Human Anatomy
Blood

Blood

- A **specialized connective tissue**
  - Carries respiratory gases, nutrients, and hormones
  - Helps body regulate temperature
- Blood volume: 4-6 liters (gender dependent)
- Contains cellular and liquid components:
  - Blood cells—**erythrocytes** (red), **leukocytes** (white), and **platelets** (bits of fragments of cells; blood clotting)
    - **Hematocrit**—measure of % of RBC (~45%)
  - **Plasma**—fluid portion and fibrinogen (blood clot protein)

Blood Plasma

- Straw-colored, sticky fluid portion of blood
- Approx. **90% water**
- Contains over 100 kinds of molecules
  - Ions—Na+, Cl- and Ca++
  - Nutrients—sugars, amino acids, lipids, wastes, and proteins
  - Three main proteins
    - Albumin, globulins, and fibrinogen

Erythrocytes

- Have NO organelles or nuclei
- Oxygen-transporting cells—7.5um in diameter (diameter of capillary 8-10um)
- Biconcave shape
- Useful for estimating sizes of nearby structures
- 97% oxygen-carrying **hemoglobin**
- Hemoglobin holds four oxygen molecules (O2) each bound to an iron molecule
- Oxidation of this iron gives blood its red
- Pick up O2 (lung capillaries) release in other capillaries
  - Capillaries are sites of exchange

Leukocytes — White Blood Cells (WBCs)

- Originate in bone marrow
- Protect the body from infectious microorganisms
- Function outside the bloodstream in loose CT
- **Diapedesis**—circulating leukocytes leaving the capillaries
- Two types:
  - **Granulocytes**: Neutrophils (50-70%), Eosinophils (2-4%), Basophils (0.5-1%)

    - **Agranulocytes**: Lyphocytes, Monocytes
- Never let Monkey Eat Bananas

Granulocytes

1. **Neutrophils**—most numerous WBC
    a. Phagocytize and destroy bacteria
    b. Nucleus—has two to six lobes
    c. Granules pick up acidic and basic stains
2. **Eosinophils**—compose 2-4% of all WBCs
    a. Play roles in
        i. Ending allergic reactions, parasitic infection
3. **Basophils**—about 0.5-1% of all leukocytes
    a. Nucleus—usually two lobes
    b. Granules secrete histamines
    c. Function in inflammation mediation

Agranulocytes

1. **Lymphocytes**—composed 25-45% of WBCs
    a. *The most important cells of the immune system*
    b. Effective in fighting infectious organisms
    c. Act against a specific foreign molecule (antigen)
    d. Nucleus stains dark purple
        i. Two main types
            1. **T-cells**—attack foreign cells directly
            2. **B-Cells**—multiply to become plasma cells
                a. Secrete antibodies
2. **Monocytes**—composed 3-8% of WBCs
    a. **Largest leukocytes**
    b. Transform into macrophages
        i. Phagocytic cells

Platelets

- Cell fragments
    - Break off from **megakaryocytes**
    - Volume of platelets>volume of WBCs
- Function in clotting of blood
- Release many cell-to-cell signaling molecules

STUDY IT Table 18.1

Cell lines in Blood Cell Formation

- All blood cells originate in bone marrow
- All originate from one cell type
    - **Blood stem cells**
        - **Lymphoid stem cells** (develop from blood stem cells)
            - Give rise to lymphocytes
        - **Myeloid stem cells** (develop from blood stem cells)
            - Give rise to all other blood cells

Bone Marrow as the Site of Hematopoiesis

- Hematopoiesis—process by which blood cells are formed in red marrow (100 billion formed each day)
- Bone marrow—located within all bones
    - **Red marrow**—actively generates new blood cells
    - Contains immature erythrocytes
    - In adults, red marrow is located:
        1. Between the trabeculae of spongy bone in axial skeleton
        2. Bones of the pelvic and pectoral girdles
        3. Proximal epiphyses of the humerus and femur
    - Yellow marrow
        - Many fat cells
        - Located in the long bones of adults

Cell lines in Blood Formation

- Genesis of erythrocytes
    - Committed cells are **proerythroblasts**
    - **Reticulocytes** eject organelles, become biconcave and enter the blood stream
    - Circulate for 1-2% days before becoming mature red blood cells (erythrocytes)
    - Make up about 1-2% of all erythrocytes in circulation
- Formation of Leukocytes (*fig 18.8*)
    - Granulocytes form from myeloblasts
    - Monoblasts enlarge and form monocytes
- Platelet-forming cells from megakaryoblasts
    - Break apart into platelets