Blood

Functions of Blood
- Transporting
  - nutrients
  - respiratory gases
  - waste products
- Distributing body heat

Components of Blood
A type of connective tissue
- Formed elements
  - Living blood cells
- Plasma
  - Nonliving fluid matrix
Plasma

Liquid part of blood -
- 55% of blood volume
- 90% water
- 100+ substances dissolved in plasma
  - Nutrients
  - Metal ions (salts)
  - Respiratory gases
  - Hormones
  - Plasma proteins
  - Waste products of cell metabolism

Composition of Plasma

<table>
<thead>
<tr>
<th>Water (90-92% of plasma)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plasma proteins (7-9% of plasma)</td>
</tr>
<tr>
<td>Albumin</td>
</tr>
<tr>
<td>Fibrinogen</td>
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<tr>
<td>Immunoglobulins</td>
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<tr>
<td>Salts (less than 1% of plasma)</td>
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<tr>
<td>Gases</td>
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<tr>
<td>Oxygen</td>
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<tr>
<td>Carbon dioxide</td>
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<tr>
<td>Nutrients</td>
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<tr>
<td>Fats</td>
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<tr>
<td>Glucose</td>
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<tr>
<td>Amino acids</td>
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<tr>
<td>Nitrogenous waste</td>
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<tr>
<td>Urea</td>
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<tr>
<td>Uric acid</td>
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<tr>
<td>Other</td>
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<tr>
<td>Hormones, vitamins, etc.</td>
</tr>
</tbody>
</table>

Physical Characteristics of Blood

- Sticky, opaque fluid
- Metallic taste
- Color - scarlet (oxygen-rich) - dull red (oxygen poor)
- Density - 5 times denser than water
- pH 7.35 - 7.45
- Temperature 37°C
- Volume 5 - 6 liters
Formed Elements of the Blood

- 45% of blood volume
  - Erythrocytes or red blood cells (RBCs)
  - Leukocytes or white blood cells (WBCs)
  - Thrombocytes or platelets

**Erythrocytes**

- **Function** - carry oxygen to all body cells
- **Structure**
  - Biconcave disk shape
  - Lacks nucleus (anucleate)
  - Contains hemoglobin
    - 12 - 18 grams per 100 milliliters of blood
- **4.5 - 5.5 million cells per cubic millimeter**
- **Lifespan** 100 - 120 days
Anemia

A decrease in the oxygen-carrying ability of blood

- **Causes**
  - Lower than normal number of RBCs
  - Abnormal/deficient hemoglobin content of RBCs

- **Examples**
  - Sickle-cell anemia
  - Polycythemia
Leukocytes

Function - crucial in body's defense against disease
- 4000 - 11,000 WBCs per cubic millimeter

Classification
- Granulocytes
- Agranulocytes

Granulocytes

- Granule-containing WBCs
- Lobed nuclei
- Types
  - Neutrophils
  - Eosinophils
  - Basophils
**Neutrophil**

- **Cytoplasm**: Stains pale pink and contains fine granules.
- **Nucleus**: Stains deep purple with 3-5 lobes.
- **Function**: Phagocytic; increases during acute infections.

**Eosinophil**

- **Cytoplasm**: Has coarse red-orange granules.
- **Nucleus**: Stains blue-red; figure-8 or bilobed shaped.
- **Function**: Kills parasitic worms.
Eosinophil
electronmicrograph - 10,000X

- granules

Basophil

- Cytoplasm: has few large blue-purple granules
- Nucleus: U or S shaped; stains dark blue
- Function: histamine discharged during inflammation

Agranulocytes

- Lack visible granules
- Nuclei spherical, oval or kidney-shaped
- Types
  - Lymphocytes
  - Monocytes
Lymphocyte

Cytoplasm - stains pale blue; thin rim around nucleus
Nucleus - spherical; stains dark purple
Function - part of immune system

Monocyte

electronmicrograph - 10,000X

nucleus

cytoplasm
Monocyte

Cytoplasm - abundant; stains gray-blue
Nucleus - "U" or kidney shaped
Function - phagocytic; increases during chronic infection

Changes in Numbers of WBCs

- Leukocytosis - increase in number of WBCs
  - Normal - when body invaded by bacteria, viruses, or other foreign substances
  - Abnormal - infectious mononucleosis, leukemia
- Leukopenia - decrease in number of WBCs
  - Caused by certain drugs

Platelets

- Function - aid in blood clotting
- Fragments of cells - megakaryocytes
- 250,000 - 500,000 per cubic millimeter of blood
Hematopoiesis - Blood Cell Formation

- Occurs in red bone marrow
- All blood cells arise from common stem cell - hemocytoblast
- RBCs eliminated in spleen, liver
- RBC rate of production controlled by the hormone erythropoietin - released by kidneys
Hemostasis

Stoppage of blood flow

• Phases
  • Vascular spasms
  • Platelet plug formation
  • Coagulation or blood clotting
    • Fibrinogen > fibrin

Disorders of Hemostasis

• Undesirable clotting
  • Thrombus
    • Clot develops in unbroken blood vessel
      • Eg coronary thrombosis
  • Embolus
    • Clot breaks away from vessel wall and float in bloodstream
      • Eg cerebral embolus
Disorders of Hemostasis

- Bleeding Disorders
  - Thrombocytopenia
    - Insufficient number of circulating platelets
  - Hemophilia
    - Hereditary
    - Lacks clotting factors

Blood Groups

- Classified by proteins - antigens on RBC membrane
- ABO Group
  - Type O - most common
  - Type AB - least common
- Rh Group
  - Rh+ - most common

U.S. Blood-type Distribution

- O+ 38% of population
- A+ 34%
- B+ 9%
- O- 7%
- A- 6%
- AB+ 3%
- B- 2%
- AB- 1%
The End