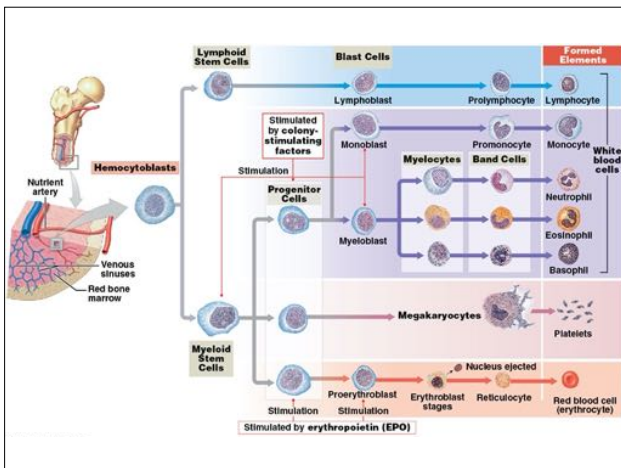
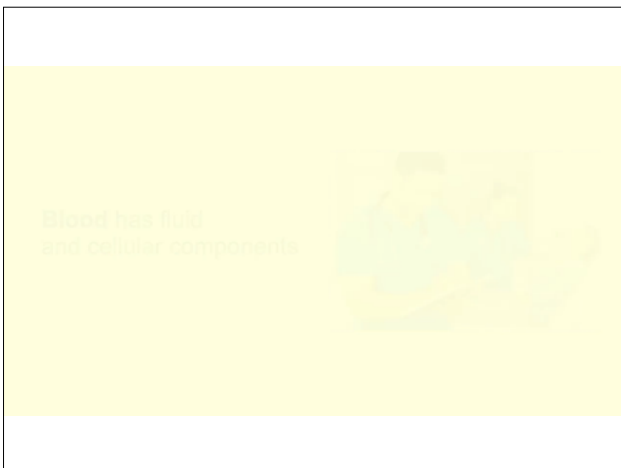
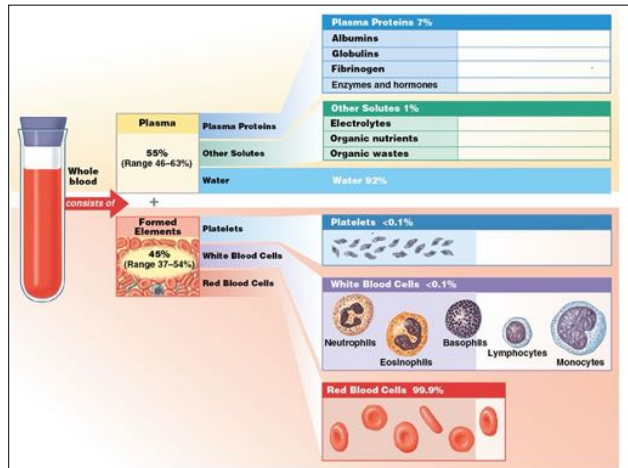


Functions of Blood

- Transport dissolved gases, nutrients, hormones, and metabolic wastes
- Regulate the pH and ion composition of interstitial fluids
- Restrict fluid losses at injury sites
- Defend against toxins and pathogens
- Stabilize body temperature

Properties of Whole Blood

- Blood temperature is about 38°C (100.4°F), slightly above normal body temperature.
- Blood is five times as viscous as water—that is, five times as resistant to flow. Blood's high viscosity results from interactions among dissolved proteins, formed elements, and water molecules in the plasma.
- Blood is slightly alkaline, with a pH between 7.35 and 7.45 (average: 7.4).

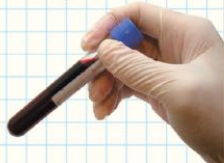


Structure and Function of Platelets

Appearance in a Stained Blood Smear	Abundance (Average Number per μL)	Function	Remarks
Platelets are flattened discs that appear round when viewed from above and appear spindle shaped in section or in a blood smear.	350,000 (range: 150,000-500,000)	Platelets clump together and stick to damaged vessel walls, and they release chemicals that stimulate blood clotting.	Platelets are continuously replaced. Each platelet circulates for 9-12 days before being removed by phagocytes, mainly in the spleen.

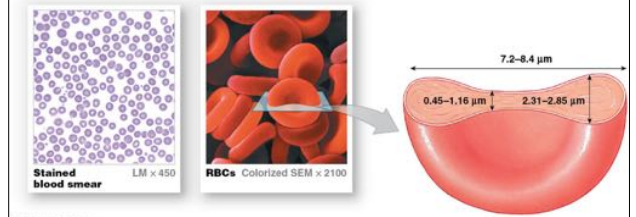
Complete Blood Count (CBC)

Hematocrit: 42%
Hemoglobin: 14.9 g/dL
MCH: 30 µg/RBC
MCV: 90 µm³/cell
Platelet count: 350,000/mm³
RBC: 5.2 million/µL
WBC: 7000/µL
WBC differential count:
 Neutrophils: 67%
 Lymphocytes: 25%
 Monocytes: 3%
 Eosinophils: 4%
 Basophils: 1%



RBC Tests and Related Terminology

Test	Determines	Terms Associated with Abnormal Values	
		Elevated	Depressed
Hematocrit (Hct)	Percentage of formed elements in whole blood Normal = 37–54%	Polycythemia	Anemia
Hemoglobin Concentration (Hb, Hgb)	Concentration of hemoglobin in blood Normal = 12–18 g/dL	Polycythemia	Anemia
Mean Corpuscular Hemoglobin Concentration (MCHC)	Average weight of Hb in one RBC Normal = 27–34 µg/RBC (normochromic)	Hyperchromic	Hypochromic
Mean Corpuscular Volume (MCV)	Average volume of one RBC Normal = 82–101 µm ³ /cell (normocytic)	Macrocytic	Microcytic
RBC Count	Number of RBCs per µL of whole blood Normal = 4.2–6.3 million cells/µL	Erythrocytosis/polycythemia	Anemia
Reticulocyte Count (RetiC.)	Percentage of circulating reticulocytes Normal = 0.8%	Reticulocytosis	Diminished erythropoiesis

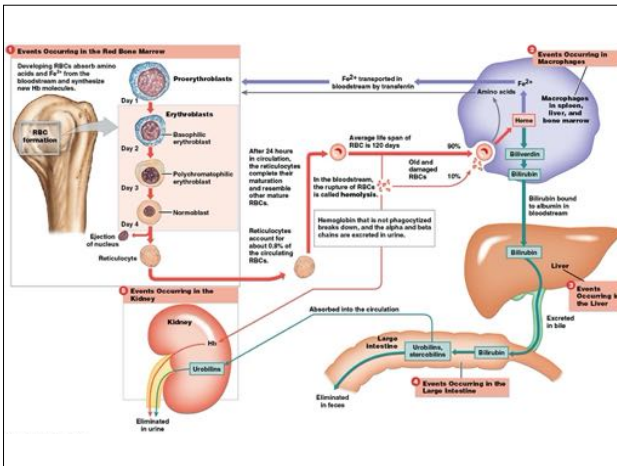
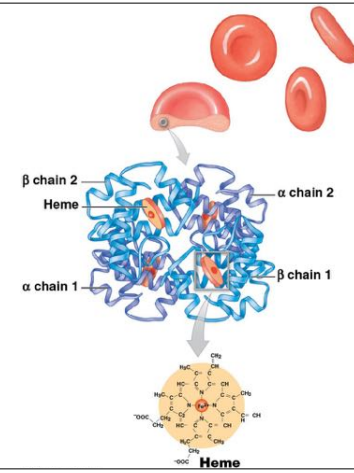
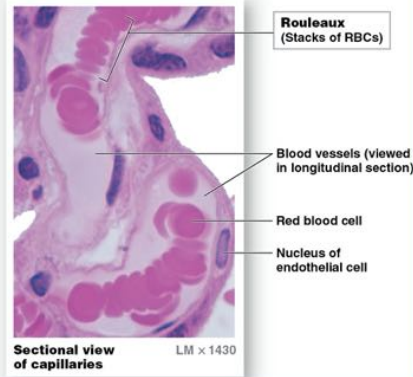


Functional Aspects of Red Blood Cells

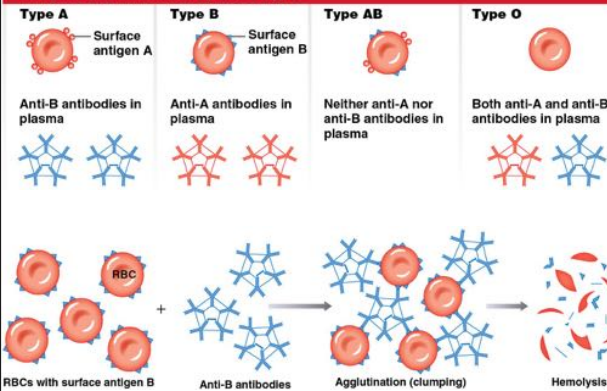
- Large surface area-to-volume ratio.
- RBCs can form stacks.
- Flexibility.

Functional Aspects of Red Blood Cells

- Large surface area-to-volume ratio.
- RBCs can form stacks
- Flexibility



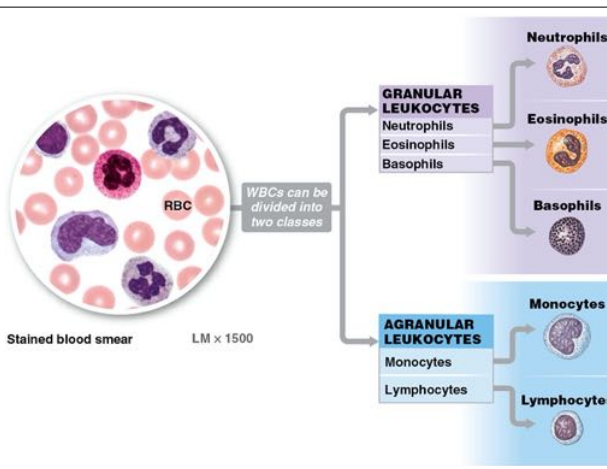
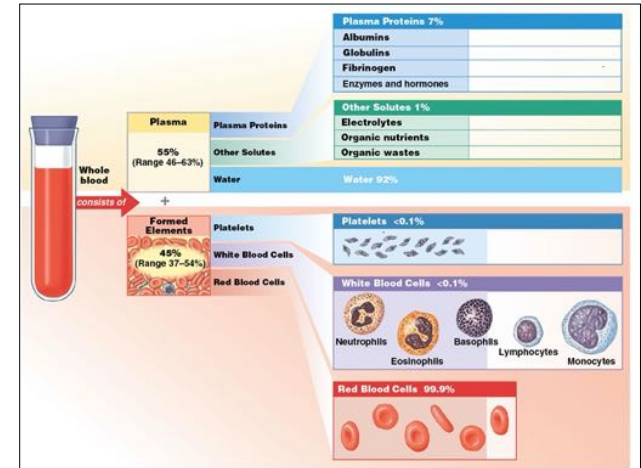
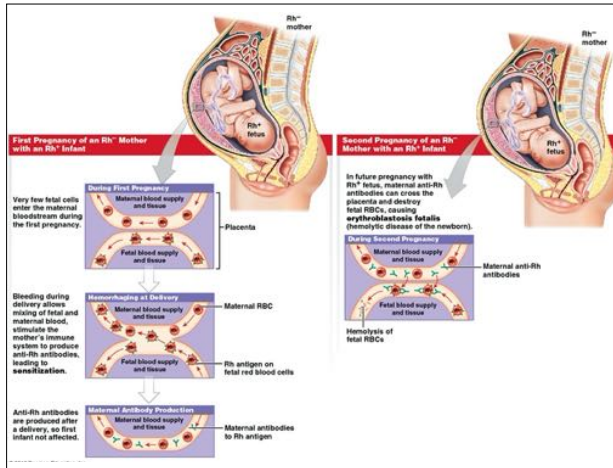
Antigens and Antibodies by Blood Type



Anti-A Antibodies	Anti-B Antibodies	Anti-Rh Antibodies	Blood type	Can receive blood from
Clumping	No clumping	Clumping	A ⁺	A ⁺ , O ⁺ , O ⁻
No clumping	Clumping	Clumping	B ⁺	B ⁺ , O ⁺ , O ⁻
Clumping	Clumping	Clumping	AB ⁺	A ⁺ , B ⁺ , AB ⁺ , O ⁺ , O ⁻ (universal recipient)
No clumping	No clumping	No clumping	O ⁻	O ⁻ (universal donor)

Differences in Blood Type Distribution

Population	Percentage with Each Blood Type					Rh ⁺
	O	A	B	AB		
United States						
Black American	49	27	20	4		95
Caucasian	45	40	11	4		85
Chinese American	42	27	25	6		100
Filipino American	44	22	29	6		100
Hispanic	57	31	10	2		92
Japanese American	31	39	21	10		100
Korean American	32	28	30	10		100
Native North American	79	16	4	<1		100
Native South American	100	0	0	0		100
Australian Aborigine	44	56	0	0		100



White Blood Cells				
Cell Type	Quantity (Average Number per μ L)	Appearance in a Stained Blood Smear	Functions	Remarks
Neutrophils	4150 (range: 1800-7300) Differential count: 50-70%	Round cell, nucleus lobed and may resemble a string of beads; cytoplasm contains large, pale inclusions	Phagocytic; engulf pathogens or debris in injured or infected tissues; release cytotoxic enzymes and chemicals	Move into tissues after several hours; may survive for minutes to days, depending on tissue activity; produced in red bone marrow
Eosinophils	165 (range: 0-700) Differential count: 2-4%	Round cell, nucleus generally has two lobes; cytoplasm contains large granules that generally stain bright red	Phagocytic; engulf antibody-labeled materials; release cytotoxic enzymes; reduce inflammation; increase in abundance in allergies and parasitic infections	Move into tissues after several hours; may survive for minutes to days, depending on activity in red bone marrow
Basophils	44 (range: 0-150) Differential count: <1%	Round cell, nucleus generally cannot be seen through dense, blue-stained granules in cytoplasm	Enter damaged tissues and release histamine and other chemicals that promote inflammation	Survival time unknown; assist most cells of tissues in producing inflammation; produced in red bone marrow

White Blood Cells				
Cell Type	Quantity (Average Number per μ L)	Appearance in a Stained Blood Smear	Functions	Remarks
Monocytes	456 (range: 200-950) Differential count: 2-8%	Very large cell, nucleus kidney bean-shaped; abundant cytoplasm	Enter tissues and become macrophages; engulf pathogens or debris	Move into tissues after 1-2 days; survive for months or longer; produced primarily in red bone marrow
Lymphocytes	2185 (range: 1500-4000) Differential count: 20-40%	Generally round cell, slightly larger than RBC; round nucleus; very little cytoplasm	Cells of lymphatic system; provide defense against specific pathogens or toxins	Survive for months to decades; circulate from blood to tissues and back; produced in red bone marrow and lymphoid tissues

Shared Properties of WBCs

- WBCs circulate for only a short portion of their life span, using the bloodstream primarily to travel between organs and to rapidly reach areas of infection or injury. WBCs spend most of their time migrating through loose and dense connective tissues throughout the body.
- All WBCs can migrate out of the bloodstream. When circulating WBCs in the bloodstream become activated, they contact and adhere to the vessel walls and squeeze between adjacent endothelial cells to enter the surrounding tissue. This process is called **emigration**, or **diapedesis** (di-ah-peh-DE-sis; *dia*, through + *pedesis*, a leaping).
- All WBCs are attracted to specific chemical stimuli. This characteristic, called **positive chemotaxis** (kē-mō-TAK-sis), guides WBCs to invading pathogens, damaged tissues, and other active WBCs.
- Neutrophils, eosinophils, and monocytes are capable of phagocytosis. They can engulf pathogens, cell debris, or other materials. Macrophages are monocytes that move from the bloodstream into peripheral tissues (see Module 4.11).

