HEMATOPOIESIS

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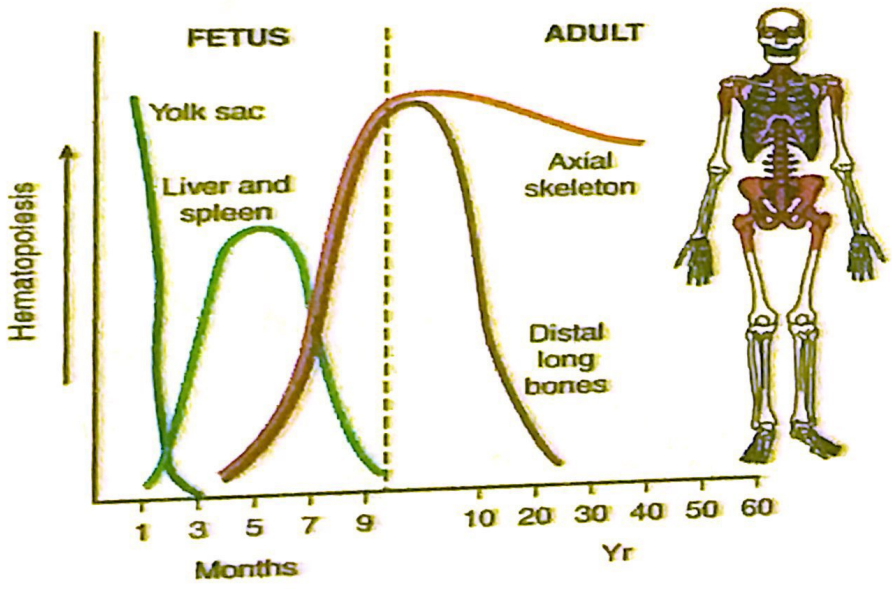
- Thus, to maintain homeostasis, the system must have the capacity for self renewal
- It involves- erythropoiesis, granulopoesis, thrombopoiesis and lmphopoisis

- Hematopoiesis begins as early as the nineteenth day after fertilization in the yolk sac of the embryo
  - Only erythrocytes are made
- At about 6 weeks of gestation, yolk sac production of erythrocytes decreases and production of RBCs in the human embryo itself begins.

- The fetal liver becomes the chief site of blood cell production.
  - Erythrocytes are produced
  - The beginnings of leukocyte and thrombocyte production occurs
- The spleen, kidney, thymus, and lymph nodes serve as minor sites of blood cell production.

HEMATOPOIESIS



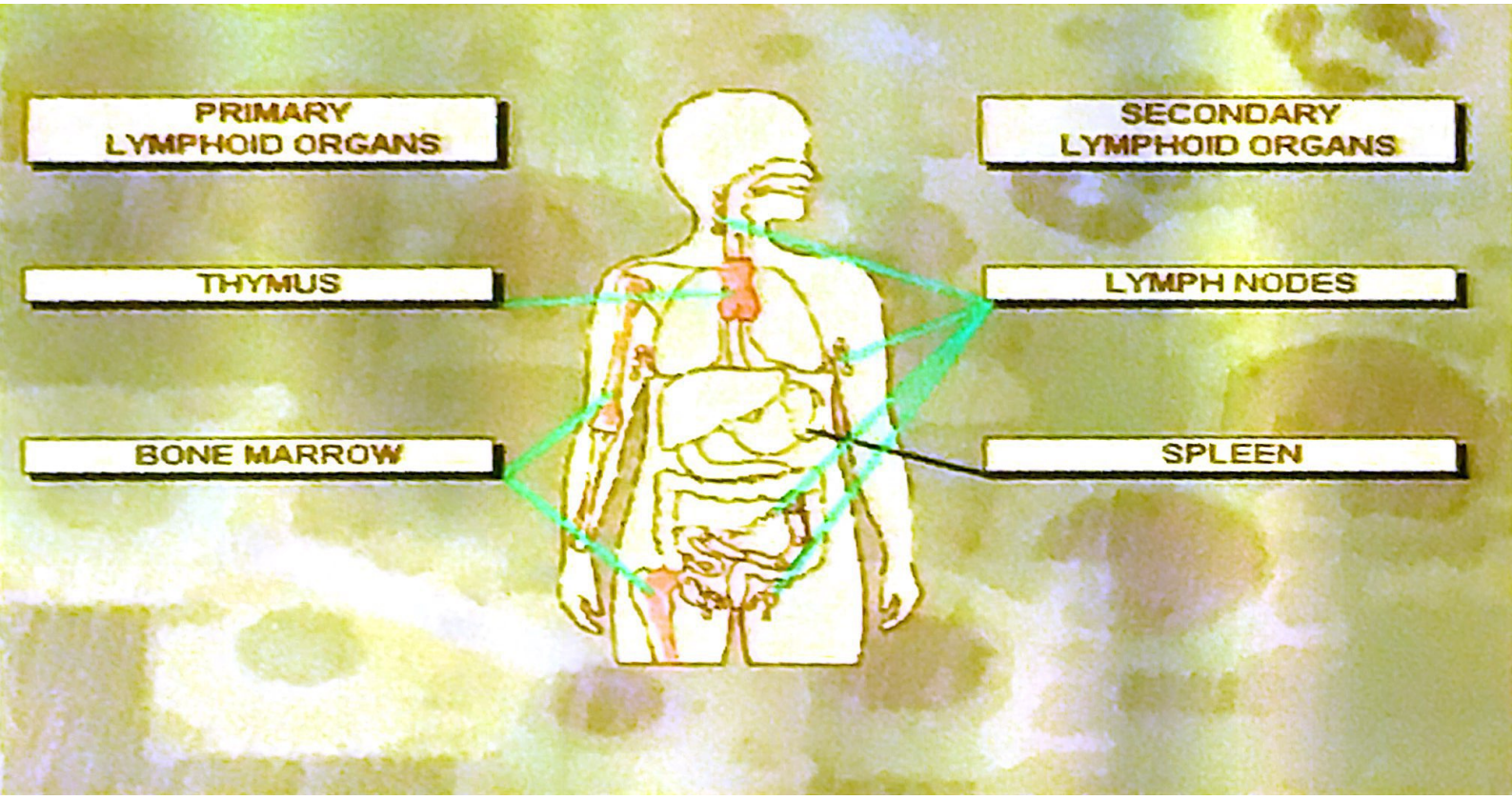
Sites of Haemopoiesis

- Fetus:
  - 0 – 2 months - Yolk sac
  - 2 – 7 months - Liver, spleen
  - 5 – 9 months - Bone Marrow
- Infants - Bone Marrow (all bones)
- Adults - Vertebrae, ribs, sternum, skull, sacrum, pelvis, proximal ends of femur

WHICH SITE IS APPROPRIATE FOR BONE MARROW AS PER THE AGE

1.adult-sternum
2.Adult-sternum and posterior iliac spine
3. Year 1-posterior iliac spine
4.One year and adults -sternum
5.One year and adults –posterior iliac spine

- Hematopoiesis in the bone marrow is called medullary hematopoiesis
- Hematopoiesis in areas other then the bone marrow is called extramedullary hematopoiesis



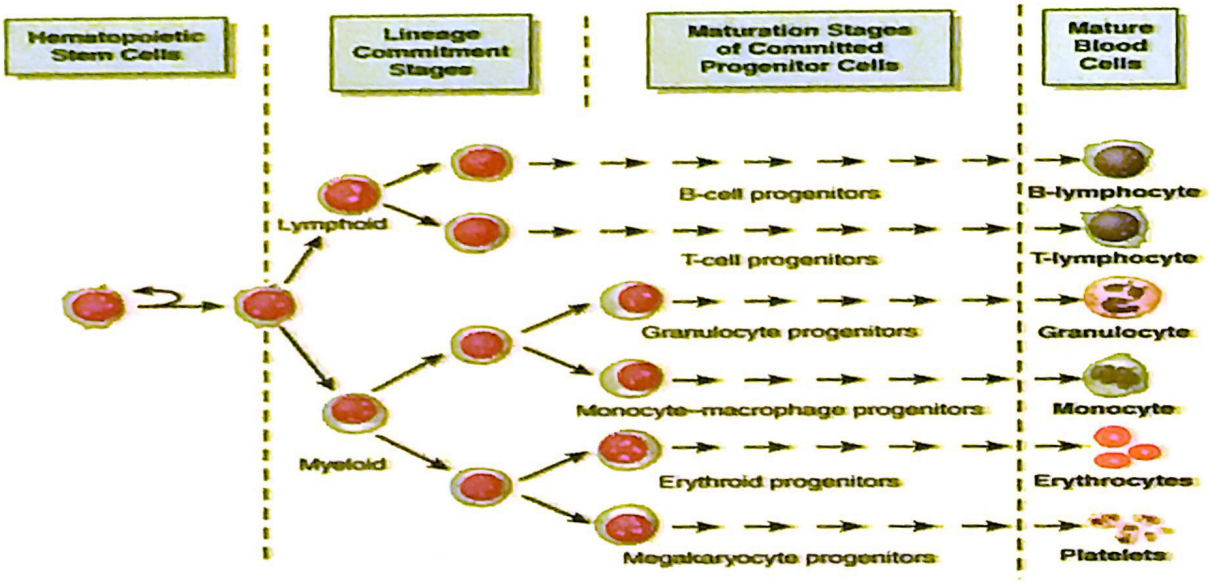
DERIVATION OF BLOOD CELLS

- Mature blood cells have a limited life span and with the exception of lymphocytes, are incapable of self-renewal.
- Replacement of peripheral hematopoietic cells is a function of the pluripotential (totipotential) stem cells found in the bone marrow
- Pluripotential stem cells can differentiate into all of the distinct cell lines with specific functions and they are able to regenerate themselves.

DERIVATION OF BLOOD CELLS

- Hematopoietic cells can be divided into three cellular compartments based on maturity:
  - Pluripotential stem cell capable of self-renewal and differentiation into all blood cell lines.
  - Committed progenitor stem cells destined to develop into distinct cell lines
    - The committed lymphoid stem cell
    - The committed myeloid stem cell
  - Mature cells with specialized functions

HEMATOPOIESIS



ERYTHROID PATHWAY

- Gives rise to red blood cells which carry oxygen from the lungs to the tissues.
  - Proerythroblast (Pronormoblast)
  - Basophilic Erythroblast
  - Polychromatic erythoblast
  - Orthochromatic erythroblast (Normoblast)
  - Polychromatic erythroblast (Reticulocyte)

GRANULOCYTIC PATHWAYS

- The granulocyte pathway divides into the ***neutrophilic, eosinophilic,*** and ***basophilic*** **pathways.**
  - Neutrophils are the body's main defense against bacterial infections.
  - Eosinophils play an important role in allergic states and in combating various parasitic infestations.
  - Basophils are the precursors of tissue mast cells.
    - **Myeloblast**
    - **Promyelocyte**
    - **Myelocyte**
    - **Metamyelocyte**
    - **Mature Neutrophil**

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Myeloblast

↓

Promyelocyte

↓

Myelocyte

↓

Metamyelocyte

↓

Mature Neutrophil

PHAGOCYTIC CELL LINE

- The phagocytic pathway, however, undergoes complex subdivisions:
  - ***Monocytic*** pathway: - Blood monocytes, which mature in the tissues to various classes of macrophages
    - Myeloblast
    - ⇩
    - Monoblast
    - ⇩
    - Promonocyte
    - ⇩
    - Monocyte

MEGAKARYOCYTIC

The megakaryocytic line, does not undergo further subdivision. provides blood platelets which are the primary defense against hemorrhage and which play a major role in maintaining and repairing the endothelium

- Megakaryoblast
- Promegakaryocyte
- Megakaryocyte
- Thrombocyte

SUMMARY OF PROGENY OF HEMATOPOIETIC PLURIPOTENTIAL STEM CELLS:

1. **Myeloid Pathway: (committed progenitor cell)**
   1. **Erythroid Line: *RED BLOOD CELLS***
   2. **Megakaryocytic Line: *BLOOD PLATELETS***
   3. **Phagocytic Lines:**
      1. **Monocytic Pathway: *BLOOD MONOCYTES , TISSUE MACROPHAGES***
      2. **Granulocytic Pathways: *NEUTROPHILS, EOSINOPHILS, BASOPHILS***
2. **Lymphoid Pathway: (committed progenitor cell)**
3. **Include the B and T lymphocytes**
   - **B Cell Line: B lymphocytes become tissue plasma *PLASMA CELLS in maturation***
   - **T Cell Line: *HELPER T CELLS , SUPPRESSOR CELLS ltmphoctes***
   - **"Non-B, Non-T" Lines: *NATURAL KILLER CELLS***

WHICH CELLS OCCUR IN PERIPHERAL BLOOD OF NORMAL ADULTS

1.monocytes
2.plasma cells
3.lymphocytes
4.Mast cells
5.eosinophils
6.Red blood cells
7.macrophages

LYMPHOID PATHWAY

- Lymphoblast
- Prolymphocyte
- Lymphocyte (Natural Killer Cell)
- Plasma cell

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- Lymphoblast
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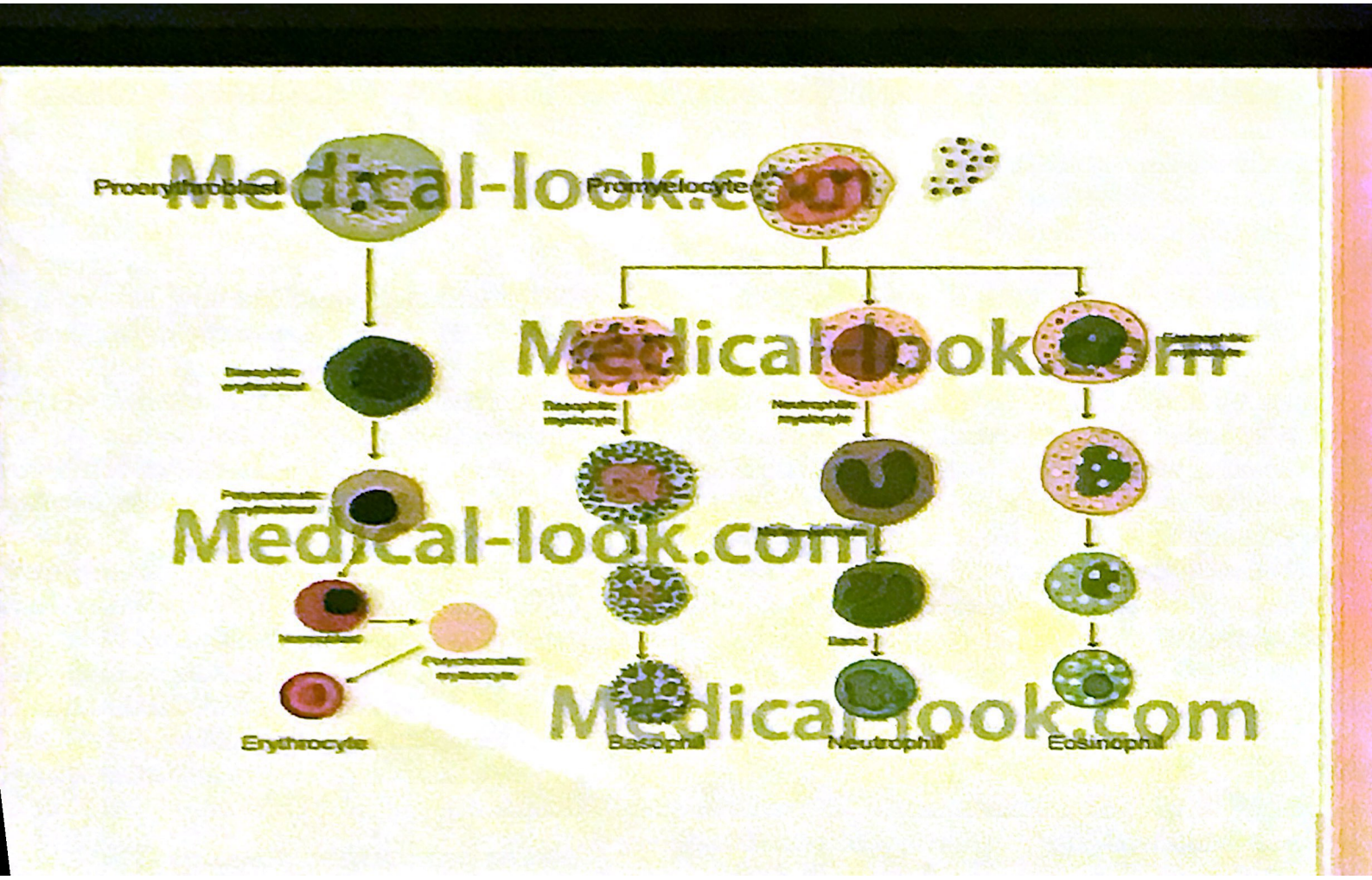

PHYSIOLOGIC CONDITIONS

- The complex orchestration of hematopoiesis through which the elaborate array of blood cells described above is produced requires three physiologic components, each of which is essential.
- These are:
  - The *stem cell pool* itself
  - *Hematopoietic cytokines*, which are the hormones that regulate hematopoiesis through both endocrine and paracrine mechanisms; and
  - The *hematopoietic inductive microenvironment*, which is made up of the bone marrow stroma and vasculature.

HEMATOPOIETIC CYTOKINES

- The hormones that regulate blood cell production are called ***hematopoietic cytokines***.
- Example:
  1. Erythropoietin - Red blood cells
  2. G-CSF - Neutrophils
  3. Thrombopoietin - Megakaryocytes
  4. Interleukin-4 - T cells and basophils
  5. Interleukin-5 - B cells and eosinophils
  6. M-CSF - Monocyte/macrophages
  7. Others: Stem cell factor, GM-CSF, IL-3
- Hematopoietic cytokines are produced by different cells and tissues.
  - Eg Erythropoietin, which controls red blood cell production is produced primarily by cells in the kidney that perceive hypoxia.