LECTURE 5
COMPOSITION OF THE BLOO
All are from haematopoeitic stem cells in bone marrow
Fluids:

- Total Body Water (TBW) 60% of body weight (males) is water (~50% females)
- Fluid inside cells is intracellular fluid (ICF)
- Fluid outside cells is extracellular fluid (ECF)
- Two thirds of total body water (TBW) is in ICF
- One third of TBW is in ECF
- ECF found in solid organs is interstitial fluid (IF)
- Plasma, lymph and IF are all part of ECF

Blood:

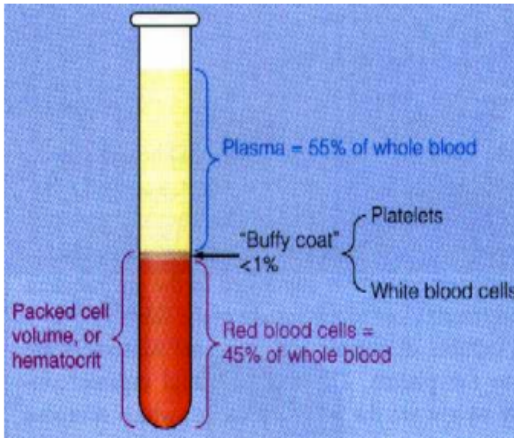
- Fluid in the blood vessels and chambers of the heart
- 6 – 8% of body mass
- 60 – 80 ml/kg
- A 70 kg person has about 5 L of blood
- 55% fluid (plasma) and 45% cells (red blood cells, white blood cells and platelets)
- Serum is fluid from clotted blood

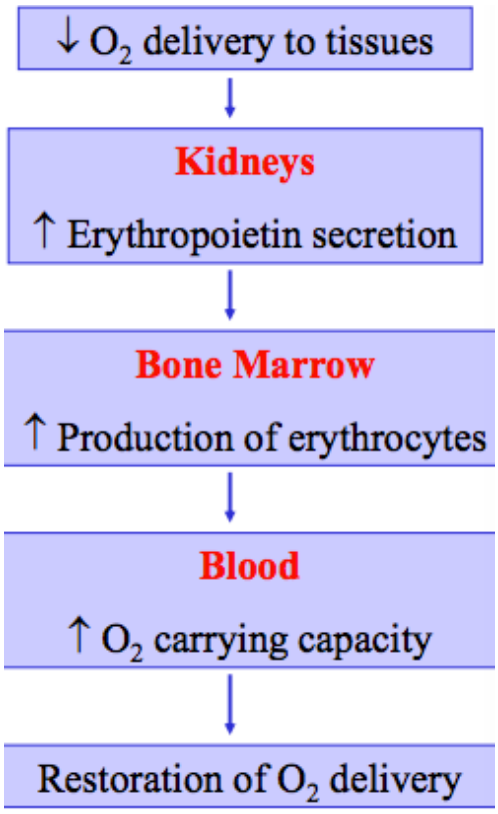
Plasma:

- Straw-coloured fluid
- Made up of
  - Water (90% by weight)
  - Plasma proteins (7% by weight)
  - Salts (mainly Na+, Cl-, HCO3-)
  - Nutrients (eg. glucose, amino acids, fatty acids
  - Wastes (eg. urea, uric acid, bilirubin)
  - Dissolved gases (eg. oxygen, carbon dioxide)
  - ~20% of EFC is in plasma
- Rapid transport system: nutrients, wastes, hormones, heat
- Plasma protein functions
  - Colloid osmotic pressure (especially albumin)
  - pH buffering
  - Transport (eg. lipoproteins, hormone-binding proteins)
  - Immunity (eg. immunoglobulins)
  - Blood coagulation (fibrinogen -> fibrin)

Haematocrit

- Packed Cell Volume (PCV) or Haematocrit
- Proportion of cells in blood.
- PCV out of 1
  - = 0.45 (M)
  - = 0.42 (F)
  - (Haematocrit is %)





Cells of the Blood
Red blood cells – erythrocytes

- Biconcave disc
  - 7 - 8mm diam
  - 2 mm high
- Consists of membrane enclosing
  - Water
  - Electrolytes
  - haemoglobin
  - metabolic enzymes
- no nucleus or organelles

- Regulation of RBC production
    - Stimulated by Erythropeitin (Epo)
    - Released from kidneys
    - In response to hypoxia
    - Also stimulated by testosterone, growth hormone, thyroid hormone
- Functions:
    - Oxygen transport : O2binds reversibly to haemoglobin (Hb) in RBC
    - Carbon dioxide transport:
        - Carbonic anhydrase in RBC catalyses the reaction CO2 + H2O D H2CO3 D H+ + HCO3-
        - Hb in RBC, and proteins in plasma, bind CO2 forming carbamino compounds
            - Heamoglobin (Hb)
                - 4 subunits each consisting of
                    - a polypeptide (globin) chain
                    - a haem unit (one Fe2+and one protoporphyrin molecule)
                - HbA has 2a and 2b globin chains
                - O2 binds reversibly to Fe2+of Hb

White Blood Cells

- Granulocytes (Polymorphonuclear leukocytes)
    - Neutrophils (50-70%)
    - Eosinophils (1-4%)
    - Basophils (<1%)
- Lymphocytes (25-35%)
- Monocytes (2-10%)
- Functions
    - All function as part of body's defence system
    - Neutrophils: phagocytic (esp bacteria), most abundant, first to arrive at site of infection
    - Eosinophils : weakly phagocytic, destroy parasites extracellularly, role in allergies and inflammation
    - Basophils: contribute to inflammation and allergic reactions
    - Monocytes: become macrophages, powerful phagocytes, release messenger molecules (cytokines) that enhance immune response
    - Lymphocytes: each responds to only one foreign antigen
    - B lymphocytes: (20% of circulating lymphocytes) proliferate and become plasma cells that produce antibodies (humoral immunity)
    - T lymphoctyes: (80% of circulating lymohocytes) proliferate and become active T-cells (cell-mediated immunity)
        - Cytotoxic T-cells (Kill foreign or altered cells)
        - Helper T-cells (release cytokines that enhance all aspecets of immune response

Platelets

- Cytoplasmic fragments of Megakaryocytes (large cells found in bone marrow)
- Small flat discs (1-4 mm in diameter)
- Cell membrane & organelles but no nucleus
- Function
    - Prevent blood loss
    - Adhere to damaged blood vessel walls
    - Aggregate or clump together to form a platelet plug
    - Aid coagulation enzymes in forming insoluble strands of fibrin that holds platelet plug and trapped RBCs to form "blood clot"
    - Release growth factors that initiate repair