Introduction to Blood

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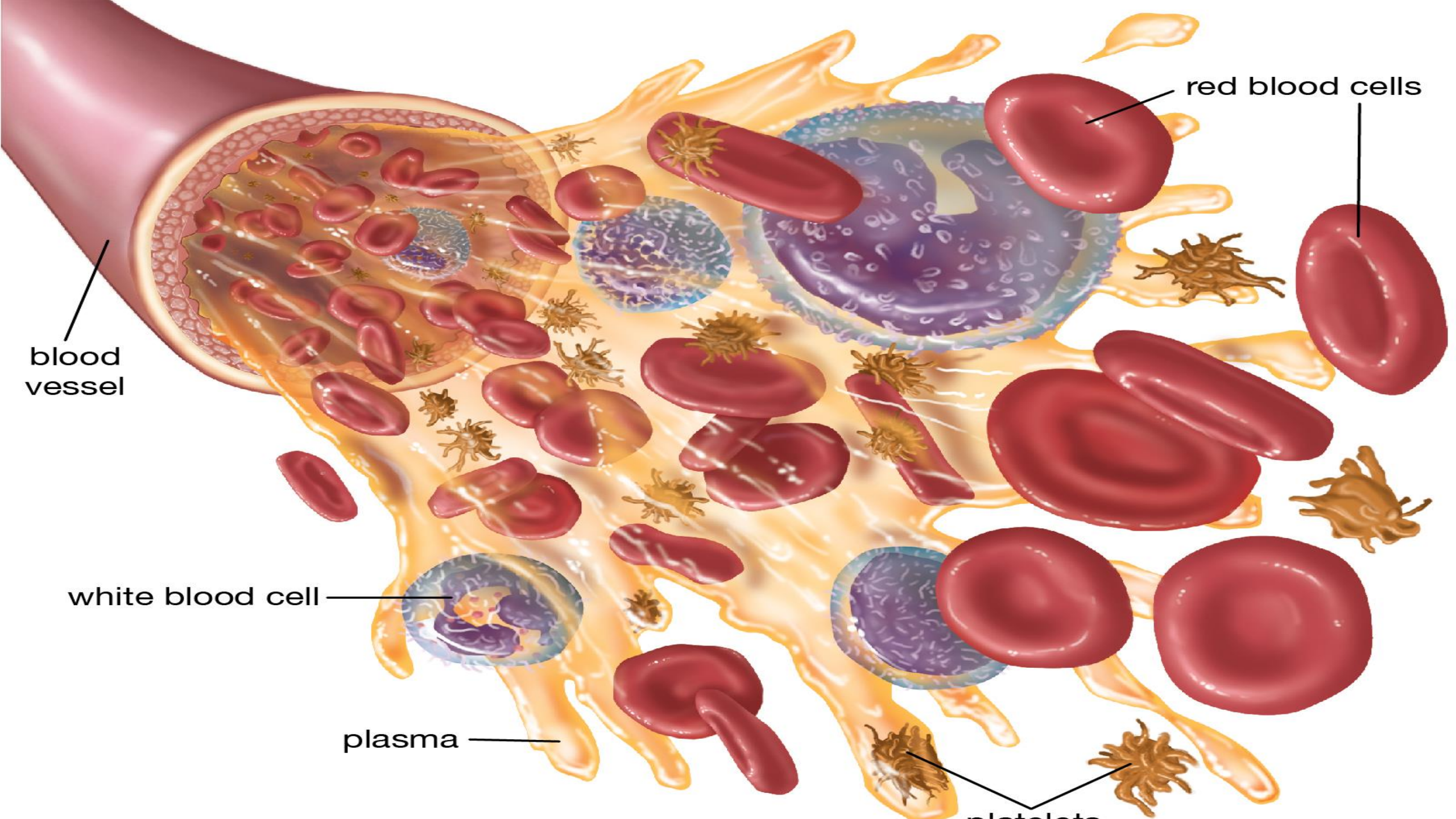
Learning Objectives:

- Describe the composition and functions of blood.
- Define Hematocrit.
- Enlist the components of plasma.
- Explain the difference between serum and plasma.

What is Blood

- Blood is a specialized **connective tissue** in which there is a liquid intercellular substance known as **plasma** and **formed elements.**


red blood cells
blood vessel
white blood cell
plasma
platelets

Hematocrit

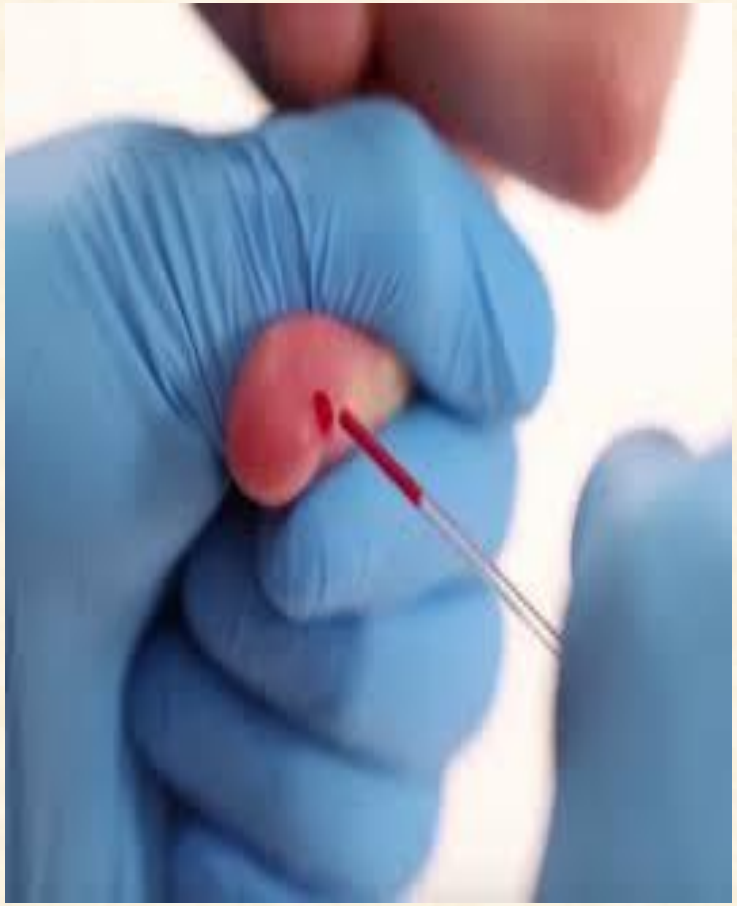
- A 70 kg adult with a bleeding peptic ulcer who had a 750 mL hematemesis within the past 30 minutes, may have postural hypotension due to acute volume depletion, but will have normal values for hemoglobin and HCT.
- Over the ensuing 36 to 48 hours, most of the total blood volume deficit will be repaired by the movement of fluid from the extravascular into the intravascular space. Only at these later times will the hemoglobin and HCT reflect blood loss.

Hematocrit

Hematocrit (HCT), also called **packed cell volume.**

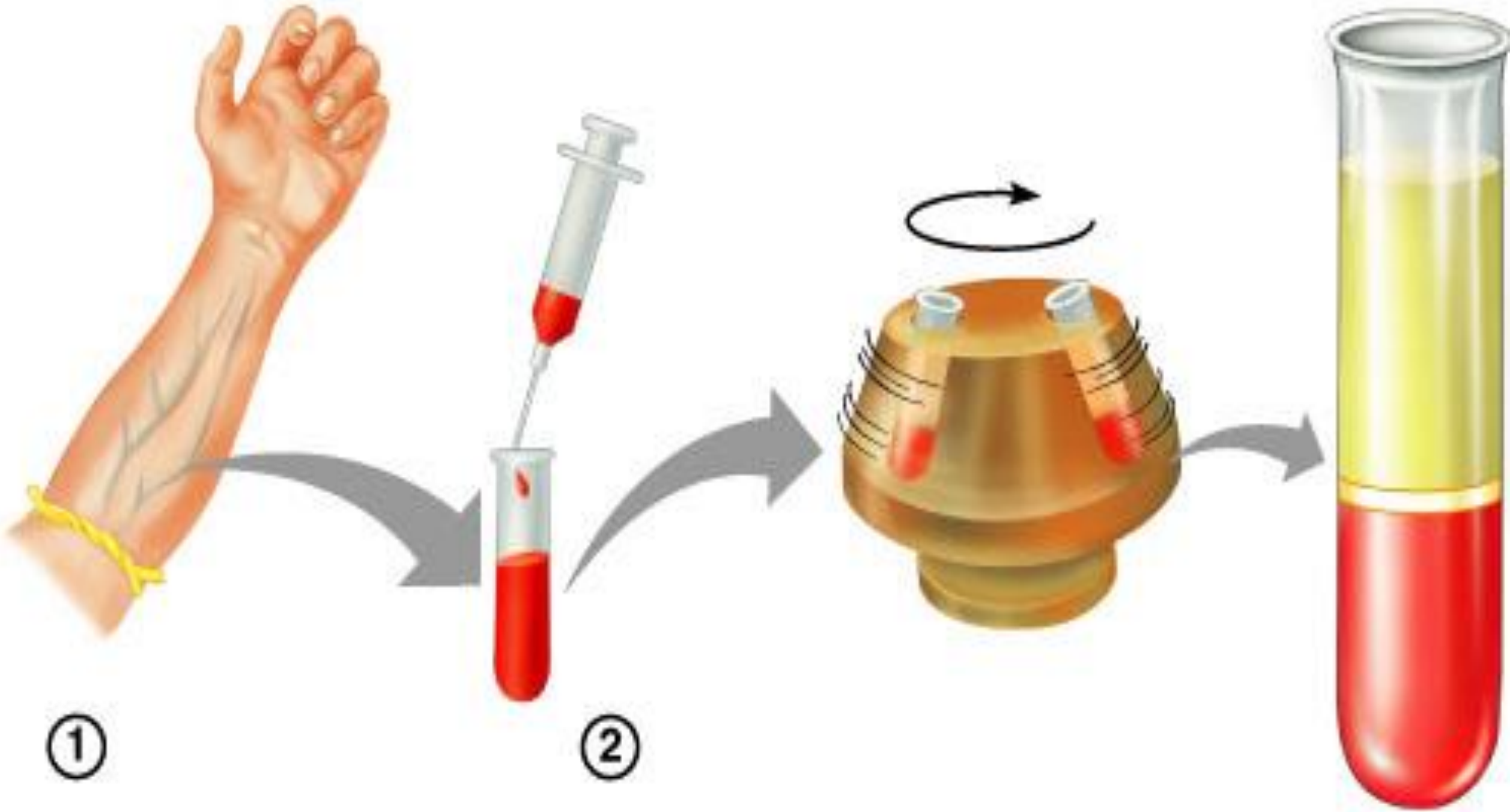
Is the packed spun volume of blood that consists of intact RBCs, expressed as a percentage.

HCT can be measured directly following centrifugation of a blood sample or calculated (HCT = [RBC x MCV]/10).



Why is Hematocrit done?

1. May be used to identify and evaluate the severity of anemia or polycythemia.
2. Monitor response to treatment of anemia or polycythemia and other disorders that affect the production or life span of RBC’s.
3. Help make decisions about blood transfusions or other treatments if anemia is severe.
4. Evaluate dehydration.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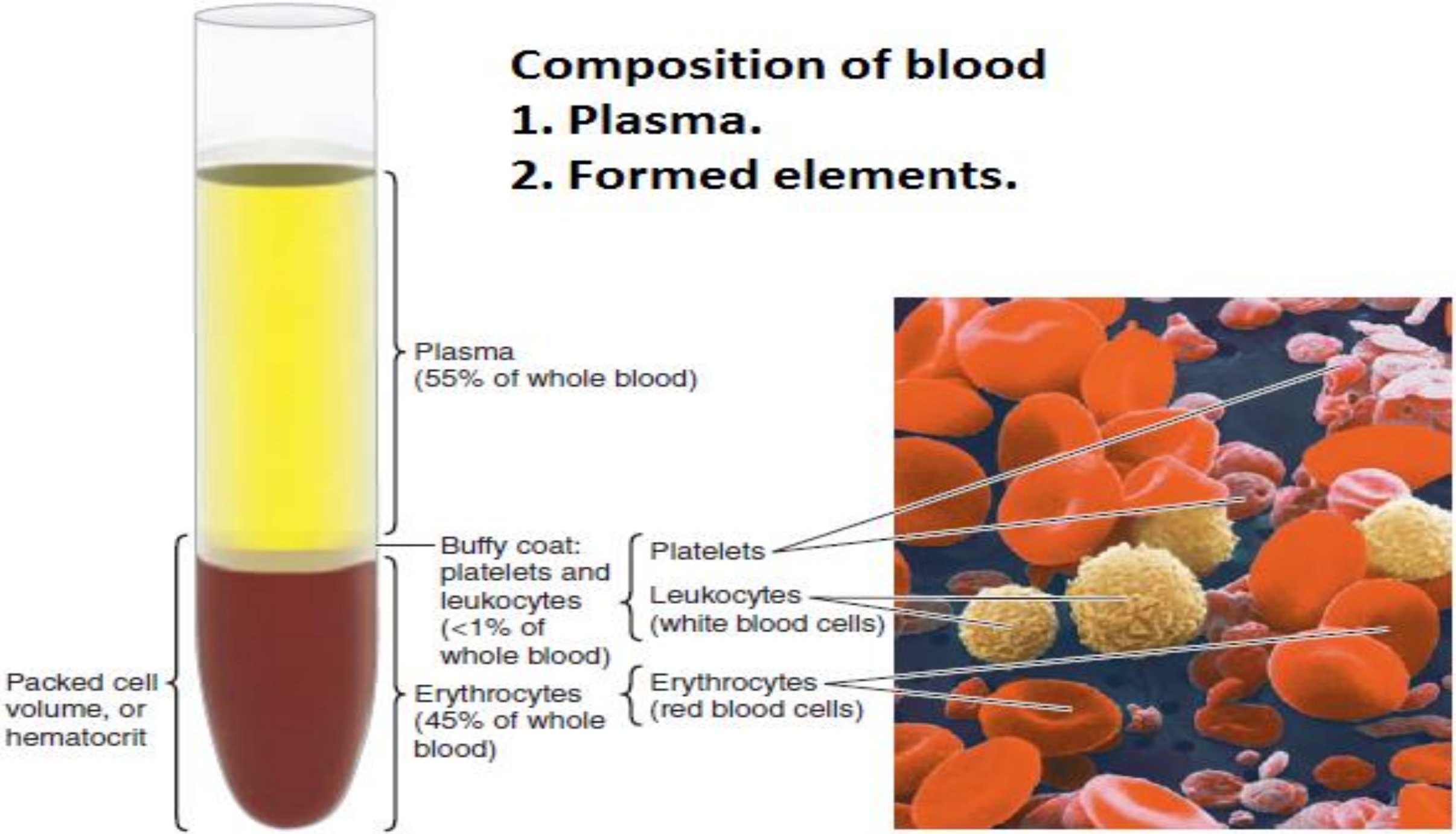
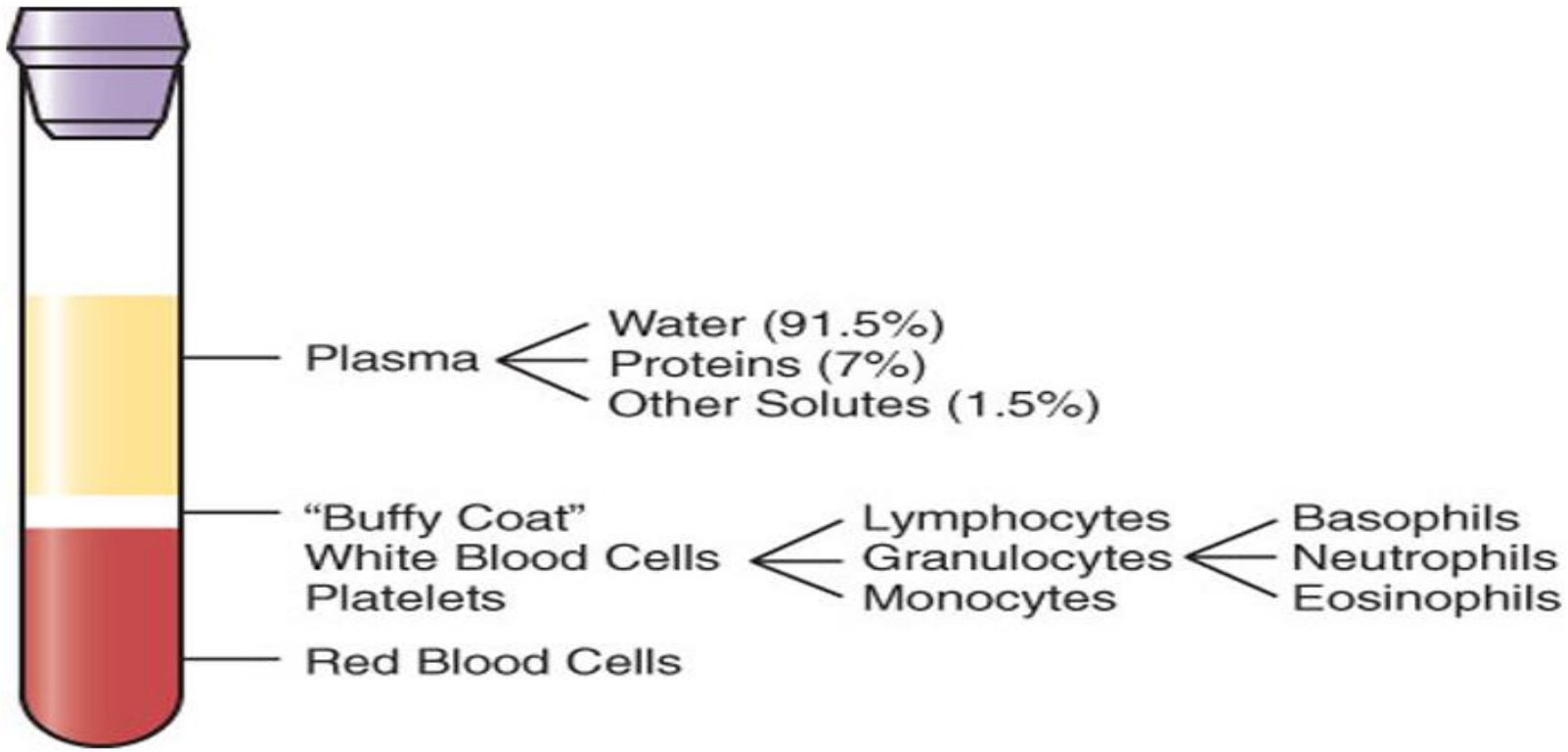
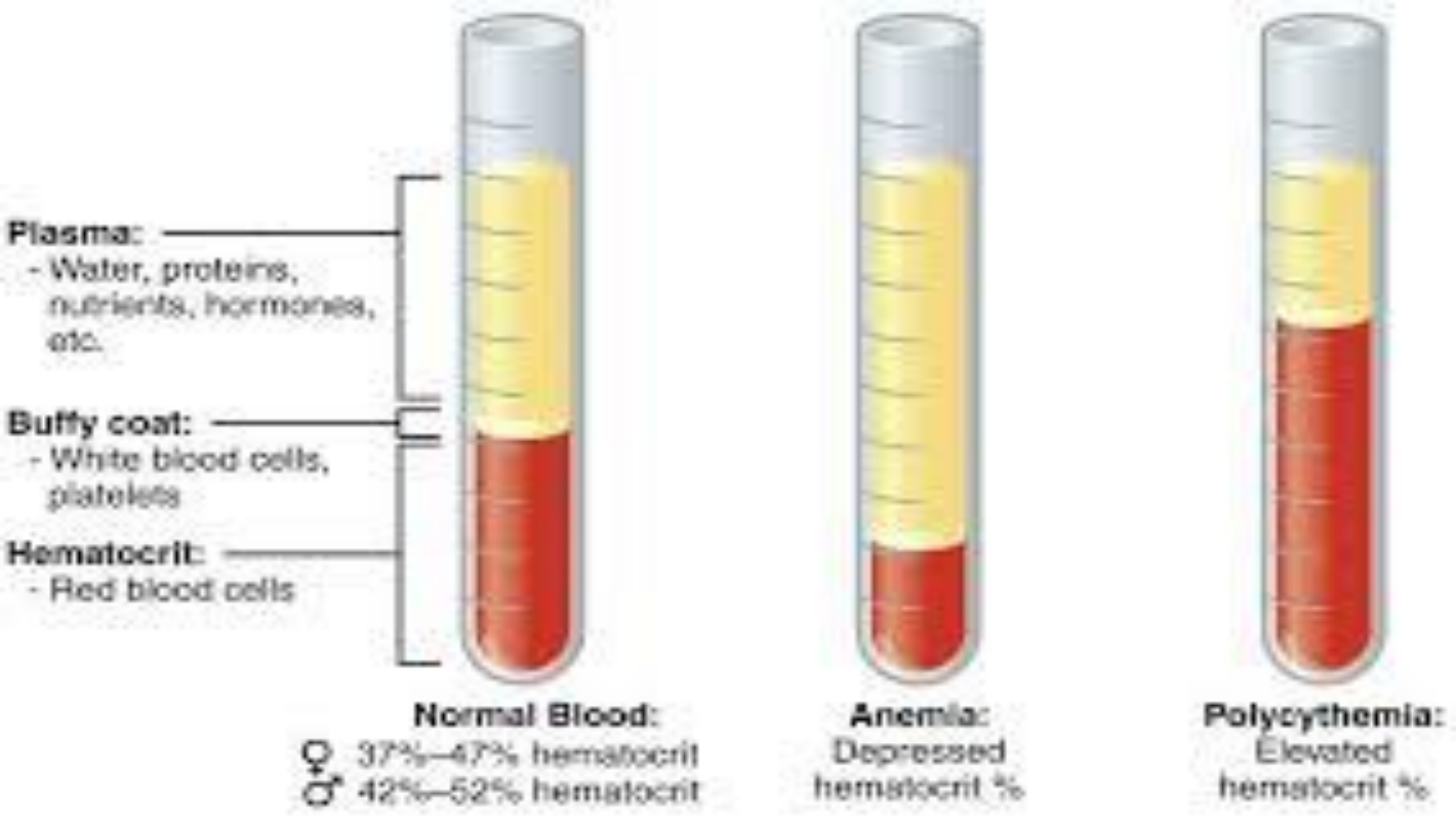
②

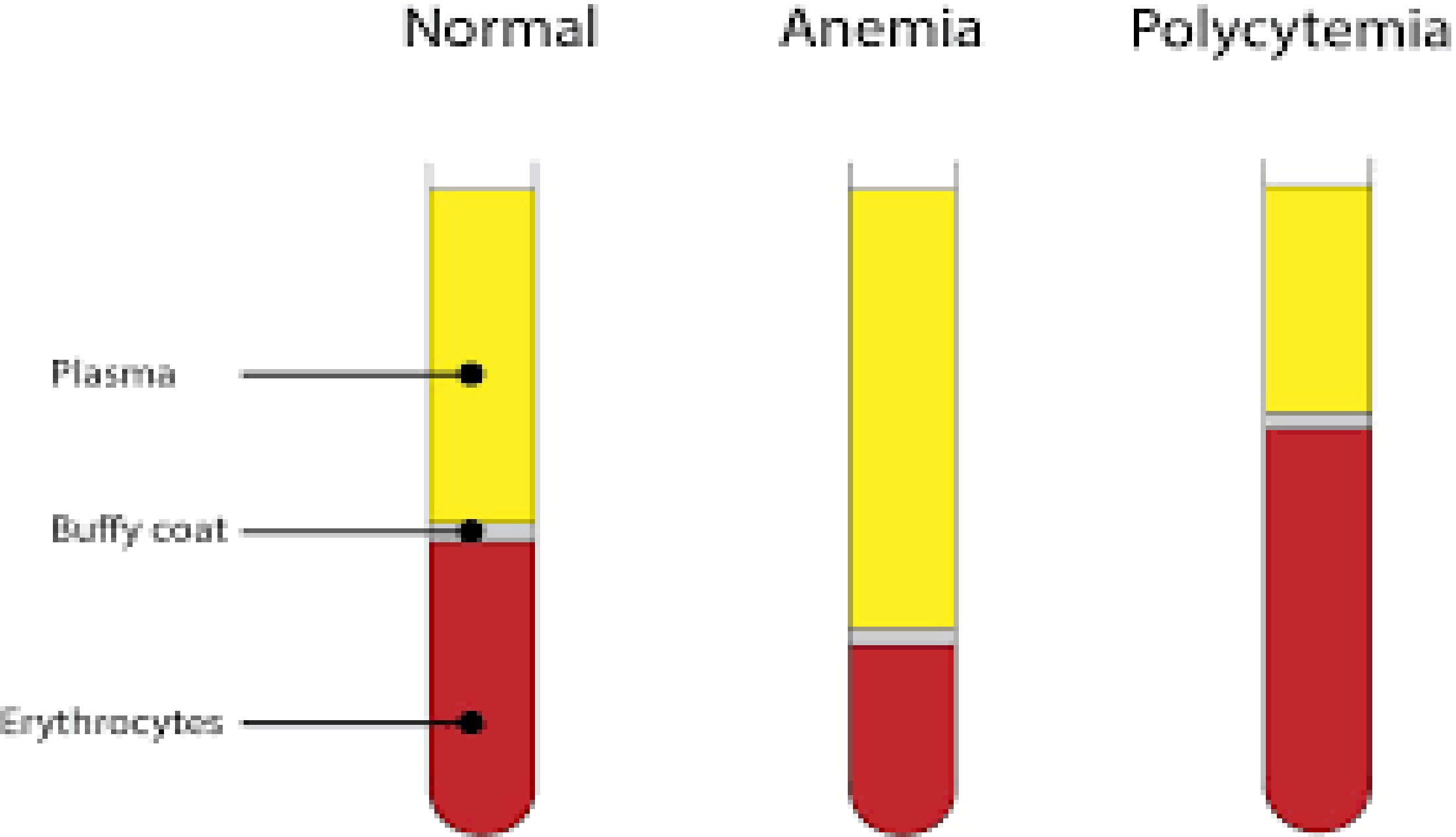
Composition of blood

1. Plasma.
2. Formed elements.





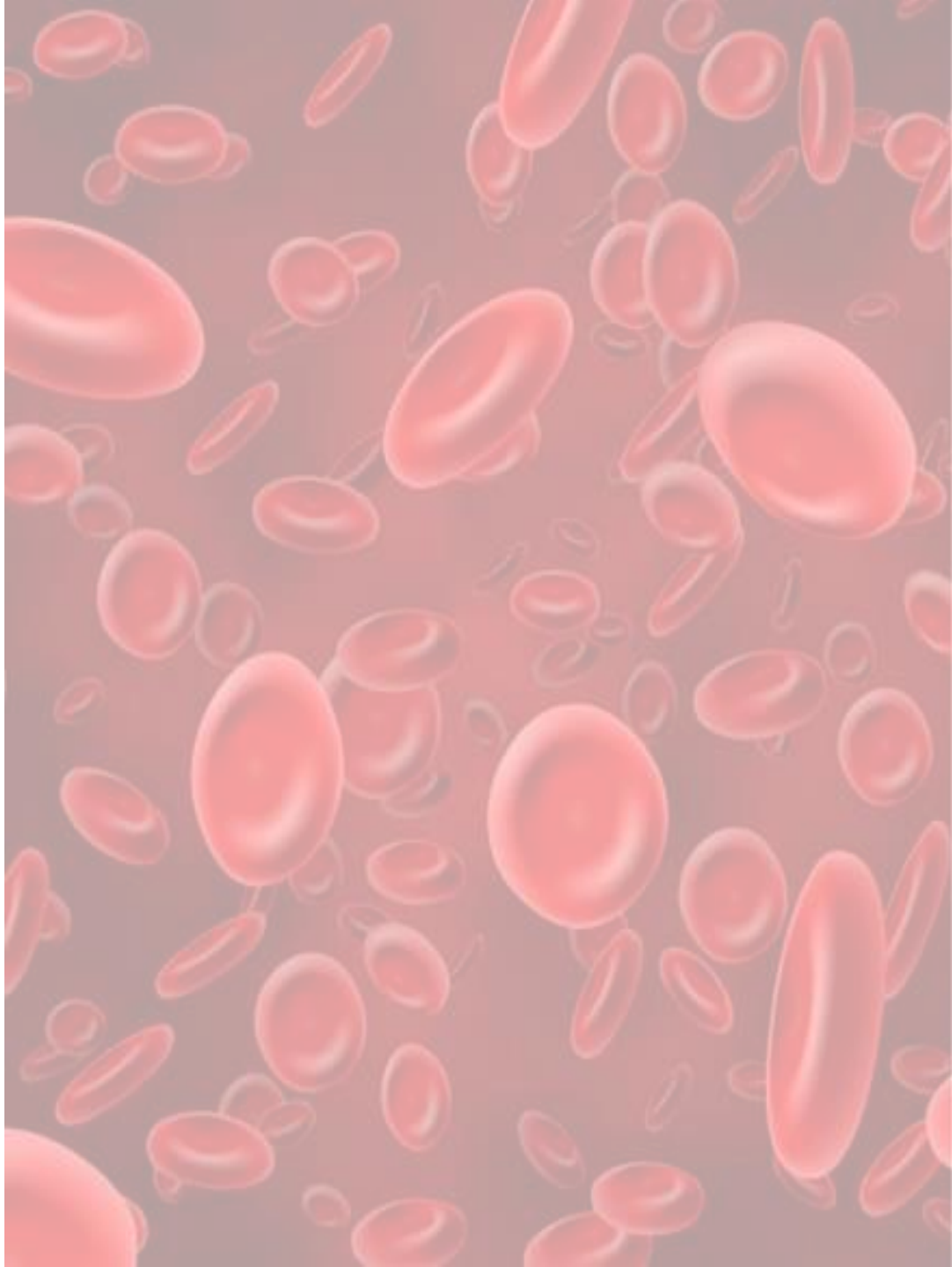

Plasma:
- Water, proteins, nutrients, hormones, etc.
Buffy coat:
- White blood cells, platelets
Hematocrit:
- Red blood cells
Normal Blood:
♀ 37%–47% hematocrit
♂ 42%–52% hematocrit
Anemia:
Depressed hematocrit %
Polycythemia:
Elevated hematocrit %


Normal
Anemia
Polycytemia
Plasma
Buffy coat
Erythrocytes

- Blood represents 8% of body weight.

- Average volume: 5.5 Liters in men & 5 Liters in women.
- Consists of 3 kinds of specialized elements
  - Erythrocytes (Red Blood cells)
  - Leukocytes (White blood cells)
  - Platelets (thrombocytes)

    Suspended in plasma



- Volume of blood same for everyone??

- The total amount of blood in humans varies with age, gender, weight, body type, and other factors, but a rough average for adults is about **60 to 65 ml per kg** (about 1 ounce per 1.2 pounds) **of body weight.**

Composition of blood

SOLIDS:

A- Inorganic constituents

B- Organic constituents

D- Colored substances

E- Other substances

INORGANIC CONSTITUENTS

Na^+	138--- 142 mEq/L
K^+	4.5---5.5 mEq/L
Ca^{++}	2.4 mEq/L
Mg^{++}	1.2---1.5 mEq/L
Cl^-	103 mEq/L
HCO^-_3	24-32 mEq/L ,28mEq/L
PO_4	1-4 mEq/L
SO_4	1 mEq/L

Organic constituents

A-Plasma proteins 6.5---7.5 gm/dl

Albumin 4.5gm/dl

Globulin 2.5gm/dl

Fibrinogen 100---300mg/dl

Prothrombin 10---20mg/dl

B-Non-protein nitrogenous substances

28---48mg/dl

Urea 15-40mg/dl, Uric acid 4---8mg/dl,

Creatinine 0.2---1.2mg/dl,

Amino acids 40mg/dl

Xanthine, hypoxanthine

Colored substances

Bilirubin 0.3---1mg/dl

Carotene

Other substances

Hormones,

enzymes,

vitamins,

minerals,

Metabolites (Lactic acid, Ketone bodies)

Functions of Blood

Blood constituent and their functions (Plasma)

Constituent	**Functions**
Water	1. Act as a transport medium for materials being carried in blood 2. Carries heat.
Electrolytes	1. Important in membrane excitability 2. Distribute fluid by osmosis b/w ECF & ICF. 3. Buffer pH changes.

Nutrients, wastes, gases And Hormones.	Transported in blood;blood CO_2 plays a role in acid base balance.
Plasma proteins	In general, exert an osmotic effect imp for regulation of fluid b/w ECF & Interstitial fluid
Albumin	1.Most abundant, contribute most extensively to Colloid osmotic pressure. 2. Bind substances poorly soluble in plasma, e.g. Bilirubin, bile salts, penicillin
Globulins	Three sub classes α,β and ɣ , highly specific TBG
Fibrinogen	Key factor in blood clotting.

Blood constituent and their functions (Cellular elements)

- Erythrocytes
- Leukocytes
  - Neutrophils.
  - Eosinophils.
  - Basophils.
  - Monocytes
  - Lymphocytes.
- Platelets.

Functions of Blood

Transport function.

- Respiratory
- Nutritive
- Excretory
- Distributive (Transport of hormones and enzymes)
- Temperature regulation

Regulation of acid base balance.

Defensive functions.

Functions due to plasma proteins.

Transport functions

A-Respiratory function:

Hemoglobin the respiratory pigment present in the Red Blood Cells (RBCs) increases oxygen carrying capacity of blood O_2 & CO_2.

B-Nutritive function:

glucose, amino acids, fatty acids, vitamins, minerals & water.

C- Excretory function: Urea, uric acid, creatinine through kidney.

Bile pigments through liver.

CO_2 through lungs.

D-Distribution function: Hormones & hormone binding proteins towards target tissues & organs.

Cont……

- ***E: Temperature regulation*:** Heat produced in active tissues in the body core is brought to the skin and lungs. It is regulated by the amount of blood flow to these areas.

The water in plasma has

i) High specific heat-can absorb large amount of heat.

ii) High thermal conductivity-distribute heat.

iii) High heat of evaporation-heat loss.

Regulatory functions

a) Maintenance of **ionic balance** and internal environments between cells & ICF

b) Maintenance of **water balance** between interstitial, intracellular and vascular compartments.

c) Maintenance of **acid base equilibrium**.

d) Regulation of **blood volume,** Hemostasis; Excessive blood loss is prevented by clotting of blood (clot formation) by platelets and clotting factors .

Defensive functions

Neutrophils and monocytes: Phagocytosis of dead tissues invading micro-organisms.

T lymphocytes: Cellular immunity

B lymphocytes & plasma cells: Humoral immunity (antibodies).

Eosinophils: Phagocytosis of allergic complex

What's in plasma?

- water (90-92%)
- Solids –(8-10%)
  - nutrients
  - plasma proteins
    - albumins
    - alpha and beta globulin
    - gamma globulin (antibodies)
  - all except gamma globulins are formed in the liver

➢ maintain osmotic pressure (and thus blood volume)

- Gases CO_2 3ml/dl, PCO_2 46mmHg
  O_2 0.3ml/dl, PO_2 35mmHg
  N_2 0.9ml/dl
- wastes

Plasma verses Serum

- Plasma is the liquid straw-colored component of blood in which other cells are suspended.
- Plasma = water + protein + dissolved substances.

- It contains 90-92% of water and 8-10% of solids.
- These solids are the organic and inorganic components.
- Removal of coagulation factors from plasma leaves a fluid similar to interstitium known as **Serum**.

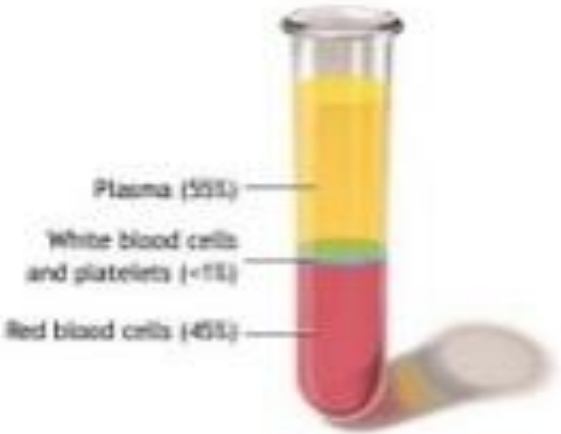
2. Plasma vs. serum

•**Plasma** is the liquid, cell-free part of blood, that has been **treated with anti-coagulants**.

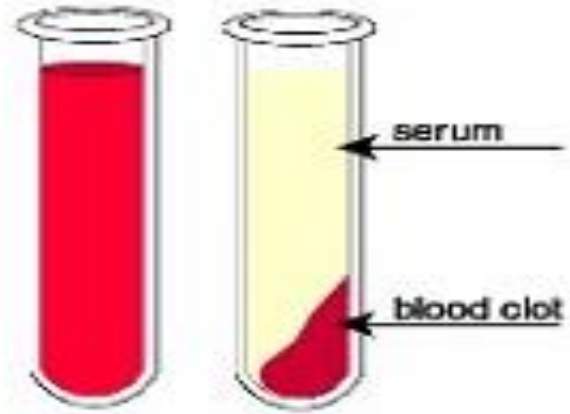
Serum is the liquid part of blood **AFTER coagulation**, therfore devoid of clotting factors as fibrinogen.

Anticoagulated

Clotted



•serum= plasma - fibrinogen



References

- Guyton and Hall Textbook of Medical Physiology (Guyton Physiology)
- Human Physiology: From Cells to Systems (Lauralee Sherwood)
- Google Images Text

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DON'T TELL
PEOPLE
ABOUT
YOUR DREAMS.

SHOW THEM!!