**Blood for Foundation Block**

**Objectives of L1:**

The student should

1. Identify the composition & functions of the Blood
2. Recognize the morphological features of RBC.
3. Identify the mechanism of RBCs production
4. Identify the regulatory mechanism of RBCs production

**Function of blood**:

* + 1. Transport: of O2, CO2, nutrient, hormones, waste product
  1. Homoeostasis: Regulation of body temperature, ECF pH
  2. Protecting against infections: White Blood Cells, Antibodies
  3. Blood clotting prevent blood loss

**Blood composition**:

1. Cellular components: Red Blood Cells (Erythrocytes), White Blood Cells (Leucocytes), Platelets (Thrombocytes)
2. Plasma: Same ionic composition as interstitial fluid; 98% water, ions, plasma proteins (Albumin, globulin, Fibrinogen)

**Blood volume**

5 liter in adult: 45% is packed cells volume and 55% is plasma volume

**Blood Cells Formation**

* Erythropoiesis: Formation of RBC (erythrocytes), Leucopoiesis: Formation of WBC (leucocytes), Thrombopoiesis: Formation of platelets (thrombocytes)

**Red Blood Cells:**

* Function: O2 transport; CO2 transport; Buffer
* Shape and size: Flat Biconcave Disc, Non-nucleated, Diamter 7-8 mm x 2.5 mm , 1 mm, Average volume 90-95 mm3 , Flexible, Number =4.7-5 x106, Hb =34g/dl of cells, Hb= 14-16 g/dl in the blood
* Production: Early few weeks of embryo nucleated RBCs are formed in yolk sac; Middle trimester mainly in liver & spleen & lymph nodes; Last month’s RBCs are formed in bone marrow of all bones; Bone marrow of flat bone continue to produce RBC into adult life; Shaft of long bone stop to produce RBC at puberty while epiphysis continued
* Genesis of RBC: All blood cell are formed from Pluripotential hematopoietic stem cells ⇒ committed cells to form RBC, or committed stem cells for WBC; growth of different stems cells are controlled by growth factors
* Stages of differentiation of RBC: Stages of RBC development: Committed stem cell; Proerthroblast; basophil erythroblast; polychromatophil erythroblast; orthochromatic erythroblast; Reticulocytes ; Mature erythrocytes. Rapid RBC production → ↑ reticlocytes in the circulation
* RBC development is characterize by: decrease in cell size; disappearance of nuclus; appearance of haemoglobin
* Erythropoietin: Glycoprotein; 90% from renal cortex 10% liver; Stimulate the growth of early stem cells and does not affect maturation process; can be measured in plasma & urine; High level of erythropoietin are detected in anemia; High altitude; Heart failure

**Objectives of L2**

The student should

* 1. Identify the essential elements needed for erythropoiesis
  2. Identify the role of Vitamin B12 and folic acid in RBC maturation.
  3. Identify the fate of old RBCs in the circulation
  4. Identify the regulatory mechanism of RBCs production
  5. Identify the structure & functions of Hb
  6. Identify iron Metabolism.
  7. Recognize abnormal erythropoiesis such as anemia and polycythemia
* Essential elements RBC formation and maturation: Amino acid needed for the formation of globin in Hb in case of sever protein deficiency result in anaemia; Ironneeded for formation of Hb and iron deficiency leads to anaemia; Vitamins B12 and Folic acid in the Synthesis of nucleoprotein their deficiencies results in anemia; Other vitmins such as B6, Riboflavin, nicotinic acid, biotin, Vit C, Vit E are also needed for the formation of healthy RBC; essential elements such as Copper, Cobalt, zinc, manganese and hormones as androgens, Thyroid, cortisol & growth hormones are all needed for erythropoiesis and deficiencies of any one results in anaemia
* Vitamin B12 & Folic acid: Important for DNA synthesis and final maturation of RBC; Dietary source: meat, milk, liver, fat, green vegetables; Deficiency leads to: Failure of nuclear maturation & division, Abnormally large & oval shape RBC, Short life span, reduced RBC count & Hb ,Macrocytic (megaloblastic) anemia
* Pernicious Anemia due to malabsorption of Vit. B12 VB12 absorption needs intrinsic factor secreted by parietal cells of stomach, VB12 + intrinsic factor is absorbed in the terminal Ileum, Deficiency arise from Inadequate intake or Poor absorption due to Intestinal disease
* Destruction of RBC: RBC life span in circulation = 120 days, old cell has a fragile cell membrane, cell will rupture as it pass in narrow capillaries (spleen); Released Hb is taken up by macrophages in liver, spleen & bone marrow, Hb is broken into its component: Polypeptidegoes to amino acid storage; Iron to ferrtin storage; Porphyrin gives bilirubin which will be secreted by the liver into bile

**Hemoglobin and iron metabolism**

* + Structure & functions of Hb
  + Iron Metabolism.
  + Absorption, transport
  + storage
  + Anemia
  + Polycythemia
* Structure: Hb molecules consist 4 chains each formed of heme & polypeptide chain (globin); Heme consist of protoporphyrin ring + iron; Abnormality in the polypeptide chain - abnormal Hb (hemoglobinopathies) e.g thalassemias, sickle cell
* Functions of Hemoglobin: Carriage of O2 reversibly bind O2 to form oxyhemoglobin, affect by pH, temperatre, H+ ; Carriage of CO2 in the form of carboxyhemaglobin ; Buffer
* Iron metabolism: Iron is needed for the synthesis of Hb, myoglobin cytochrome oxsidase, peroxidase & catalase , Total Iron in the body = 4-5g, 65% Haemoglobin,5% other hems, 1% bound to transferrin (betaglobulin) in blood, 15-30% stored iron in the form of ferritin in the liver, spleen and bone marrow, Iron in food mostly in oxidized form (Ferric), Better absorbed in reduced form (Ferrious), Iron in stomach is reduced by gastric acid, Vit. C., Rate of iron absorption depend on the amount of iron storedIron is transport in plasma in the form of Transferrin (apotransferrin+iron),Iron is stored in two forms as ferritin (apoferritin+iron) or as haemosiderin (insoluble complex molecule), Daily loss of iron is 0.6 mgm in male & 1.3mgm/day in females
* **ANAEMIAS:**
* is defined as a decrease number of RBC and decrease Hb; Symptoms: Tired, Fatigue, short of breath, heart failure; Causes of anaemia 1. Blood Loss: acute such as accident (RBC return to normal 3-6w), Chronic example microcytic hypochromic anaemi (ulcer, worms) 2. Decrease RBC production: Nutritional causes( Iron deficiency and microcytic anaemia; VB12 & Folic acid deficiencies and megaloblastic anaemia ; Bone marrow destruction by cancer, radiation, drugs leading to Aplastic anaemia. 3. Haemolytic: excessive RBC destrction or Abnormal cells or Hb such as Spherocytosis, sickle cells, Incompatible blood transfusion, Erythroblastosis fetalis
* Polycythemia Increased number of RBC; 1. Primary (polycythemia rubra vera) 2. Secondary to hypoxia: high altitude (physiological), chronic respiratory or cardiac disease