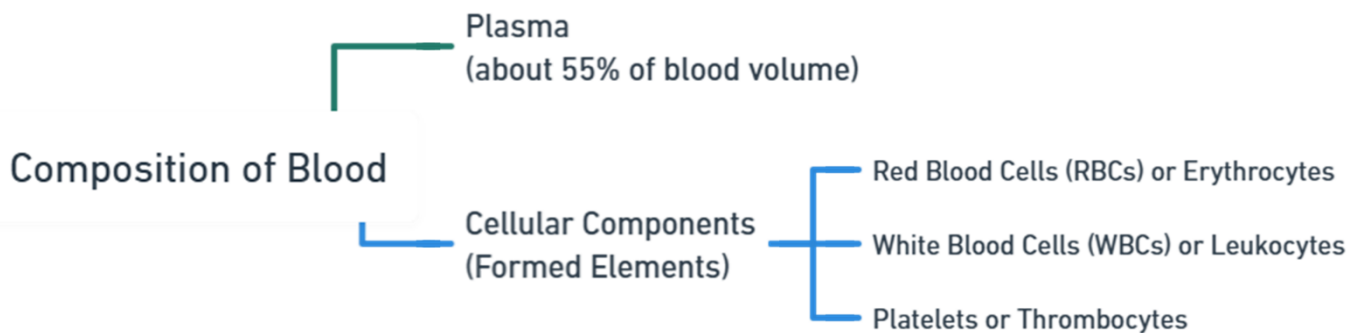


Haemopoetic System

Composition and functions of blood

- Blood is a specialized connective tissue consisting of cells suspended in a liquid matrix called plasma.
- Blood is composed of various cellular components, including red blood cells (erythrocytes), white blood cells (leukocytes), and platelets (thrombocytes), suspended in plasma.
- The red blood cells are responsible for oxygen transport, while white blood cells are involved in immune responses. Platelets aid in clotting.

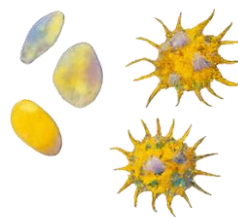
Composition of Blood



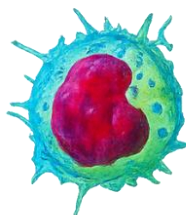
Formed Elements of Blood



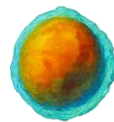
Red Blood Cells



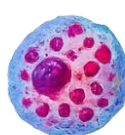
Platelets



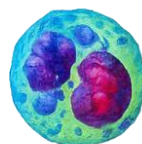
Monocyte



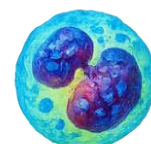
Lymphocyte



Eosinophil



Basophil



Neutrophil

White Blood Cells

1. Plasma (about 55% of blood volume)

- Plasma is the liquid portion of blood, primarily made of water (about 90%) and contains dissolved proteins, glucose, mineral ions, hormones, and other substances.

Functions:

Transport Medium:

- Carries nutrients, waste products, and hormones throughout the body.

Regulation:

- Helps regulate body temperature and maintain the acid-base balance.

2. Cellular Components (Formed Elements)

- The cellular components, or formed elements, include red blood cells (RBCs), white blood cells (WBCs), and platelets.
- Each has specific roles:

A. Red Blood Cells (RBCs) or Erythrocytes

- The most abundant blood cells, responsible for oxygen transport.

Functions:

- **Oxygen Transport:** RBCs transport oxygen from the lungs to body tissues and remove carbon dioxide, a waste product of cellular metabolism.
- **Haemoglobin:** RBCs contain haemoglobin, an oxygen-binding protein that gives them their red color.
- **Acid-Base Balance:** RBCs help maintain the blood's pH balance.

B. White Blood Cells (WBCs) or Leukocytes

- Nucleated cells crucial for the immune system, protecting the body against infections and diseases.

Types and Functions:

- I. **Neutrophils:** The most abundant WBCs, which phagocytize (engulf and destroy) bacteria and foreign particles.
- II. **Lymphocytes:** Produce antibodies and regulate immune responses; include:
 - **B-cells:** Produce antibodies.
 - **T-cells:** Directly attack infected cells and regulate immune responses.
 - **Natural Killer (NK) Cells:** Kill abnormal cells, such as cancerous or virus-infected cells.
- III. **Monocytes:** Transform into macrophages that phagocytize pathogens, dead cells, and debris.
- IV. **Eosinophils:** Combat parasitic infections and participate in allergic reactions.
- V. **Basophils:** Release histamine during allergic reactions and contribute to inflammation.

C. Platelets or Thrombocytes

- Small cell fragments critical for blood clotting and wound healing.

Functions:

- **Clot Formation:** Platelets clump together at injury sites to form a plug, preventing excessive blood loss.
- **Wound Healing:** Release growth factors that promote tissue repair and regeneration.

Functions of blood

1. Transportation:

- Carries oxygen to tissues, removes carbon dioxide, and transports nutrients, hormones, and waste products.

2. Immune Response:

- Contains white blood cells that defend against infections and diseases.

3. Clotting:

- Platelets form clots to prevent excessive bleeding.

4. Regulation:

- Maintains pH balance and electrolyte levels (e.g., sodium, potassium).

5. Temperature Regulation:

- Distributes heat throughout the body.

6. Hormone Transport:

- Delivers hormones from glands to target organs.

Hemopoiesis (Haematopoiesis)

Definition:

- Haemopoiesis (or hematopoiesis) is the biological process by which new blood cells are formed. It includes the production, multiplication, and differentiation of all types of blood cells from a common precursor — the **hematopoietic stem cell (HSC)**.
- This process is **continuous and lifelong**, ensuring the body maintains an adequate supply of red blood cells (RBCs), white blood cells (WBCs), and platelets.

Sites of Haemopoiesis:

Haemopoiesis occurs in different locations throughout life:

A. Embryonic and Fetal Life:

1. **Yolk Sac** (2–3 weeks after fertilization): First site of blood cell formation.
2. **Liver and Spleen** (2–7 months gestation): Major sites of haemopoiesis during fetal development.
3. **Bone Marrow** (from ~5 months gestation onwards): Takes over as the primary site before birth.

B. After Birth:

- **Red bone marrow** becomes the main site of haemopoiesis.
- In infants and children, it occurs in almost all bones.
- In adults, it's limited to **axial skeleton**: vertebrae, sternum, ribs, pelvis, and proximal ends of long bones (femur, humerus).

Types of Haemopoiesis:

Haemopoiesis is categorized based on the type of blood cell being formed:

1. Erythropoiesis

- Production of erythrocytes (red blood cells) responsible for oxygen transport.

Process:

- Begins with HSCs differentiating into proerythroblasts.
- Under the influence of erythropoietin (EPO), proerythroblasts develop through several stages:
 - Proerythroblast → Basophilic erythroblast → Polychromatophilic erythroblast → Orthochromatophilic erythroblast → Reticulocyte.
- Reticulocytes enter the bloodstream and mature into erythrocytes.

2. Leukopoiesis

- Production of leukocytes (white blood cells) for immune defense.

Process:

- HSCs differentiate into myeloid or lymphoid progenitor cells.
- **Myeloid progenitor cells** develop into granulocytes (neutrophils, eosinophils, basophils) and monocytes.
- **Lymphoid progenitor cells** develop into B and T lymphocytes and natural killer (NK) cells.
- Regulated by cytokines and growth factors like GM-CSF, G-CSF, and interleukins.

3. Thrombopoiesis

- Production of thrombocytes (platelets) for blood clotting.

Process:

- HSCs differentiate into megakaryocyte progenitor cells.
- Under the influence of thrombopoietin (TPO), these progenitors mature into megakaryocytes.
- Megakaryocytes extend proplatelets into bone marrow blood vessels, which fragment into platelets released into the bloodstream.

Hematopoietic Stem Cells (HSCs):

- All blood cells originate from a **multipotent hematopoietic stem cell (HSC)**, which has two important properties:
 - **Self-renewal:** Can divide and produce more stem cells.
 - **Differentiation:** Can become specialized blood cells.
- From HSCs, two main lineages arise:

A. Myeloid Lineage (produces):

- Erythrocytes
- Platelets
- Neutrophils
- Eosinophils
- Basophils
- Monocytes (which become macrophages)

B. Lymphoid Lineage (produces):

- B lymphocytes
- T lymphocytes
- Natural killer (NK) cells

Regulation of Haemopoiesis:



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