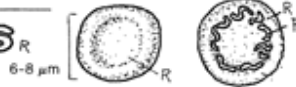


# BLOOD & BLOOD ELEMENTS

**CN:** Color P purple, PP pale purple, O orange, PO pale orange, PB pale blue, R red, and T tan. Except for the latter, these colors match the stains used to observe these cells. First color the cytoplasm of the cell; if you don't have any of the pale colors, leave the cytoplasm background blank. Then stipple the granules with the darker color. The results should create a rough impression of the actual colors.

## ERYTHROCYTES<sub>R</sub>

(RED BLOOD CORPUSCLES)



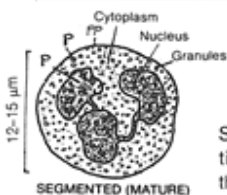
Erythrocytes (RBCs; approximately 4.5–6.2 million per milliliter of blood in men; 4–5.5 million/ml in women) are formed in the bone marrow. There each cell loses its nucleus and most of its organelles prior to release into the peripheral blood. Recently released immature erythrocytes (reticulocytes) may retain some ribosomal RNA in their cytoplasm; these granules appear dark purple and reticulated when stained. Normally making up about 1% of the RBC population, reticulocytes may increase in number during chronic oxygen lack (e.g., at prolonged high altitude). The circulating RBC (without nucleus or organelles, it is truly a corpuscle and not a cell) is a non-rigid, biconcave-shaped, membrane-lined sac of hemoglobin, a large iron-containing protein. Hemoglobin (12–16 grams/deciliter of blood in women; 14–18 g/dL in men) has a powerful affinity for oxygen and is the principal carrier of oxygen in the body; plasma is the other carrier. Erythrocytes pick up oxygen in the lungs and release it in the capillaries to the tissues/cells. RBCs circulate for about 120 days until defective and are then taken out of the blood and broken down by cells of the spleen.

## THROMBOCYTES<sub>P</sub>

(PLATELETS)

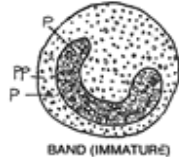


Thrombocytes or platelets (150,000–400,000/ml of blood; 2–5 μm in diameter) are small bits of cytoplasm from giant cells (megakaryocytes) of the bone marrow. Circulating in the blood for a lifetime of 10 days or so, platelets adhere to injured endothelium and play a significant role in limiting hemorrhage (aggregation of platelets, blood coagulation/clotting, and clot removal).



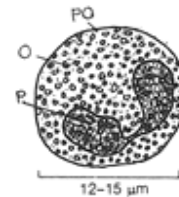
## GRANULAR<sub>\*</sub> NEUTROPHIL<sub>\*</sub>

Segmented neutrophils (55–75% of the WBC population) arise in the bone marrow and live short lives in the blood and connective tissues (hours–4 days). Immature forms (*band neutrophils*, 1–5%) may be seen in the blood; their numbers often increase in acute infections. Neutrophils rapidly engulf foreign elements/cellular debris; strong enzymes in specific granules and lysosomes destroy them (phagocytosis).



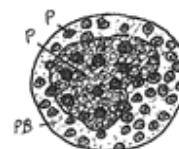
## EOSINOPHIL<sub>\*</sub>

Eosinophils (1–3% of WBCs) exhibit colorful granules when properly stained. Eosinophils are phagocytic in immune reactions. They are involved in the late-onset phase of asthmatic attacks (subsequent bronchial constriction), possibly enhancing cell injury by increasing cell membrane permeability in the bronchial mucosa to allergic substances. They also appear to limit the expression of mast cell degranulation (histamine release and effects) during allergic reactions.



## BASOPHIL<sub>\*</sub>

Basophils (0–1% of WBCs) contain dark-staining granules. Basophils are known to degranulate in allergic reactions, releasing histamine, serotonin, and heparin. Such degranulation induces contraction of smooth muscle, increases vascular permeability (enhancing the effects of inflammation), and slows down movement of white blood cells in inflammation.



## LEUKOCYTES<sub>D+\*</sub>

(WHITE BLOOD CELLS)



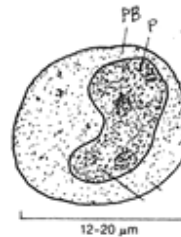
## NONGRANULAR<sub>\*</sub> LYMPHOCYTE<sub>\*</sub>

Lymphocytes (20–45% of WBCs) arise from the bone marrow and reside in the blood as well as the lymphoid tissues (lymph nodes, thymus, spleen, and so on). Lymphocytes generally consist of about 20% B cells (short-lived cells from the bone marrow, concerned with humoral immunity, transformation into plasma cells, and the secretion of antibodies or immunoglobulins) and 70% T cells (long-lived cells from the thymus; may be cytotoxic, helper, or suppressor cells associated with cell-mediated immunity). Lymphocytes with neither B or T surface antigens (less than 5%) are called natural killer cells.

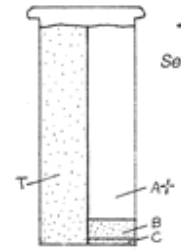


## MONOCYTE<sub>\*</sub>

Monocytes (2–8% of WBCs) arise in the bone marrow, mature in the blood (about eight hours), then leave the circulation to enter the extracellular spaces as macrophages. They are critical to the functioning of the immune system, as they present antigen to the immune cells, secrete substances in immune reactions, and destroy antigens (see glossary). They phagocytose cellular and related debris in wound healing, bone formation, and multiple other cellular activities where breakdown occurs.

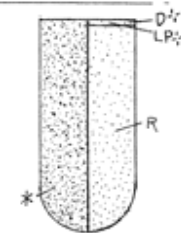


**PLASMA (55%)<sub>T</sub>**  
**WATER (90%)<sub>A+\*</sub>**  
**PROTEINS (8%)<sub>B</sub>**  
**ACIDS, SALTS (2%)<sub>C</sub>**



## FORMED ELEMENTS OF THE BLOOD (45%)<sub>\*</sub>

**ERYTHROCYTES (99%)<sub>R</sub>**  
**THROMBOCYTES (0.6–1.0%)<sub>LP</sub>**  
**LEUKOCYTES (0.2%)<sub>D+\*</sub>**



All constituents of the blood that can be observed as discrete structures with the aid of the light microscope are called *formed elements of the blood*. The rest of the blood is a protein-rich fluid called plasma. When blood is allowed to clot, the cells disintegrate (hemolysis) and a thick yellow fluid called serum emerges. Serum is basically plasma less clotting elements. If whole blood is centrifuged in a test tube, the RBCs will settle to the bottom, the *leukocyte fraction* will form a buffy coat on top of that, and the *plasma*, being the lightest, will take up the upper 55% of the total volume. Packed RBCs in a test tube constitute a *hematocrit* (40–52% of the blood volume in men; 37–47% in women). The difference in blood values between men and women is probably related to iron storage and metabolism differences (men store up to 50% more iron than women). A low hematocrit may be associated with anemia or hemorrhage.