8.2 Blood and Circulation
In this section, you will:
• Describe components of blood
• Explain role of blood in regulating body temperature
• Explain the role of the circulatory system and exchange of matter and energy
• Identify blood disorders and technologies used to treat them

Overview
• Khan Academy- What’s inside blood?

Blood
• Connective tissue- links cells and organs
• Two elements
  – Fluid = plasma
  – Solid = formed portion
    • Red blood cells, white blood cells, and platelets
      – Produced in the bone marrow
• Blood Composition
• Types of blood cells (optional)

Plasma
• Plasma
• Fluid portion of blood
• Consists of:
  – Water Dissolved gases
  – Minerals
  – Hormones
Red Blood Cells

- Erythrocytes
- 44% of blood volume
- Oxygen transport
- No nucleus
  - Iron containing molecules
  - Hemoglobin

White Blood Cells

- Leucocytes
- Respond to infection
- 1% of total blood volume
- Nuclei and colorless
- Three groups
  - Granulocytes
  - Monocytes
  - Lymphocytes

Granulocytes

- Neutrophils
- Basophils
- Eosinophils

Monocytes

- Can leave bloodstream
- Become macrophages
  - Destroy bacteria
**Lymphocytes**

- Produce **proteins**
  - **Antibodies**
- Incapacitate (knock out) pathogens
  - Can be detected and destroyed

**Platelets**

- **Fragments** that form when larger cells in bone marrow break apart
- No nucleus
- **Cause clotting** of blood
- Prevent excessive blood loss
Components of Blood

- Four main components of blood
  - Separated using a blood centrifuge. When separated, it briefly settles into layers
- Red blood cells (RBC)
  - Biconcave disks.
  - Hemoglobin reflects red wavelengths of light so cells appear a bright red color.
- White blood cells (WBC)
- Platelets
- Plasma

### Cellular Components of Blood

<table>
<thead>
<tr>
<th>Point of Comparison</th>
<th>Red blood cells</th>
<th>White blood cells</th>
<th>Platelets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Origin</td>
<td>red bone marrow</td>
<td>thymus, red bone marrow</td>
<td>red bone marrow, lungs</td>
</tr>
<tr>
<td>Cells present per mm$^3$ of blood</td>
<td>5,500,000 (male) / 4,500,000 (female)</td>
<td>6,000</td>
<td>250,000</td>
</tr>
<tr>
<td>Relative size</td>
<td>small (8 μm diameter)</td>
<td>largest (up to 25 μm)</td>
<td>large (10 μm)</td>
</tr>
<tr>
<td>Function</td>
<td>to carry oxygen and carbon dioxide to and from cells</td>
<td>to engulf foreign particles</td>
<td>to play a role in the formation of antibodies (defence function)</td>
</tr>
<tr>
<td>Life span</td>
<td>120 days</td>
<td>a few hours to a few days</td>
<td>unknown</td>
</tr>
<tr>
<td>Appearance</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Plasma

<table>
<thead>
<tr>
<th>Constituent</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>~92%</td>
</tr>
<tr>
<td>Blood proteins</td>
<td>~7%</td>
</tr>
<tr>
<td>Fibrinogen</td>
<td></td>
</tr>
<tr>
<td>Serum albumin</td>
<td></td>
</tr>
<tr>
<td>Serum globulin</td>
<td></td>
</tr>
<tr>
<td>Other organic substances</td>
<td>~0.1%</td>
</tr>
<tr>
<td>Non-protein nitrogen (urea)</td>
<td></td>
</tr>
<tr>
<td>Organic nutrients</td>
<td></td>
</tr>
<tr>
<td>Inorganic ions:</td>
<td>~0.9%</td>
</tr>
<tr>
<td>calcium, chlorine, magnesium</td>
<td></td>
</tr>
<tr>
<td>potassium, sodium, bicarbonates</td>
<td></td>
</tr>
<tr>
<td>carbonates, phosphates</td>
<td></td>
</tr>
</tbody>
</table>
Maintaining Balance

- Blood helps maintain temperature
- Blood is able to dissipate heat through blood vessels and skin
- Under control of nervous system
  - Vessels dilate (widen) to allow heat to be lost through skin (vasodilation)
  - Vessels contract to prevent heat loss (vasoconstriction)
- Alcohol and nicotine can increase vasodilation

Homeostatic Regulation

- (A) Vasodilation (B) Vasoconstriction.

- Vein and artery are adjacent to one another
  - Heat is exchanged
- Arterial blood is cooled as it nears hand
- Venous blood is warmed as it leaves hand
- During heat conservation
  - More blood returns to the heart through the deep vein.
- In higher-temperature conditions
  - More blood returns through the surface vein.

Blood Disorders

- Hemophilia – insufficient clotting proteins.
  - Constantly in danger of bleeding to death.
- Leukemia – cancer of the white blood cells.
  - Myeloid is the presence of too many white blood cells (these blood cells are too immature to fight infection and overcrowd red blood cells)
  - Lymphoid is cancer of the white blood cells themselves
    - Both can be acute (appears suddenly and death soon occurs) or chronic (may have it for months or years without symptoms)
    - Blood transfusions and bone marrow transplants are done as treatment