## **Anatomy and Physiology**

For

The First Class

2<sup>nd</sup> Semester

## Hematologic System

**Blood** 

### The Blood

- Blood is a <u>fluid connective tissue</u>. It circulate continually around the body, allowing constant communication between tissues distant from each other.
- Blood makes up about 7% of body weight (about 5.6 liters in a 72 Kg man). This proportion is less in women, while in children is greater (gradually decreasing until the adult level is reached).

### **Functions of the Blood**

- 1. The main function of the blood is to **maintain intracellular homeostasis** by:
  - a). Carries O2 and nutrients (glucose, amino acids, lipids, and vitamins) to the cells.
  - **b).** Carries CO2 and other wastes (nitrates, creatine, nucleic acid) **away from the cell**.
- 2. Providing intercellular communication in the body: carryies hormones (secreted by endocrine glands) to the target organs.
- 3. Production and defense: it allows cells and immunological proteins to transport from place to place where need them.
- 4. Self repair mechanism: clotting cascade.

### **Blood Components**

• Blood is composed from 2 fractions:

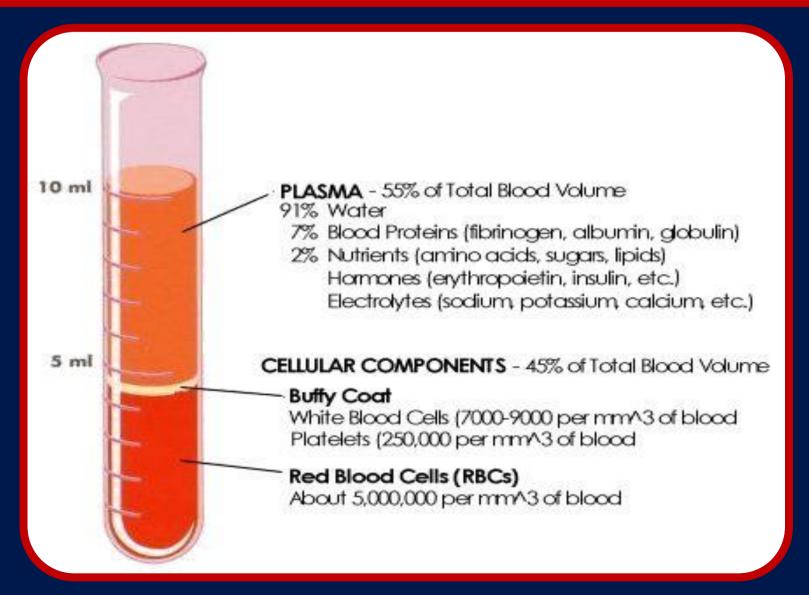
#### 1. Plasma

Non living extracellular matrix composes about 55% of total blood volume.

# 2. Formed elements (living cells) composes about 45% of total blood volume.

• The two frictions of blood can be separated by spinning.

# Hematocrit tube with blood after centerfugation Plasma forms the supernatant, buffy coat forms the middle layer and the red blood cells form the sediment

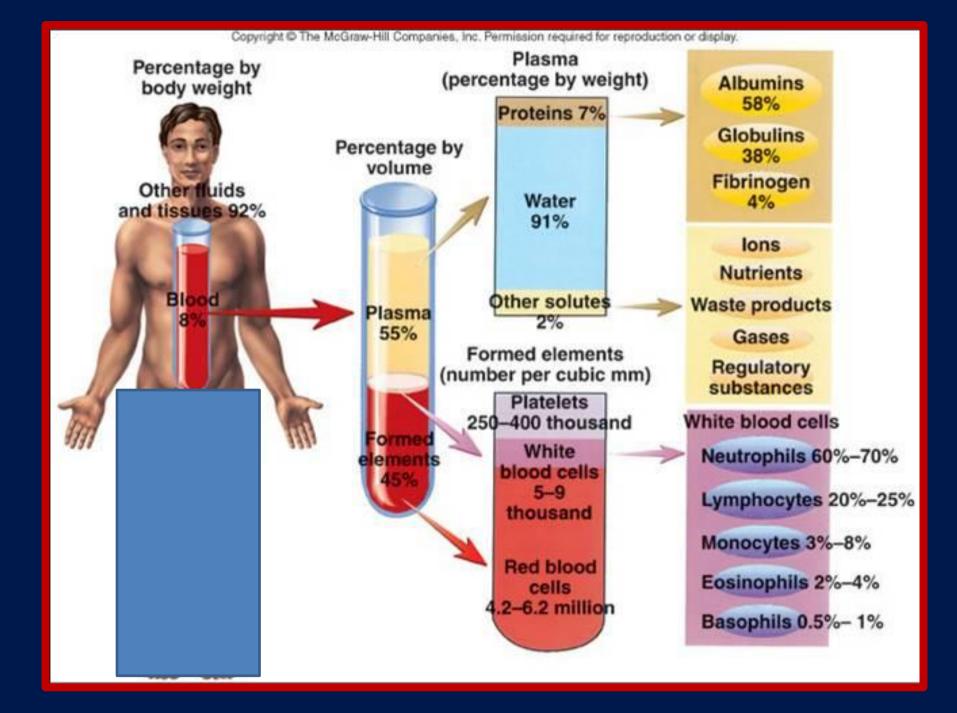




- 1. Plasma 55% total volume of blood
  - → mostly liquid water (91%)
  - → soluble blood proteins (7%)
  - → hormones—
  - → electrolytes
  - → nutrients...
- 2. Cellular Component 45% total volume of blood

(2%)

- → White blood cells
- → Platelets
- → Red blood cells



### Plasma

- the constituents of plasma are:
- 1. Water (90-92%)
- **2. Plasma proteins**: make up about 7% of plasma.
  - **Albumins** (about 60% of total plasma protein) They are responsible for maintain normal plasma *osmotic pressure*. Albumins also act as *carrier molecules* for free fatty acids, some drugs and steroid hormones.
  - Globins their main functions are: as *antibodies (immunoglobulins)*, *transportation of some hormones and mineral salts* (e.g. thyroglobulin carries the hormone thyroxin and transferrin carries the mineral iron.
  - Clotting factors. These are responsible for *coagulation of blood*. And inhibition of some proteolytic enzymes (e.g. macroglobulin inhibits trypsin) activities)
- **3. Inorganic salts** (electrolytes) like Ca, Na, Po4 which are responsible for muscle contraction, transmission of nerve impulses, --ect.
- 4. Nutrients: glucose, amino acid, fatty acids and glycerol.
- 5. Waste products like urea, creatinine and uric acid they are carried in the blood to the kidney for excretion.
- 6. Hormones and gases

# Formed Elements (Cellular Content of Blood)

- There are three types of blood cell:
- 1. Erythrocytes (Red Blood Cells =RBC).
- 2. Platelets (thrombocytes)
- **3. Leukocytes** (white blood cells = WBC) they include monocytes, lymphocytes, neutrophils, eosinophils, and basophils.

### Source of Blood Cells

- Mature blood cells have a relatively short life spine.
- Blood cells are synthesised mainly in the red bone marrow.
- Some lymphocytes, additionally are produced in lymphoid tissue.
- The organ or system responsible for synthesis blood cells are called hematopoietic system and the process of blood cell formation is called hematopoiesis.

### Differentiation of pluripotential stem cells during hematopoiesis.

Phase	Stem Cells	Progenitor Cells	Precursor Cells (Blasts)	Mature Cells
Early morphologic	distinguishal	hologically ble; have the of lymphocytes	Beginning of morphologic differentiation	Clear morphologic differentiation
Mitotic activity	Low mitotic activity; self-renewing; scarce in bone marrow	High mitotic activity; self-renewing; common in marrow and lymphoid organs; mono- or bipotential	High mitotic activity; not self-renewing; common in marrow and lymphoid organs; monopotential	No mitotic activity; abundant in blood and hematopoletic organs
Lymphoid multipotential cells	Migrate to lymphoid	Lymphocyte-colony- forming cell (LCFC)	Lymphoblast	B and T lymphocytes
Myeloid multipotential cells remain in bone marrow		Erythrocyte-colony- forming cell (ECFC)	Erythroblast	Erythrocyte
		Megakaryocyte- forming cell	Megakaryoblast	Megakaryocyte
		Monocyte- colony-forming cell (MCFC)	Promonocyte	Monocyte Monocyte
		Granulocyte- colony-forming cell (GCFC)	Neutrophilic myelocyte	Neutrophilic granulocyte
		Eosinophil-colony- forming cell (EoCFC)	Eosinophilic myelocyte	Eosinophilic granulocyte
		Basophil-colony- forming cell (BCFC)	Basophilic myelocyte	Basophilic granulocyte