

Theoretical Physiology

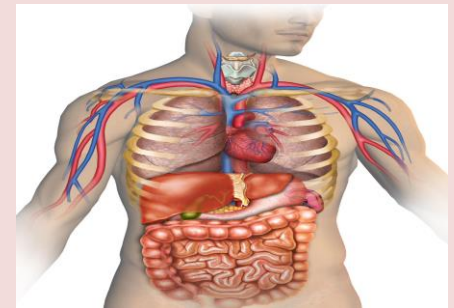
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lecture.2 , 3

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First Stage



Introduction (lecture2)

- **Body of human**
- The relative continuous of the body fluid is remarkable because there are continuous exchanges of fluid and solutes with the external environment , as well as within the different body compartments.
- **Body** Is formed by solids and fluids . Fluid part is more than
third of the whole body . water forms most of the fluid part of the body.

- Body fluids are the fluids such as blood , lymph, milk and saliva .
- which are produced in the body and then either circulated within the body or secreted outside.
- In human the total body water varies from
- 45%to 75% of body weight.

- **Factors affecting body water content.**

1. **Fat** .. water less in fatty cells .. Fat in Females is more than males(inverse relationship).
2. **Gender** .. Total body water is lower in women(why).
3. **Age** ..total body water decreases with increasing age
4. **Organ type** ..(Brain80% liver and muscles70% blood50% bones25% teeth 10%)

WATER IN THE HUMAN BODY BY AGE



60%

ADULT MALE



55%

ADULT FEMALE



65%

CHILDREN



75%

INFANT

The Significance or benefits of body fluids.

***In transport mechanism..** Body water forms the transport medium by which nutrients and other essential substances

enter the cells and unwanted substances come out of the cells.

In metabolic reactions .. Water inside the cells forms the medium for various metabolic reactions. Which are necessary

for growth and functional activities of the cells.

***In texture of tissues** .. water inside the cells is necessary for characteristic form and texture of various tissues.

***In temperature regulation** ..water plays a vital role in the maintenance of normal body temperature .

***In Homeostasis** ..its the state of steady internal physical and chemical conditions maintained by living systems.

Compartments of Body Fluids(Distribution of body fluid)

The total body water (TBW) In an average human being weighting about 70 kg is about 40 L(60% of body weight) its distributed into two major compartment..

- **1. Extracellular fluid (ECF)(20% of the body weight)**

Its volume is 18 L and it forms 45% of the body water .

ECF is divided into three subunits..*Plasma (blood)

*The Transcellular interstitial fluid (synovial, peritoneal ,Pericardial and intraocular, CSF) * The interstitial fluids

- **2. Intracellular fluid (ICF) (40% of the body weight)**

It's the fluid inside cells(cytosol)

The fluid of each cell its individual mixture of different constituents , but the concentrations of these substances are similar from one cell to another.



Total body Water
TBW (40 L or 60% of
body weight)

Extracellular fluid (ECF)
20% of body weight

Intracellular fluid (ICF)
40% of body weight

Interstitial fluid
(15% of the body weight)

Transcellular fluids
(1% of the body weight)

Plasma
(4% of the body weight)



70kg

Total body water (TBW)
60% OF BODY WEIGHT, 42L

Extracellular fluid
35% of TBW, 14L

Intracellular fluid
65% of TBW, 28L

Plasma fluid
7% of TBW, 3L

Interstitial fluid
28% of TBW, 11L

Composition of Body Fluid

1. Organic Substances include Glucose , Amino acid , Protein and fatty acid and other lipids and hormones and enzymes.

2. Inorganic Substances include potassium ions, sodium ions, chloride ,calcium and magnesium .

Measurement of body fluid volume

Total body water and the volume of different compartments of the body fluid are measured by **indicator dilution method** or **dye dilution method** .

Blood volume

Blood contains both extracellular fluid(**ECF**)(the fluid in plasma)
And intracellular fluid(**ICF**) (the fluid in the red blood cell)

However , blood is considered to be a separate fluid compartment because its contained in a chamber of its own , the circulatory system .

The blood volume is especially important in the control of cardiovascular dynamics.

The average blood volume of adults is about **7%** of body weight

Or about **5 L** (percent **60%** from blood in plasma and **40%** from blood in the cells)

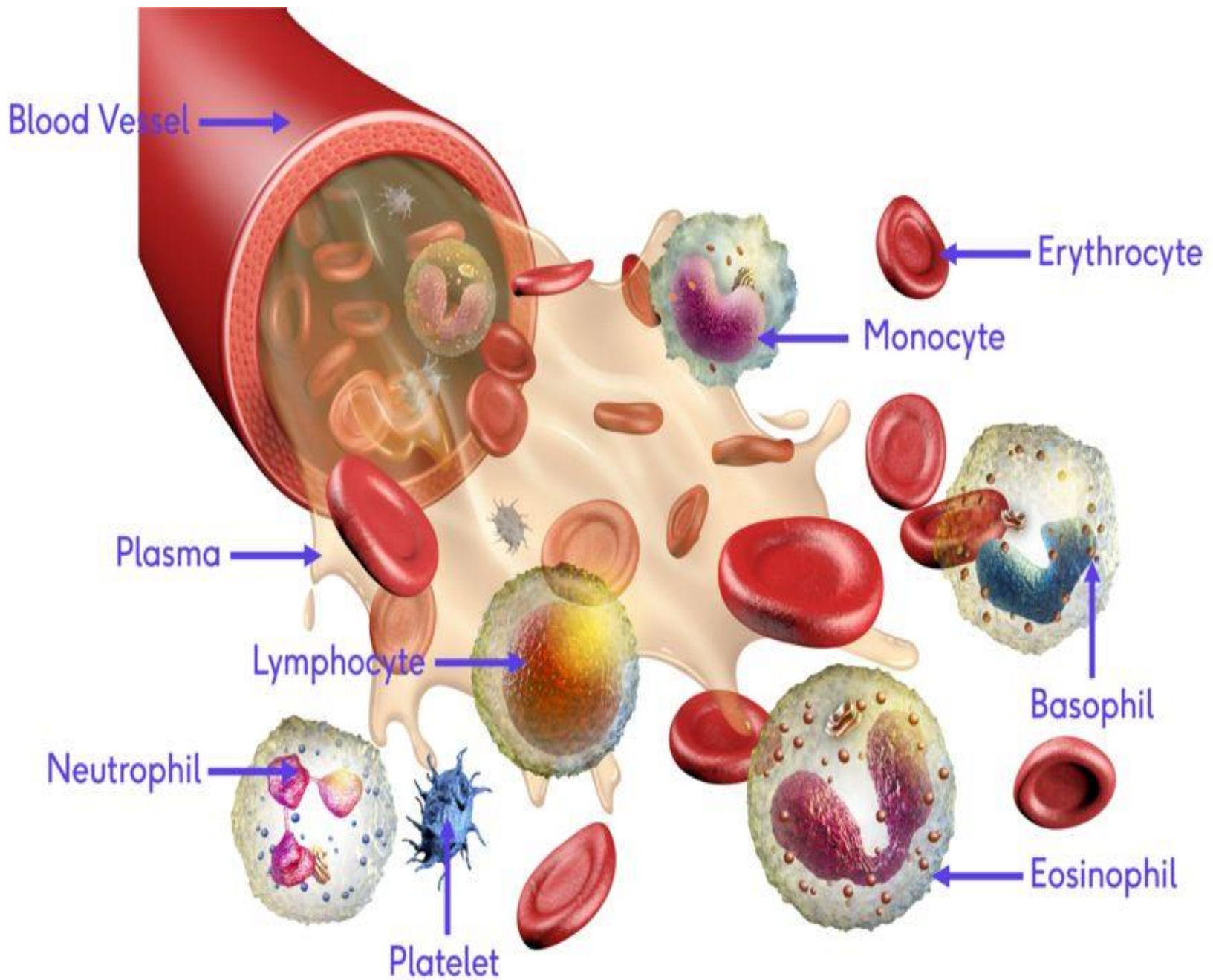
But these percentage can vary considerably in different people depending on gender , weight , and other factors.

Answer Questions

Q. Enumerate of Significance of body fluids and explain two from it.

Q. What are the factors affecting on the body water content .

Q. How the body fluids are distributed .



Lecture 3

The Blood physiology

Blood is a special type of connective tissue derived from mesoderm due to its origin in the bone marrow.

Its considered as the **fluid of life** because it carries **O₂** from lung to all parts of the body and **CO₂** from all parts of the lungs .

its known as **fluid of growth** because it carries nutritive substances from the digestive system and hormones from endocrine gland to all the tissues.

And is called **fluid of health** because it protects the body against the diseases and gets rid of the waste products.

Hematology .. The branch of science with the study of blood , blood forming tissue , and the disorders.

blood is a transport system used to carry substances it carries O₂ from lung to all parts of the body and CO₂ From all parts of the body to the lungs.

Blood cells are made in the **bone marrow** .

Characteristics or Properties of Blood

1. **Color:** Blood is red in color. Arterial blood is scarlet red because it contains more O₂ and venous blood is purple red because of more CO₂.

2. **Volume:** Average volume of blood in a normal adult is 5 L. In a newborn baby, the volume is 450 ml. It increases during growth and reaches 5 L at the time of puberty.

In females, it is slightly less and is about 4.5 L. It is about 8% of the body weight in a normal young healthy adult, weighing about 70 kg.

3. **Reaction and pH:** Blood is slightly alkaline and its pH in normal conditions is 7.4

4. **Temperature:** 38 C (100.4 F) is normal temperature for blood.

5. **Viscosity:** Blood is five times more viscous than water. It is mainly due to red blood cells and plasma proteins.

Functions of Blood

1. Distribution & Transport.

- a.** Oxygen from lungs to body cells.
- b.** CO₂ from body cells to lungs.
- c.** Nutrients from GI (Gastrointestinal) tract to body cells.
- d.** Nitrogenous wastes from body cells to kidneys.

2. Regulation (maintenance of homeostasis) .

- a.** Maintenance of normal body pH by blood proteins (albumin) & bicarbonate.
- b.** Maintenance of circulatory/interstitial fluid by electrolytes that aid blood proteins (albumin).
- c.** Maintenance of temperature.

3. Protection

a. Platelets and proteins "seal" vessel damage.

b. Protection from foreign material & infections by leukocytes, antibodies & complement proteins.

Composition of Blood

1. Blood cell (Formed elements) (45%), the actual cellular components of blood.

a. Red blood cells (**Erythrocytes**)

(carry O₂ from lungs to tissues by hemoglobin)

b. White blood cells (**Leukocytes**)

(Protect the body against infection so tis part from immune system)

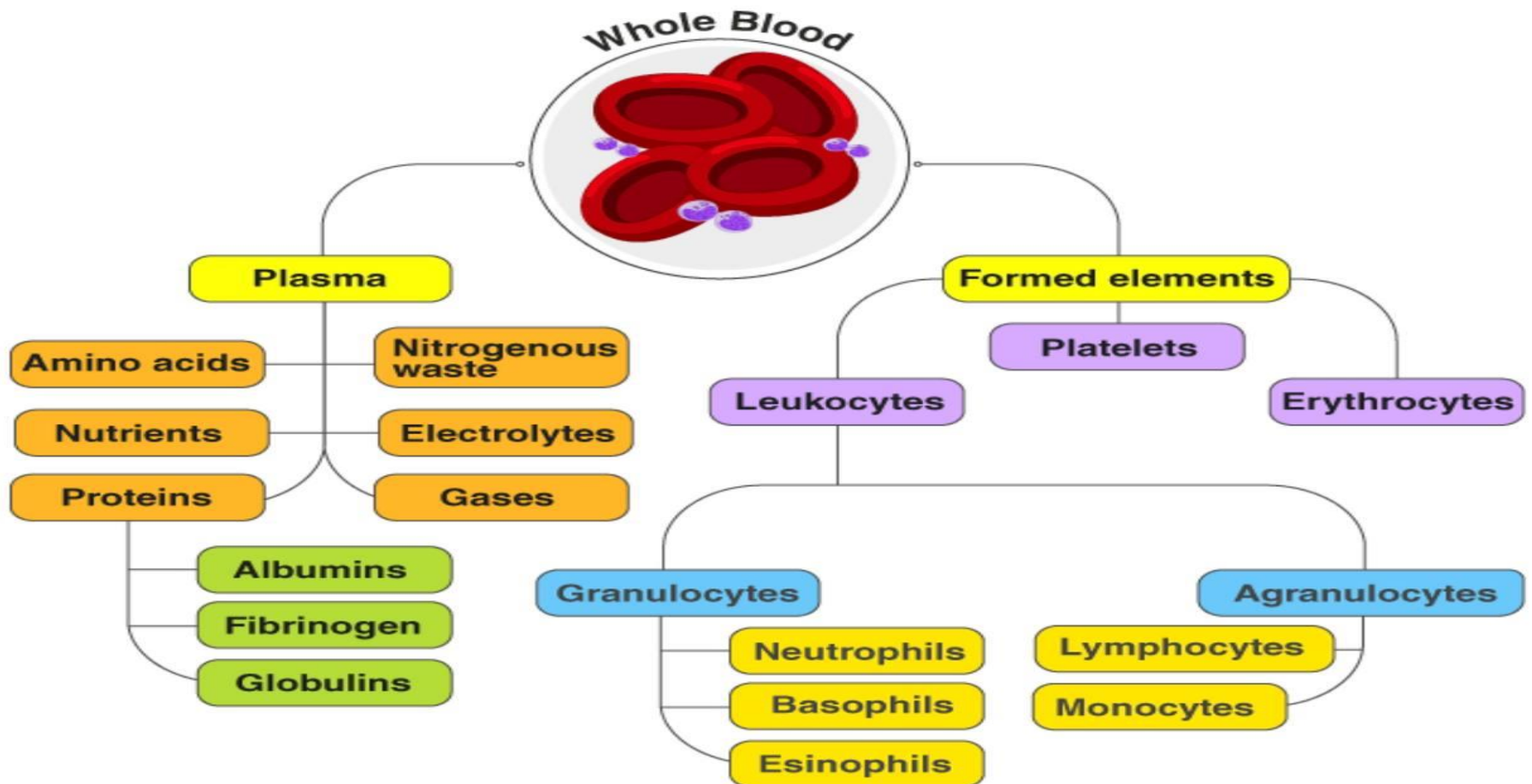
c. Platelets (**thrombocytes**)cell fragments for clotting.

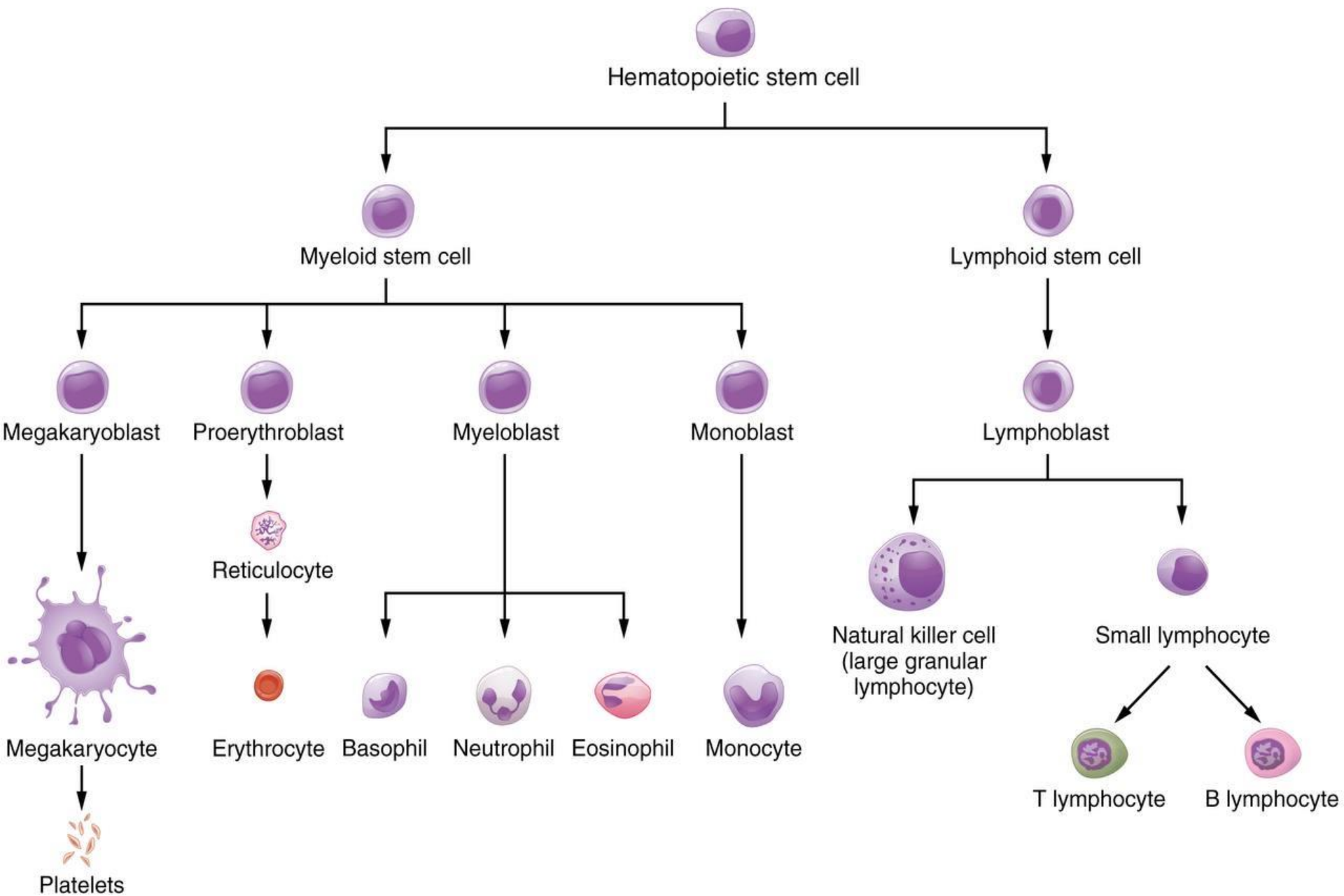
2.Blood plasma(55%)

Plasma is a straw-colored clear liquid part of blood.

It contains 91% to 92% of water and 8% to 9% of solids. The solids are the organic and the inorganic substances.

Plasma is complex non-cellular fluid surrounding formed elements





Types of white blood cells

Type of WBC	Main function
Neutrophil	Acute infection, bacterial and fungal
Lymphocyte	Chronic infection and viral infection
Monocyte	Chronic infection
Eosinophil	Allergic reaction, parasitic infection
Basophil	Allergic reactions, blast crisis in chronic myeloid leukemia

Types of plasma proteins

1. Albumin: makes up 60% of plasma proteins, to maintain osmotic balance between the blood and tissue fluid.

2. Globulin: makes up 36% of plasma proteins, designated into three groups alpha, beta and gamma, the liver synthesizes alpha and beta globulin, lymphatic tissues produce gamma globulin that assist the immune system in defense against infection and transport the lipid and fat soluble vitamin.

3. Fibrinogen: makes up 4% of plasma proteins, plays primary roles in coagulation.

Normal Values - Normal values of the plasma are:proteins

✓ Total proteins: 7.3 g/dl (6.4 to 8.3 g/dl)

*Serum albumin : 4.7 g/Dl

✓ *Serum globulin 2.3 g/dl

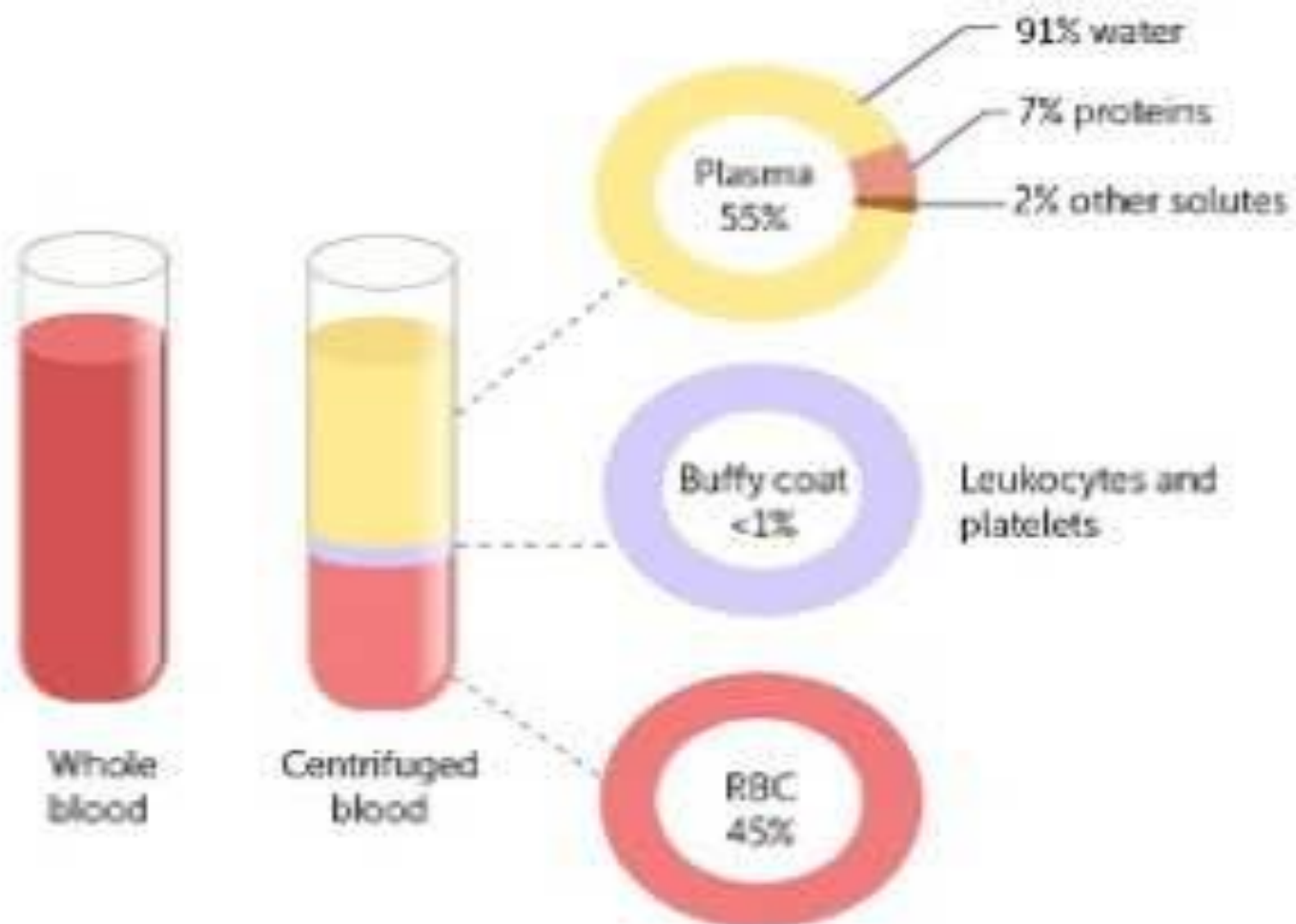
✓ *Fibrinogen: 0.3 g/dl.

Hematocrit value

If blood is collected in a hematocrit tube along with a suitable anticoagulant and centrifuged for 30 minutes at a speed of 300 revolutions per minute , The red blood cells settle down at the bottom having a clear plasma at the top. Plasma forms 55% and the Red blood cells 40% of the total blood .

Volume of red blood cells expressed in percentage is called the hematocrit value or (PCV) packed cell volume .

In between the plasma and Red cell there is thin layer of white buffy coat .this white buffy coat is formed by the aggregation of white blood cells and platelets .



Serum

Serum is the clear straw-colored fluid that oozes from blood clot. When the blood is shed or collected in a container, it clots.

In this process, the fibrinogen is converted into fibrin and the blood cells are trapped in this fibrin forming the blood clot.

For clinical investigations, serum is separated from blood cells and clotting elements by centrifuging.

The serum differ from the plasma by the absence of fibrinogen, i.e. serum contains all the other constituents of plasma except fibrinogen.

Fibrinogen is absent in serum because it is converted into fibrin during blood clotting.

Thus, **Serum = Plasma - Fibrinogen**

Answer Questions

Q. Define the blood and what is components of it.

Q. What are the functions of blood.

Q. What are the blood cells.

Q. What is the mean buffy coat.

Q. What are the Properties of Blood .

**Q. Enumerate the types proteins of Plasma with
A brief explanation.**

Thank you