Introduction to haematology and haematopoiesis
Haematology

The diagnosis, treatment, and prevention of diseases of the blood and bone marrow as well as of the immunologic, hemostatic (blood clotting) and vascular systems.
What is blood?

**Whole Blood:**

- **Plasma & Formed Elements**
  - Plasma = 46 - 63% (around 55%)
  - WBC & Platelets = Together make up 0.1% of Formed Elements
  - Formed Elements = 37 - 54% (around 45%)
  - RBC's = 99.9% of Formed Elements

**Formed Elements:**

- **RBC, WBC, & Platelets**
  - White Blood Cells: 6-8000/mm³
  - Platelets: 200-400,000/mm³
  - Red Blood Cells: 4-5 Million/mm³

**Images:**

- Plasma
- White Blood Cells and Platelets
- Red Blood Cells
- White Blood Cells
- T-Lymphocyte
- B Lymphocyte
- Macrophage
- RBC
How are the blood cells formed?
Bone marrow

Normal bone marrow conversion

Infant <1 year
Childhood 1-10 years
Adolescent 10-20 years
Adult >25 years

Red Bone Marrow H&E

blood sinusoids

adipocytes

BS MK Ad HP
Bone marrow

- Hypoplastic
- Normal cellular
- Hyperplastic marrow
haematopoiesis
Figure 1.2 Diagrammatic representation of the bone marrow pluripotent stem cell and the cell lines that arise from it. Various progenitor cells can be identified by culture in semi-solid medium by the type of colony they form. It is possible that an erythroid/megakaryocytic progenitor may be formed before the common lymphoid progenitor diverges from the mixed granulocytic/macrophage/monocyte eosinophil myeloid progenitor. Baso, basophil; BFU, burst-forming unit; CFU, colony-forming unit; E, erythroid; Ec, eosinophil; GEMM, granulocyte, erythroid, monocyte and megakaryocyte; GM, granulocyte, monocyte; Meg, megakaryocyte; NK, natural killer.
Hematopoiesis in humans

- Multipotential hematopoietic stem cell (Hemocytoblast)
  - Common myeloid progenitor
    - Megakaryocyte
    - Proerythroblast (Promyeloiblast)
    - Promegakaryocyte
    - Erythroblast (Normoblast)
    - Macrophage
    - Mast cell

- Common lymphoid progenitor
  - Common lymphoid progenitor
    - Lymphoblast
    - Prelymphocyte
    - Precursor lymphocytes
    - B cell
    - T cell

**Notes**
- Approximate scale information: 10 μm
- The morphological characteristics of the hematopoietic cells are shown as seen in a Wright's stain, May-Grünwald-Giemsa stain, or May-Grünwald-Giemsa stain. Alternative names of certain cells are indicated between parentheses.
- Certain cells may have more than one characteristic appearance. In these cases, more than one representation of the same cell has been included.
- Together, the monocytes and the lymphocytes comprise the agranulocytes, as opposed to the granulocytes (basophil, neutrophil and eosinophil) that are produced during granulopoiesis.
- B, N, and E stand for Basophil, Neutrophilic and Eosinophilic, respectively, as in Basophilic promyelocyte.
- [1] The polychromatophilic erythrocyte (reticulocyte) at the right shows its characteristic appearance when stained with methylene blue or Azur B.
- [2] The erythroblast at the right is a more accurate representation of its appearance in reality when viewed through a microscope.
- [3] Other cells that arise from the monocytes: osteoclast, microglia (central nervous system), Langerhan's cells (epidermis), Kupffer cell (liver).
- [4] For clarity, the T and B lymphocytes are split to better indicate that the plasma cell arises from the B-cell. Note that there is no difference in the appearance of B- and T-cells unless specific staining is applied.
Figure 1.3 (a) Bone marrow cells are increasingly differentiated and lose the capacity for self-renewal as they mature. (b) A single stem cell gives rise, after multiple cell divisions (shown by vertical lines), to >10^6 mature cells.
Hematopoietic growth factors