



Erythropoiesis

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Haematopoiesis is the development of blood cells .

- Erythropoiesis – RBCs
- Leucopoiesis- WBCs
- Thrombopoiesis – Platelets

Sites of haematopoiesis

- **During intrauterine life –**

In the first 3 months:-yolk sac is the main site.

From the 3rd month :-liver and spleen become the main sites.

From the 7th month:- bone marrow becomes the main site .

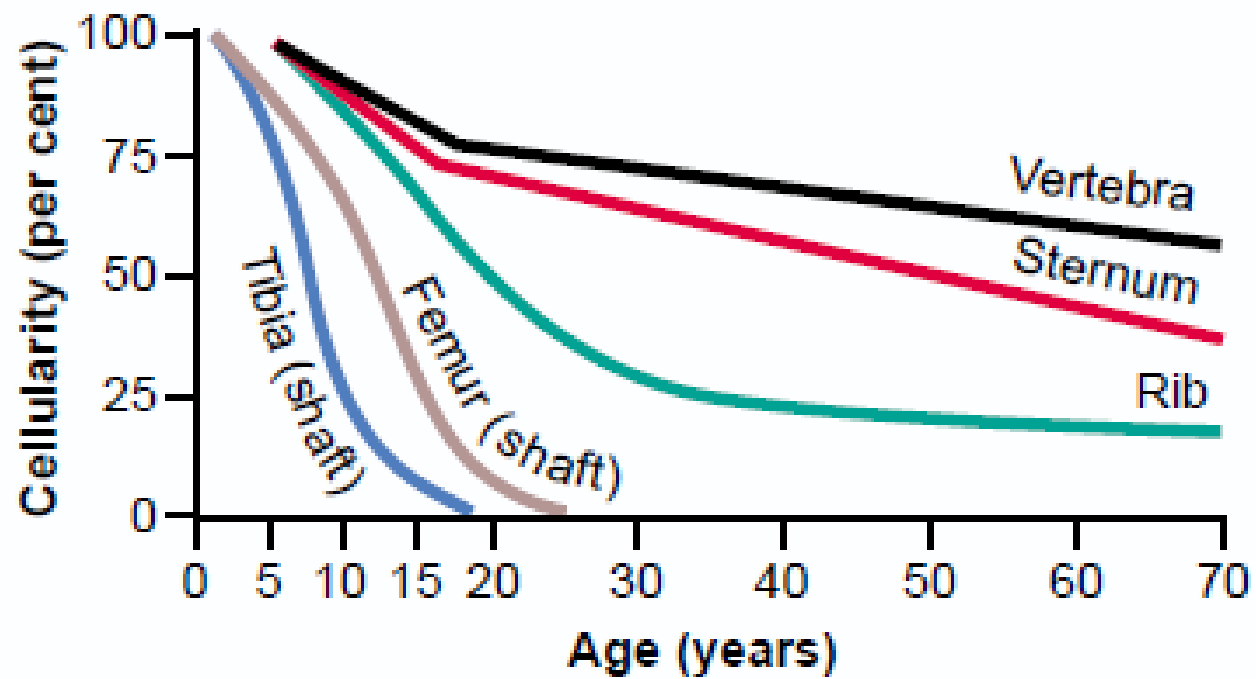
- **In children**

Haematopoiesis occurs in axial skeleton (skull , vertebrae , sternum , ribs , sacrum and pelvis) and bones of extremities .



In adults :-

Haematopoiesis occurs in axial skeleton and ends of long bones (Humerus , femur) .



Blood cell precursors

- All blood cells originate from a single ancestral cell called **Pluripotent stem cell**.
- Stem cells possess 2 properties :
self-replication and differentiation .
- The stem cells differentiate into progenitor cells .

- Progenitor cells possess ability to give rise to clones (group of cells), so they are also called **colony forming units (CFU)** .eg. CFU-E is colony forming unit – erythroid . CFU-E develops into erythrocytes .
- Haematopoiesis is regulated by **colony stimulating factors** . Eg. erythropoietin regulates erythropoiesis .

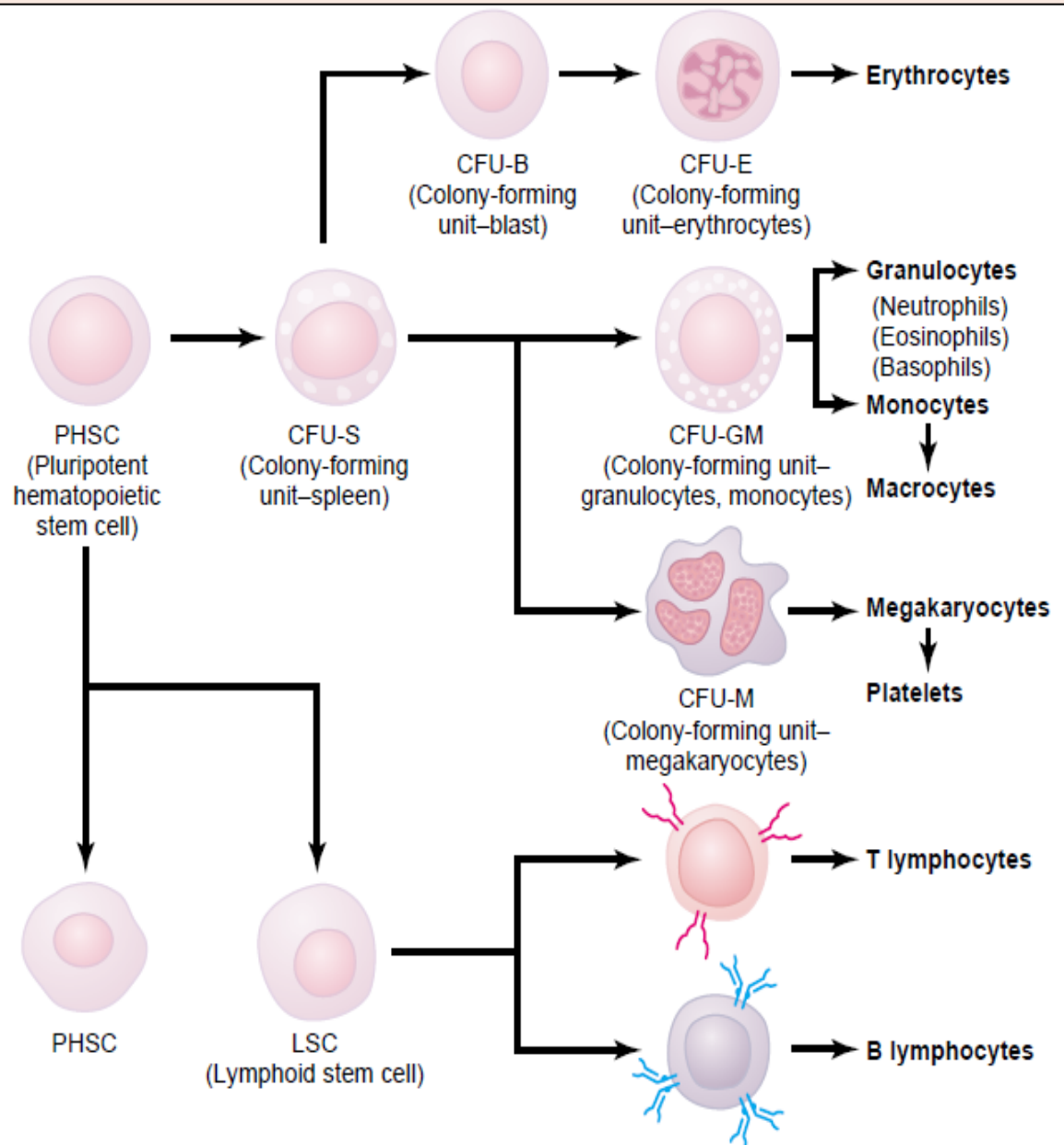


Figure 32-2

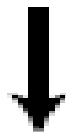
Formation of the multiple different blood cells from the original *pluripotent hematopoietic stem cell* (PHSC) in the bone marrow.

GENESIS OF RBC

Proerythroblast



Basophil
erythroblast



Polychromatophil
erythroblast



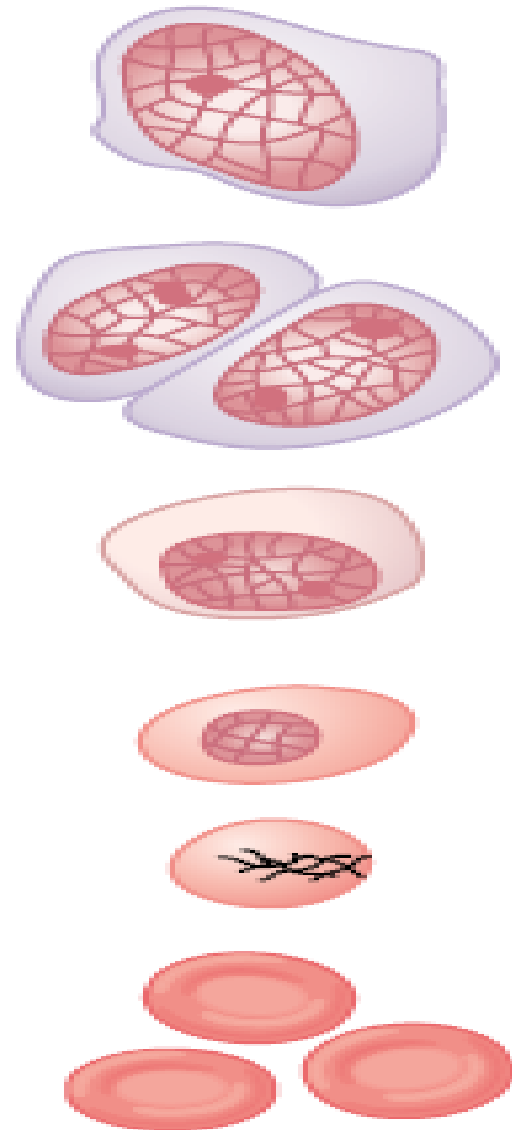
Orthochromatic
erythroblast



Reticulocyte



Erythrocytes



Stages of Erythropoiesis

- ❑ Proerythroblast
- ❑ Basophilic erythroblast(Early normoblast)
- ❑ Polychromatic erythroblast (Intermediate normoblast)
- ❑ Orthochromatic erythroblast(late normoblast)
- ❑ Reticulocyte
- ❑ RBC

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- **During the development** of erythrocytes , as the cell attains maturity, it shows the following characteristic features :
 1. Reduction in the cell size.
 2. Staining reaction of cytoplasm changes from basophilic to acidophilic.
 3. Nucleus decreases in size and finally disappears

Stage	Size (μ)	Hb	Cytoplasm	Nucleus	Mitosis
Pro erythroblast	18	Absent synthesis begins	deep basophilic RNA	large size	present
Basophilic erythroblast	15	absent	less basophilic RNA	size decreases	present
Poly chromatic erythroblast	12	appears	Polychrom atophilic RNA + Hb	size decreases	present

Stage	Size (μ)	Hb content	Cytoplasm	Nucleus	Mitosis
Ortho chromatic erythroblast	9	increases	Acidophilic Hb	degenerate	absent
Reticulocyte	7.5	increases	Acidophilic Hb	absent	absent
R.B.C.	7.2	remains same	Acidophilic Hb	absent	absent

- This process of Erythropoiesis takes about 7 days to form a mature RBC.
- Time taken for conversion of Proerythroblast to Reticulocyte is 5 days and for conversion of Reticulocyte to become mature RBC is 2 days .

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- The Reticulocyte spends 1 day in the bone marrow and another day in the peripheral blood by diapedesis before the conversion to mature RBC .
 - Normal range of Reticulocyte in healthy adults is 0.5 to 2% and in infants is 2-6% .

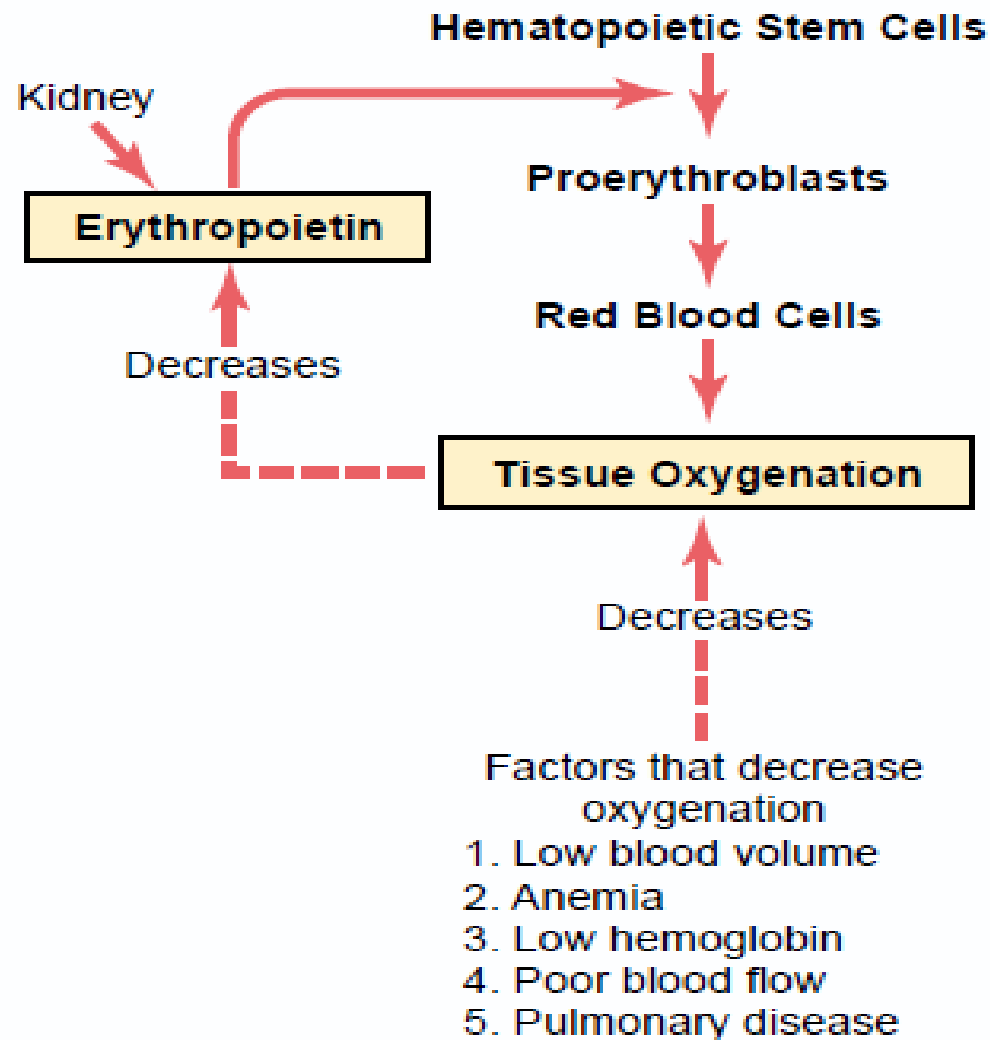
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- The RBC does not have ribosome. Thus it cannot synthesize hemoglobin and any other protein .

Regulation of Erythropoiesis

- **Hypoxia:** Hypoxia means lack of oxygen at tissue level. It is the most potent stimulus for the production of RBCs.
- Hypoxia causes stimulation of bone marrow thereby increasing RBC production This effect is mediated by erythropoietin.

- Erythropoietin is mainly produced by the juxtaglomerular apparatus of **kidney** .
(90%)
- Also ,**liver** and cells of tissue macrophage system produce erythropoietin .
(10%)

- Hypoxia causes release of renal erythropoietic factor from the juxtaglomerular apparatus of kidney .
- This acts on the plasma protein called erythropoietinogen to form erythropoietin .



- Erythropoietin or ESF or ESH
- Glycoprotein
- 161 AA
- Mol Wt- 46000
- Half life -5 hr

Erythropoietin promotes :

1. proliferation of progenitor cell .
2. differentiation of progenitor cell .
3. every stage of maturation from the proerythroblast to RBC .



4. Hemoglobin synthesis by increasing synthesis of globin

5. Release of reticulocytes from bone marrow into the peripheral blood .

Factors affecting erythropoietin production

Increase:

1. Hypoxia :- haemorrhage, high altitude, cardio respiratory disturbances
2. Vasoconstrictor agents catecholamines due to renal hypoxia
3. Nucleotides e.g. cAMP, NAD, NADP
4. Hormones- testosterone , thyroxine , growth hormone , adrenocortical hormones .

Decrease

1. Estrogen: Decreases depresses erythropoietic response to hypoxia.
2. Chronic Renal Diseases
3. Protein deficiency
4. Cirrhosis of the liver
5. Chronic inflammatory diseases



Factors necessary for Erythropoiesis

- 1. Maturation factors.**
- 2. Factors necessary for Haemoglobin synthesis.**

Maturation factors

- Vitamin B12 and folic acid are necessary for synthesis of DNA .
- Intrinsic factor of Castle helps in absorption of Vitamin B12 from ileum .

Factors necessary for Hb synthesis

- Dietary proteins provide amino acids required for synthesis of globin part of haemoglobin
- Iron is necessary for synthesis of haem part of haemoglobin .

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- Vitamin C helps in absorption of iron from duodenum by converting ferric form into ferrous form .

Factors Controlling Erythropoiesis:

- Diet
- Erythropoietin
- Stimulus for maturation
 - Vitamin B₁₂
 - Folic acid
- Iron
- Minerals, Cu, Mn, Co
- Hormones - T₃, T₄, ACTH, Testosterone
- Vitamins – Vit. E, Vit. C