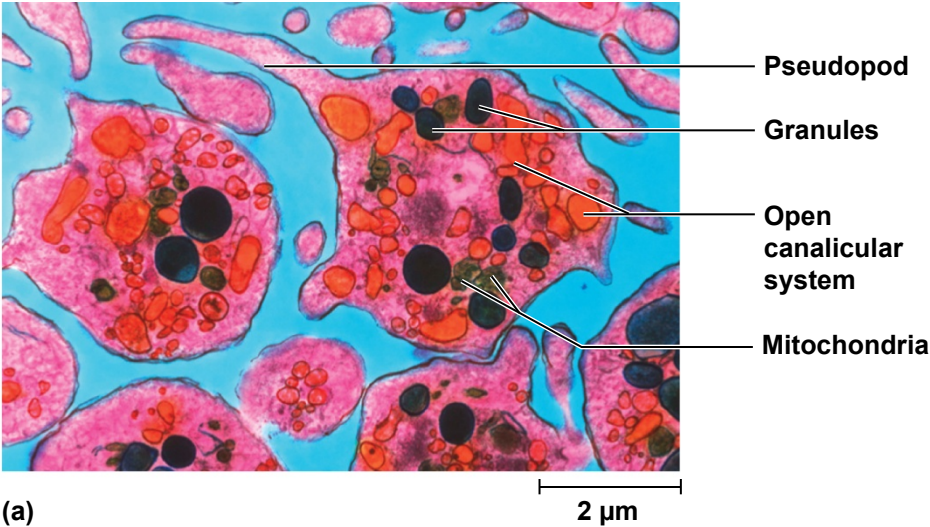
(b)

75 μ m

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Fig. 18.20

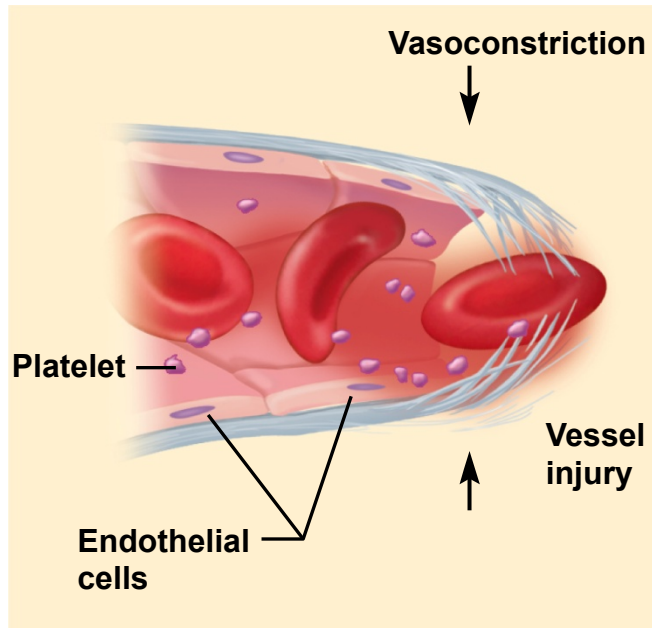
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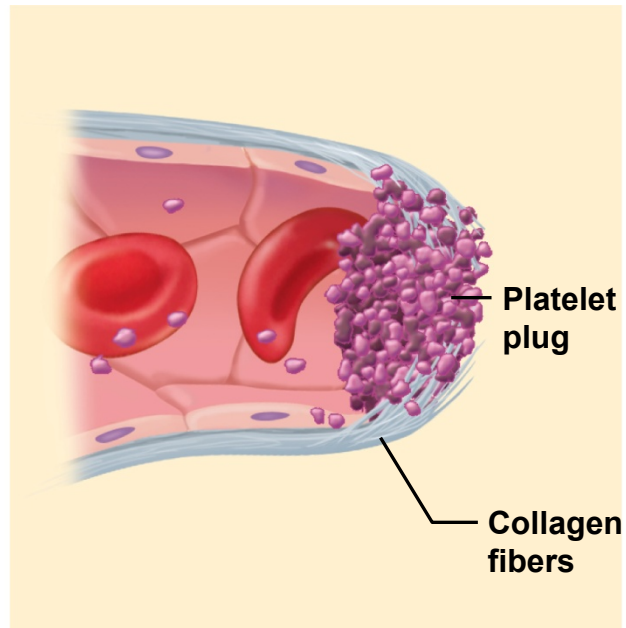
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Fig. 18.21

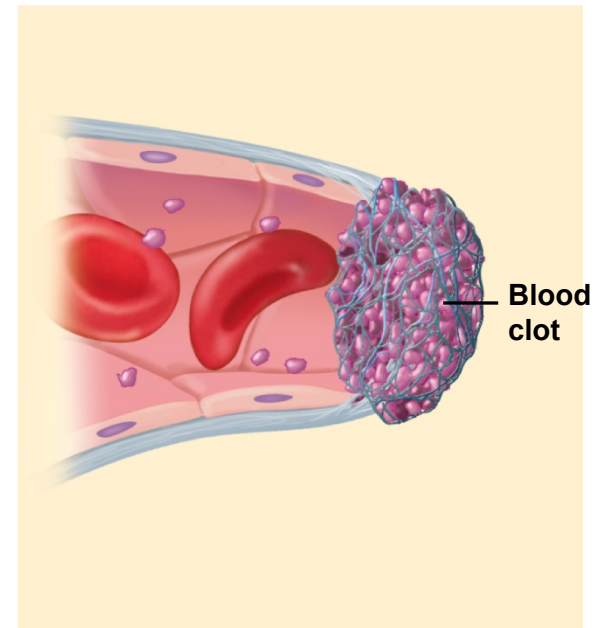
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(a) Vascular spasm



(b) Platelet plug formation



(c) Coagulation

Fig. 18.22

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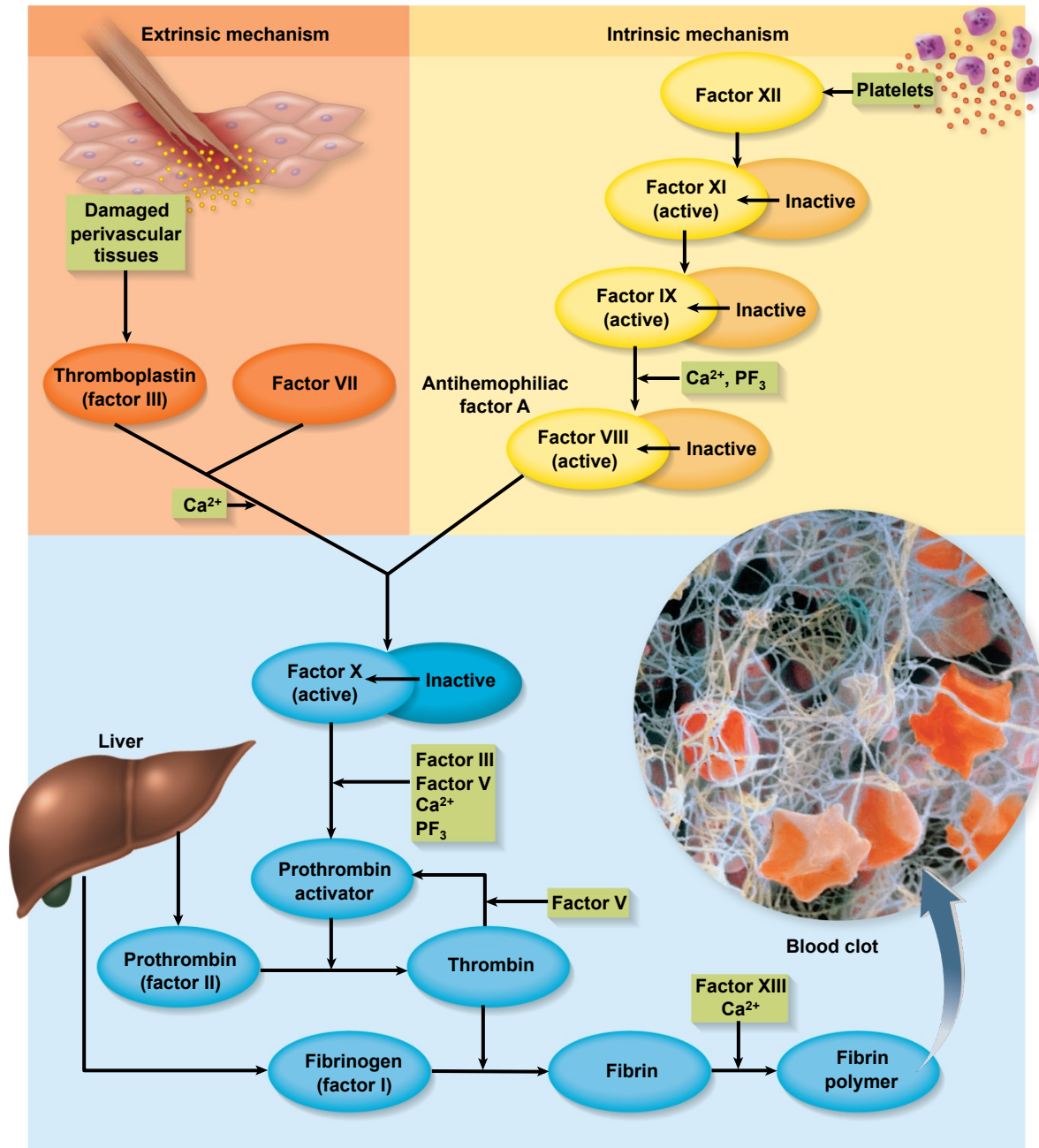


Fig. 18.23

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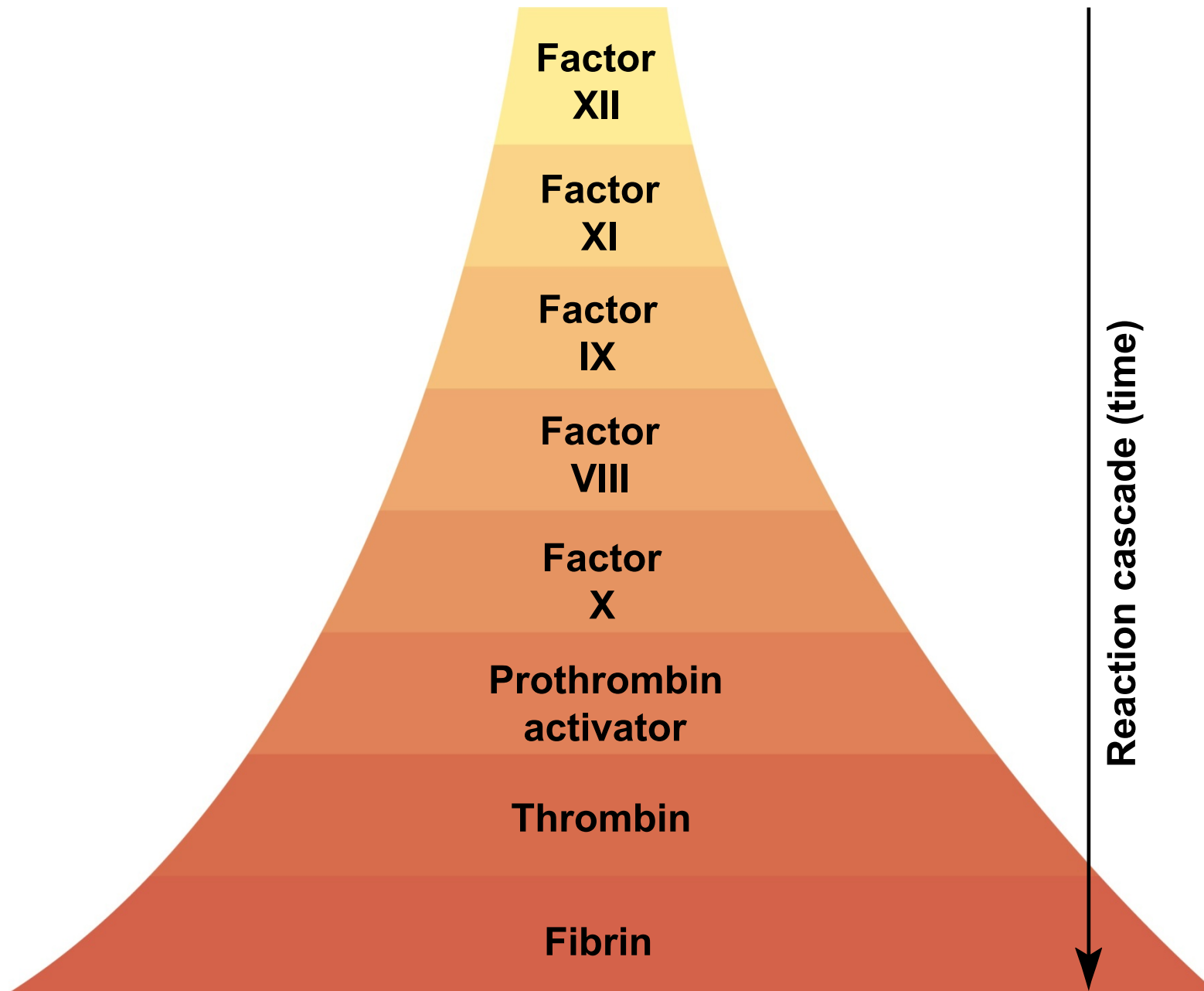


Fig. 18.24

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