Chapter 6. Cardiovascular System: Blood

Functions of Blood.
Primary transport medium of the body.
Transports gases, nutrients, wastes, hormones.
Defends body against invasion by pathogens.
Has regulatory functions for temperature, water/salt balance, pH.

Blood Composition. [Figure 6.2]
Cells.

White cells.
Platelets.
Plasma.

Blood Cell Formation. [Figure 6.1]

Begins in red bone marrow.
Red Blood Cells (RBC) and Transport. [Figure 6.3]

Oxygen transport.
Hemoglobin (Hb) (protein).
Four peptide chains (protein subunits) each with an iron containing heme group.

Each heme group can pick up 1 oxygen molecule ($O_2$).

- 1Hb can carry 4O₂
- Each RBC has $\approx 280$ million Hb = 1.12 billion Hb.
- 1mm³ contains $\approx 5$ million RBC.

Red blood cells help transport CO₂.
Dissolved in plasma: $\approx 7\%$
Attached to Hb (in RBC): $\approx 25\%$
As bicarbonate ($HCO_3^-$) ion: $\approx 68\%$
($CO_2 + H_2O \rightarrow H_2CO_3 \rightarrow + H^+ + HCO_3^-$)

O₂ Concentration and RBC Production. [Figure 6.4]
RBC Disorders.
Anemia.

Hemolysis.

Sickle-cell disease.

White Blood Cells (WBC) – Defense Against Disease.
Larger than RBCs.

Types distinguished by nuclear shape and staining characteristics.

Important components of immune system.

Can leave blood vessels and are found throughout body. [Figure 6.6]

Disorders Involving White Blood Cells.
Severe combined immunodeficiency disease (SCID)

Leukemia –

Infectious mononucleosis – also known as the “kissing disease” occurs when the Epstein-Barr virus (EBV) infects lymphocytes resulting in fatigue, sore throat and swollen lymph nodes.
Platelets.
- Fragments of large cells – made in the red bone marrow.
- About 200 billion are made per day.
- Function in blood clotting. [Figure 6.7]

Blood proteins named thrombin and fibrinogen are important for blood clotting by leading to fibrin threads that catch RBC.

1. Blood vessel is punctured.

2. Platelets congregate and form a plug.

3. Platelets and damaged tissue cells release prothrombin activator, which initiates a cascade of enzymatic reactions.

4. Fibrin threads form and trap red blood cells.

Blood-clotting process
Disorders Related to Blood Clotting.
Thrombocytopenia.
Number of platelets is too low:
not enough made in the bone marrow
or increased breakdown outside the marrow.

Thromboembolism.
A clot forms and breaks off from its site of origin and plugs another vessel.

Hemophilia.
Genetic disorder resulting in a deficiency of a clotting factor – blood does not clot properly both internally and externally.

Blood Typing and Transfusions.
Terminology.
Antigen: a foreign substance, often a polysaccharide or a protein, that stimulates an immune response.

Antibody: proteins made in response to an antigen in the body and bind to that antigen.

Blood Types in the ABO system.
A, B, AB, and O.
**Type A** blood. Red blood cells have type A surface antigens. Plasma has anti-B antibodies.

**Type B** blood. Red blood cells have type B surface antigens. Plasma has anti-A antibodies.

**Type AB** blood. Red blood cells have both type A and type B surface antigens. Plasma has neither anti-A nor anti-B antibodies.

**Type O** blood. Red blood cells have neither type A nor type B surface antigens. Plasma has both anti-A and anti-B antibodies.

**Agglutination.**

<table>
<thead>
<tr>
<th>Type</th>
<th>Antigen</th>
<th>Antibody</th>
<th>Transfusions</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>A</td>
<td>B</td>
<td>Can receive only A.</td>
</tr>
<tr>
<td>B</td>
<td>B</td>
<td>A</td>
<td>Can receive only B.</td>
</tr>
<tr>
<td>AB</td>
<td>A and B</td>
<td>None</td>
<td>Can receive all, give to AB.</td>
</tr>
<tr>
<td>O</td>
<td>None</td>
<td>A and B</td>
<td>Can give to all, receive O.</td>
</tr>
</tbody>
</table>

Ordinarily one is given one’s own type.

Blood Types in the Rh system.

Rh+, and Rh−.

Rh− individuals can become sensitized to Rh+ blood.
Fetal Rh-positive red blood cells leak across placenta into mother’s bloodstream. Mother forms anti-Rh antibodies that cross the placenta and attack fetal Rh-positive red blood cells.

Hemolytic disease of the newborn. [Figure 6.10]