Functions of Blood

1. Transport
   - Carries ________ to tissues
   - Carries _________ and __________ away from tissues
   - ________________________

2. __________________ - white blood cells
   - Defends body against ______________________________
   - Removes __________ and __________________________

3. Regulation
   - ________________________________
   - ________________________________
   - ________________________________
Components of Blood

- **Plasma**
  - About 92% is __________________________
  - About 8% is composed ________________
  - **Plasma proteins** - __________________
    - Buffer _______________________
    - Help maintain ______________________
    - _______________ – functions in blood clotting
<table>
<thead>
<tr>
<th>FORMED ELEMENTS</th>
<th>Function and Description</th>
<th>Source</th>
<th>PLASMA</th>
<th>Function</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Red Blood Cells</strong></td>
<td>Transport O₂ and help transport CO₂. 7–8 μm in diameter; bright-red to dark-purple biconcave disks without nuclei.</td>
<td>Red bone marrow</td>
<td><strong>PLASMA</strong></td>
<td>Maintains blood volume; transports molecules.</td>
<td>Absorbed from intestine</td>
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<tr>
<td>(erythrocytes)</td>
<td></td>
<td></td>
<td>Water (90–92% of plasma)</td>
<td>Maintain blood osmotic pressure and pH.</td>
<td>Liver</td>
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<td></td>
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<td></td>
<td>Plasma proteins (7–8% of plasma)</td>
<td>Maintain blood volume and pressure, transport.</td>
<td>Select white blood cells</td>
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<td></td>
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<td></td>
<td>Albumins</td>
<td>Transport; fight infection, Coagulation.</td>
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<td></td>
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<td>Globulins</td>
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<td></td>
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<td></td>
<td>Fibrinogen</td>
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<tr>
<td><strong>White Blood Cells</strong></td>
<td>Fight infection. Remove dead/dying cells. Destroy cancer cells. Phagocytose pathogens. 10–14 μm in diameter; spherical cells with multilobed nuclei; fine, lilac granules in cytoplasm if stained.</td>
<td>Red bone marrow</td>
<td><strong>PLASMA</strong></td>
<td>Maintain blood osmotic pressure and pH; aid metabolism.</td>
<td>Absorbed from intestine</td>
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<tr>
<td>(leukocytes)</td>
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<td>Salts (less than 1% of plasma)</td>
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<tr>
<td>5,000–11,000 per mm³ blood</td>
<td></td>
<td></td>
<td>Gases</td>
<td></td>
<td>Lungs, Tissues</td>
</tr>
<tr>
<td><strong>Granular leukocytes</strong></td>
<td></td>
<td></td>
<td>Oxygen</td>
<td></td>
<td></td>
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<tr>
<td>• Neutrophils</td>
<td></td>
<td></td>
<td>Carbon dioxide</td>
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<td></td>
<td></td>
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<td>Cellular respiration</td>
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<td></td>
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<td>End product of metabolism.</td>
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<td></td>
<td></td>
<td></td>
<td><strong>PLASMA</strong></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Nutrients</td>
<td></td>
<td>Absorbed from intestine</td>
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<td></td>
<td></td>
<td></td>
<td>Liids</td>
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<td></td>
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<td>Glucose</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>Amino acids</td>
<td></td>
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<tr>
<td><strong>Agranular leukocytes</strong></td>
<td></td>
<td></td>
<td>Nitrogenous wastes</td>
<td></td>
<td>Liver</td>
</tr>
<tr>
<td>• Lymphocytes</td>
<td></td>
<td></td>
<td>Uric acid</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>Urea</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td><strong>PLASMA</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Monocytes</td>
<td></td>
<td></td>
<td>Other</td>
<td></td>
<td>Varied</td>
</tr>
<tr>
<td>4–8%</td>
<td></td>
<td></td>
<td>Hormones, vitamins, etc.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Platelets</strong></td>
<td>Aid hemostasis. 2–4 μm in diameter; disk-shaped cell fragments with no nucleus; purple granules in cytoplasm.</td>
<td>Red bone marrow</td>
<td><strong>PLASMA</strong></td>
<td></td>
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<tr>
<td>150,000–300,000 per mm³ blood</td>
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</tbody>
</table>
Formed Elements-

Produced of the:

- Skull
- Ends of long bones
- Ribs
- Vertebrae
- Iliac crests
Hematopoiesis

- Multipotent stem cells –

- Multipotent cells

- Each daughter cell then differentiates
  - 1. Lymphatic stem cells differentiate

  - 2. ________ cells further differentiates into
    - Red blood cells
    - Granular leukocytes
    - Monocytes
    - Megakaryocytes
Multipotent stem cells in red bone marrow divide to produce specific stem cells.

Early differentiation separates myeloid stem cells from lymphatic stem cells.

Myeloblasts, monoblasts, and lymphoblasts produce the white blood cells.

Red blood cells | Platelets
---|---
| | | Granular leukocytes
| | | Neutrophils
| | | Basophils
| | | Eosinophils

White blood cells

Agranular leukocytes

Monocytes

B lymphocytes processed in bone marrow

T lymphocytes processed in thymus
erythrocytes (erythrocytes)

- Small, biconcave disks
- Anucleate-
- Transport
- Contain hemoglobin-

- __________________________ is formed when ____________ binds with hemoglobin
- Hemoglobin that is not combined with oxygen is called __________________________
Production of red blood cells

• Myeloid stem cells give rise to ________________________________
• Erythroblasts divide many times
• As they mature, erythroblasts gain many ______________________ and lose their _______ and most of their ____________
• Mature RBCs live about ________________
• About ____________RBCs are produced per second to keep RBC count in balance
1. Low $O_2$ blood level

2. Kidneys increase production of erythropoietin

3. Stem cells increase red blood cell production

4. $O_2$ blood level returns to normal

Stimulus is resolved
Red blood cell destruction

- Hemoglobin is ____________________________
  - Components are __________________________

- Anemia - Illness characterized by ______________
  - Cells are not getting enough ___________ due to decreased ________________ or ____________

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[Diagram: Red Blood Cells Production]

- Increase in Red Blood Cell Production
- Increase in Response to Erythropoietin
- Lack of Oxygen (Hypoxia)
- Increase in Erythropoietin Production
- Kidney
- Bone Marrow
White blood cells-

- Larger than RBCs, ________, no ________
- Derived from ________ in the ____________________
- Functions include
  
  • ______________________________
  • ______________________________
  • ______________________________
Types of white blood cells

1. Granular leukocytes
   - __________________________ - most common
     - First type of WBC to respond to ________________
     - Engulf ______________________________
   - Eosinophils
     - Lessen an ________________________________
   - Basophils
     - Release histamines – __________________________
       __________________________
     - Release heparin – __________________________
Agranular leukocytes

1. Lymphocytes
   - Specific ______________________
   - Recognize and destroy ________________
   - B lymphocytes produce ______________________
   - T lymphocytes _________ and ___________ any cell with a foreign antigen

2. Monocytes
   - Largest of the ______________
   - Differentiate into macrophages that ______________________
   - Stimulate other WBCs to _____ ______________________
- fragments of megakaryocytes

- Stop bleeding
  - _________ - blood clotting
  - Stimulate ____________
  - Platelet plug formation
    - In a broken blood vessel, _________ are exposed
    - Platelets __________________________
      ____________________________
Blood disorders

- Thrombocytopenia –
- ________________
  - Localized swelling
  - Accumulation of tissue fluid-
- Hemophelias – inherited clotting disorders caused by ________________
- Thrombus – ________________
- Embolus – ________________
- Thromboembolism – ___________________________
  - Pulmonary thromboembolism
  - Cerebrovascular accident or stroke
Blood Transfusions

- Blood must be typed

ABO Blood Groups

- Based
Blood Typing and Transfusions

- _____________ has A antigen and anti-B antibodies
- _____________ has B antigen and anti-A antibodies
- _____________ has both antigens and neither antibodies
- _____________ has no AB antigens and both antibodies
Blood Typing and Transfusions

- **Agglutination occurs if**

- Type O blood

- Type AB blood
Rh Blood Groups

- Rh\(^-\) individuals

  - **Hemolytic disease of the newborn**
    - May occur in subsequent pregnancies with an ____________
    - ____________in the blood of the newborn can lead to brain damage or death

Child is Rh positive; mother is Rh negative.

Red blood cells leak across placenta.

Mother makes anti-Rh antibodies.

Antibodies attack Rh-positive red blood cells in child.
Effects of Aging

- Anemia-

- Leukemia-

- ____________________________, such as thromboembolism
  - Associated with _______________________
  - May be controlled by _________ and ____________