Chapter 14: Blood
Introduction and
II. Blood Cells
   A. Introduction
   
   1. Blood is three to four times more viscous than water.
   2. Most blood cells form in red bone marrow.
   3. Types of blood cells are red blood cells and white blood cells.
   4. Cellular fragments of blood are platelets.
   5. Formed elements of blood are the cells and platelets.
B. Blood Volume and Composition

1. Blood volume varies with body size, changes in fluid and electrolyte concentrations, and the amount of adipose tissue.

2. Blood volume is about 8% of body weight.

3. An average-size adult has 5 liters of blood.

4. Hematocrit is the percentage of blood cells in a blood sample.

5. A blood sample is usually 45% red blood cells and 55% plasma.
B. Blood Volume and Composition

- 6. Plasma is a mixture of water, amino acids, proteins, carbohydrates, lipids, vitamins, hormone, electrolytes, and cellular wastes.

- 7. Less than 1% of formed elements of blood are white blood cells and platelets and 99% are red blood cells.
II. Blood Cells
A. The Origin of Blood Cells

1. Blood cells originate in red bone marrow from hemocytoblasts or hemopoietic stem cells.
2. A stem cell can differentiate into any number of specialized cell types.
3. Colony-stimulating factors are growth factors that stimulate stem cells to produce certain cell types.
4. Thrombopoietin stimulates the production of megakaryocytes.
B. Characteristics of Red Blood Cells

- 1. Red blood cells are also called erythrocytes.
- 2. Red blood cells are biconcave in shape.
- 3. The biconcave shape of red blood cells allows them to have an increased surface area for the transport of gases.
- 4. Hemoglobin is an oxygen carrying protein in red blood cells.
- 5. Each red blood cell is about one-third hemoglobin by volume.
B. Characteristics of Red Blood Cells

- 6. Oxyhemoglobin is hemoglobin combined with oxygen.
- 7. Deoxyhemoglobin is hemoglobin that has released oxygen.
- 8. Red blood cells extrude their nuclei as they mature.
- 9. Because red blood cells lack mitochondria they must produce ATP through glycolysis.
- 10. As red blood cells age, they become rigid and are more likely to be damaged and are removed by enzymes in the liver and spleen.
C. Red Blood Cell Counts

1. A red blood cell count is the number of RBCs in one mm$^3$ of blood.

2. A healthy adult male has a red blood cell count between 4,600,000 - 6,200,000 cells per mm$^3$.

3. A healthy adult female has a red blood cell count between 4,200,000 - 5,400,000 cells per mm$^3$.

4. A healthy child has a red blood cell count between 4,500,000 - 5,100,000 cells per mm$^3$.

5. The number of red blood cells reflects the blood’s oxygen carrying capacity.
1. Erythropoiesis is red blood cell production.

2. Initially, red blood cell formation occurs in the yolk sac, liver, and spleen.

3. After an infant is born, red blood cells are produced almost exclusively in the red bone marrow.

4. Hemocytoblasts in red bone marrow give rise to erythroblasts that give rise to erythrocytes.
D. Red Blood Cell Production and Its Control

- 5. Reticulocytes are immature red blood cells that still contain endoplasmic reticulum.
- 6. The average life span of a red blood cell is 120 days.
- 7. Erythropoietin controls red blood cell production and is released primarily from the kidneys.
- 8. When the availability of oxygen decreases, erythropoietin is released and red blood cell production increases.
E. Dietary Factors Affecting Red Blood Cell Production

- 1. Two vitamins needed for red blood cell production are vitamin $B_{12}$ and folic acid.
- 2. Two B-complex vitamins are needed for DNA synthesis.
- 3. Intrinsic factor is needed for the absorption of vitamin $B_{12}$.
- 4. Iron is required for hemoglobin production.
- 5. Anemia is a reduction in the oxygen-carrying capacity of the blood.
F. Destruction of Red Blood Cells

- 1. Damaged red blood cells rupture as they pass through the spleen or liver.
- 2. In the liver and spleen, macrophages destroy worn out red blood cells.
- 3. Hemoglobin molecules are broken down into globin and heme groups.
- 4. Heme decomposes into iron and biliverdin.
- 5. Ferritin is an iron-protein complex that stores iron in the liver.
F. Destruction of Red Blood Cells

- 6. Biliverdin is converted to bilirubin.
- 7. Bilirubin and biliverdin are excreted in bile.
- 8. The polypeptide globin chains breakdown into amino acids.