Circulatory System

Part 1: Blood

Outcomes

B11-3-02: Compare the characteristics of blood components in terms of appearance, origin, numbers, relative size, and function in the body. (GLO: D1) Include: plasma, erythrocytes (red blood cells), leukocytes (white blood cells), and thrombocytes (platelets)

B11-3-03: Compare and contrast the characteristics of different blood groups. (GLO: D1) Include: ABO and Rh factor

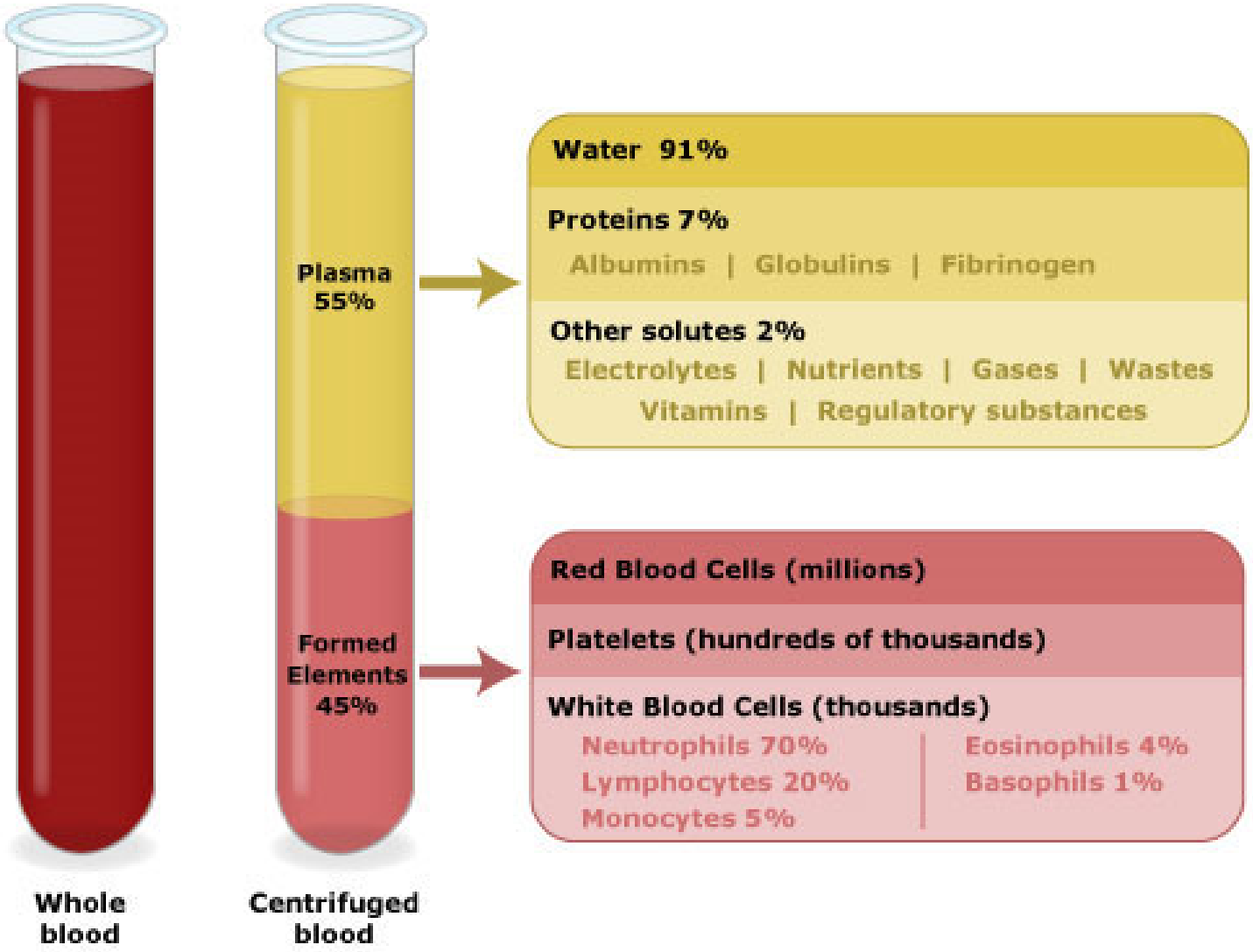
B11-3-04: Predict the physiological consequences of blood transfusions involving different blood groups. (GLOs: D1, E2)

B11-3-05: Describe the blood donation process and investigate related issues. (GLOs: B3, C4, C5, C6, C8) Examples: compatible blood groups, screening procedure, frequency of donation, use of donated blood products, blood-borne diseases…

Introduction

- The Circulatory System is circulation of the blood, all throughout the body
- Blood is:
  - Liquid tissue
  - Contains dissolved materials that travel through blood vessels
  - Each component plays an essential role

Composition of Blood



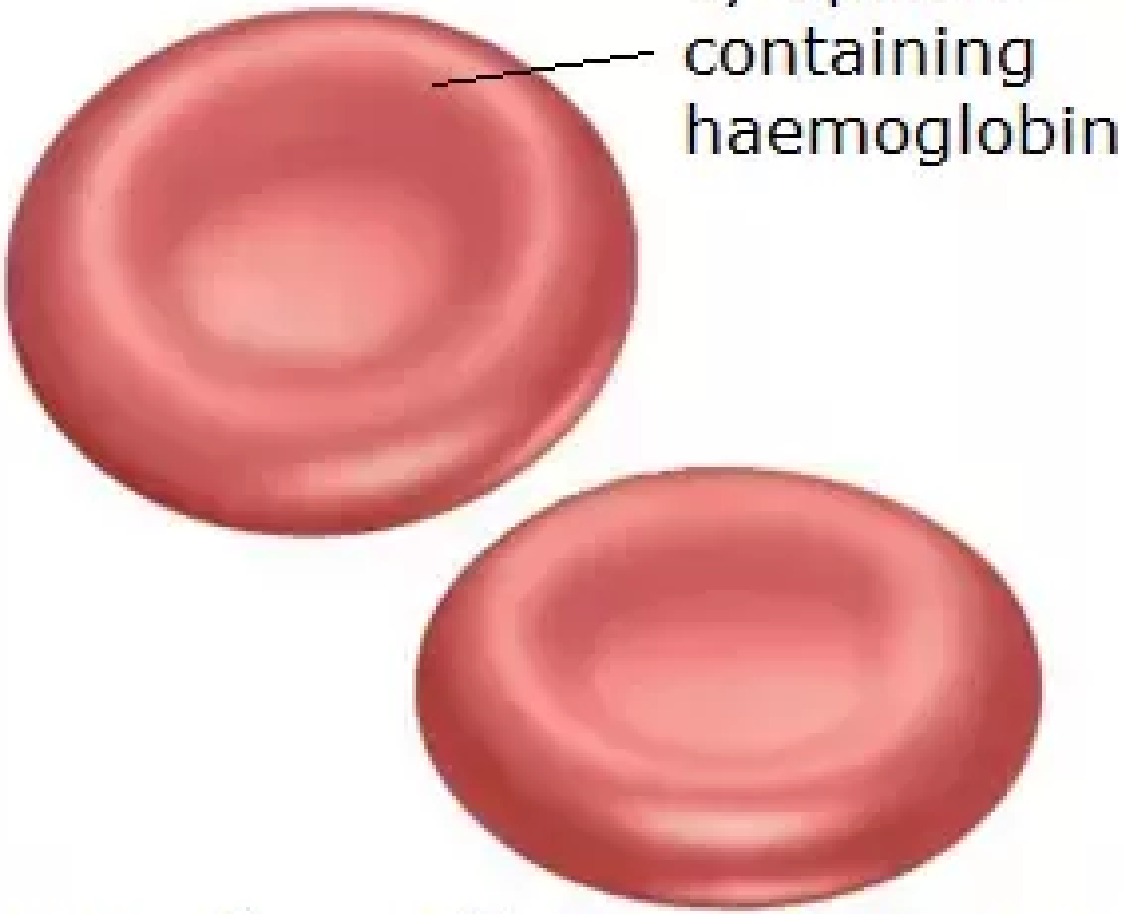
Blood Components

1. Plasma
   - Clear, light yellow portion of blood
   - 55% of total blood volume
   - 90% water, 10% dissolved substances (salts, glucose, amino acids, fatty acids, vitamins, enzymes, cellular wastes)
   - Plasma proteins include:
     - Albumin – most abundant, keeps water from leaving blood and entering cells by maintaining constant concentration
     - Fibrinogen – blood clotting
     - Globulins – many different function

Blood Components

2. Red Blood Cells (Erythrocytes)
   - 5 million in each mL of blood
   - Carry oxygen from lungs to body tissues using **hemoglobin**
   - Disc shaped, thinner in the middle and thicker at the edge since it does not have a nucleus
   - Made of bone marrow
   - Life span of 120 days
   - Worn out RBC are removed by the liver and spleen, and are then broken down
     - The iron is kept and reused by the body
   - **Anemia** results from insufficient hemoglobin

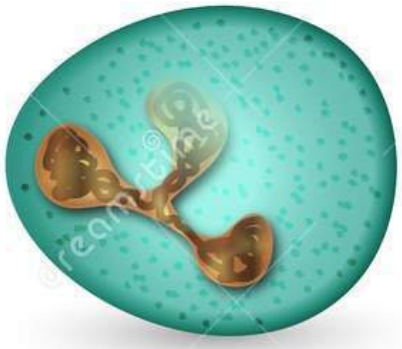
Red blood cells



biconcave discs with no nucleus, carry oxygen

Blood Components

3. White Blood Cells (Leucocytes)
   - Protect against pathogens, like bacteria and viruses
   - Have a nucleus, and are larger than RBCs
   - Make up 1% of the blood (can change if there is an infection)
   - Moves in the blood, but can also squeeze between body tissues
   - If there is an infection, WBCs collect in the infected area and attack the invading organism
   - **Phagocytosis** – process of engulfing a cell and destroying it (how they kill off pathogens)

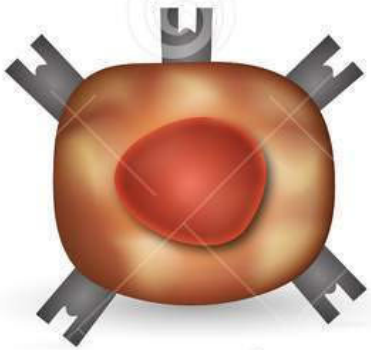


Neutrophil

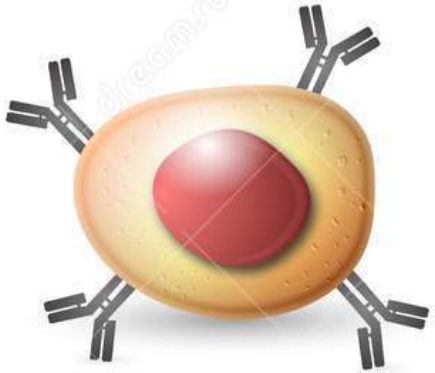
Eosinophil

Basophil

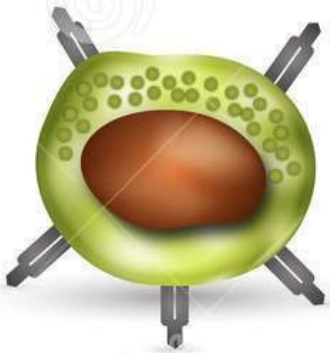
Monocyte



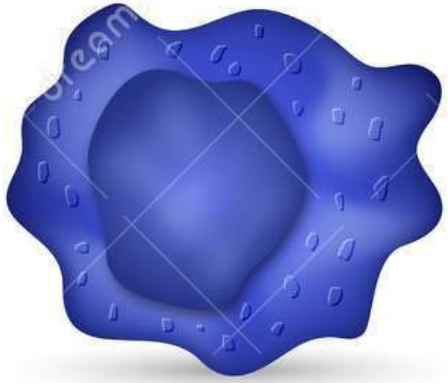
T Cell



B Cell



Natural killer



Macrophage

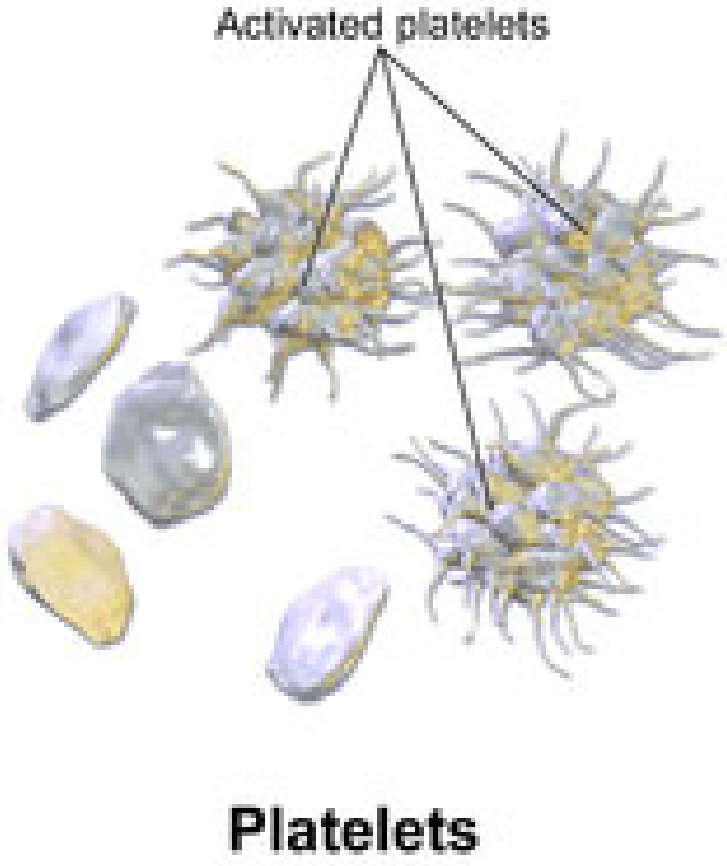
Blood Components

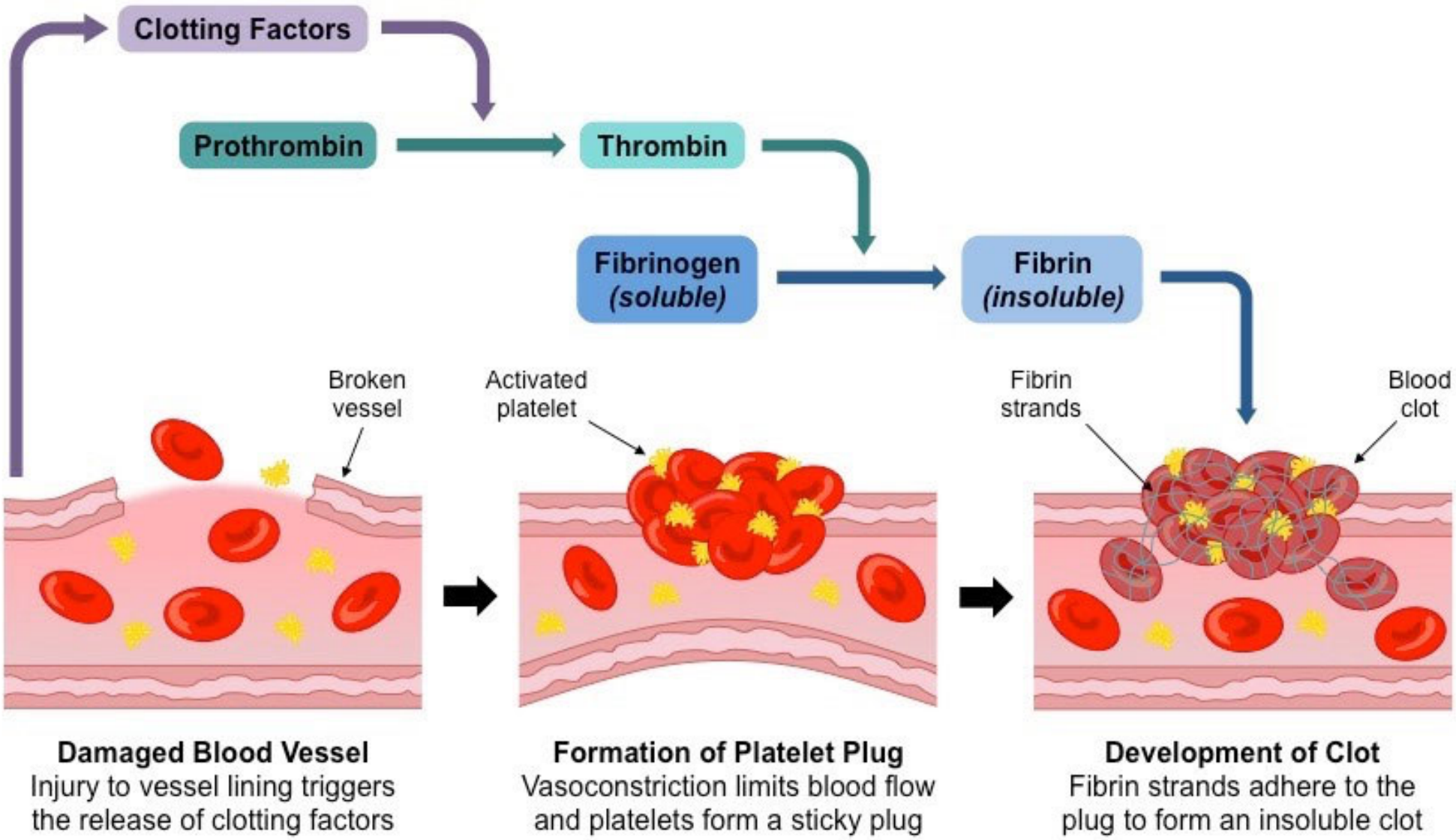
Types of WBCs

- **Myeloids**
  - Granulocytes (Neutrophils, Basophils, Eosinophils)
  - Agranulocytes (Monocytes, Macrophages)
- **Lymphoid (lymphocytes)**
  - T Cells (Helper T, Killer T, Suppressor T)
  - B Cells

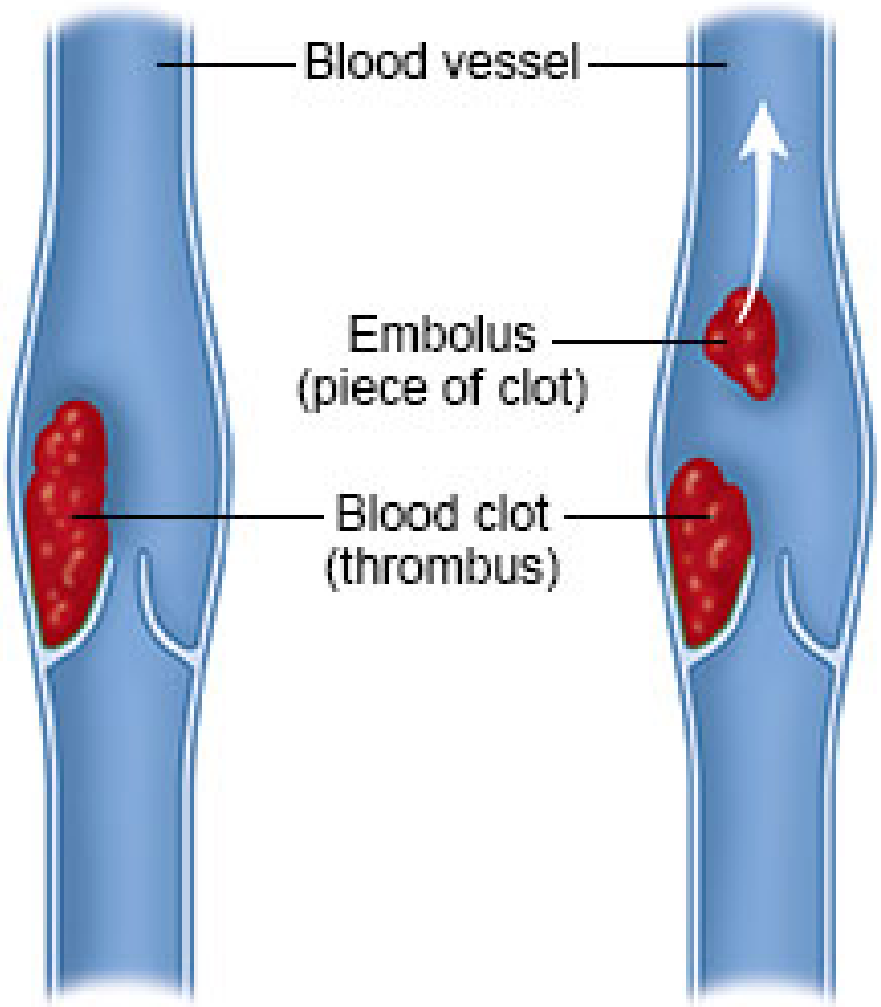
Blood Components

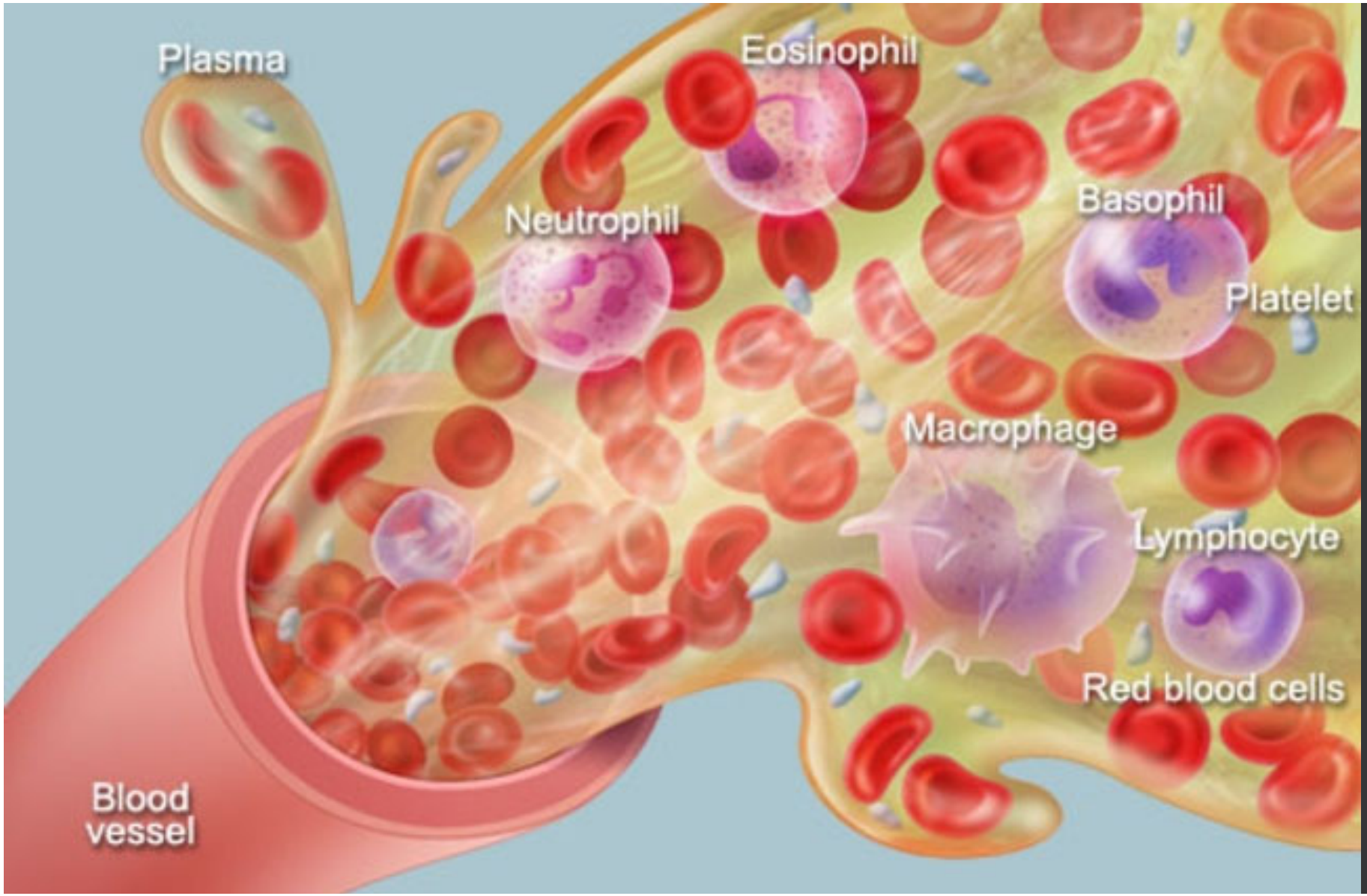
4. Platelets (Thrombocytes)
   - Important in blood clotting factors
   - Two type of blood clots
     a) Thrombus
        - Seals blood vessel after an injury
     b) Embolus
        - Dislodges from blood vessel
        - May cause stroke or heart attack




Clotting Factors
Prothrombin
Thrombin
Fibrinogen (soluble)
Fibrin (insoluble)
Broken vessel
Activated platelet
Fibrin strands
Blood clot
Damaged Blood Vessel
Injury to vessel lining triggers the release of clotting factors
Formation of Platelet Plug
Vasoconstriction limits blood flow and platelets form a sticky plug
Development of Clot
Fibrin strands adhere to the plug to form an insoluble clot

Thrombus and Embolus




Plasma
Eosinophil
Neutrophil
Basophil
Platelet
Macrophage
Lymphocyte
Red blood cells
Blood vessel

Blood Functions

1. Transportation
   - Materials to and from body cells
   - Nutrients, oxygen, wastes, chemical messengers
2. Regulation
   - Temperature, pH, water, wastes
3. Protection
   - Immune system
   - Clotting