# Introduction to Blood & Immunology 2018

Dr Senani Williams

FRCPath MD

# Blood & Immunology Module

- Duration
- Lectures
- Tutorials
- Practicals
- Seminars
- Assessments – CA 7
- Unit 3C
- Feedback

# Time Table

- 5 1/2 weeks
- A SDL each day!
- Packed schedule

- Seminar on 6 topics – voluntary participation
- Lectures – NOT COMPULSORY!

# Reference – Essential Haematology

A.V. Hoffbrand

ABC of Haematology

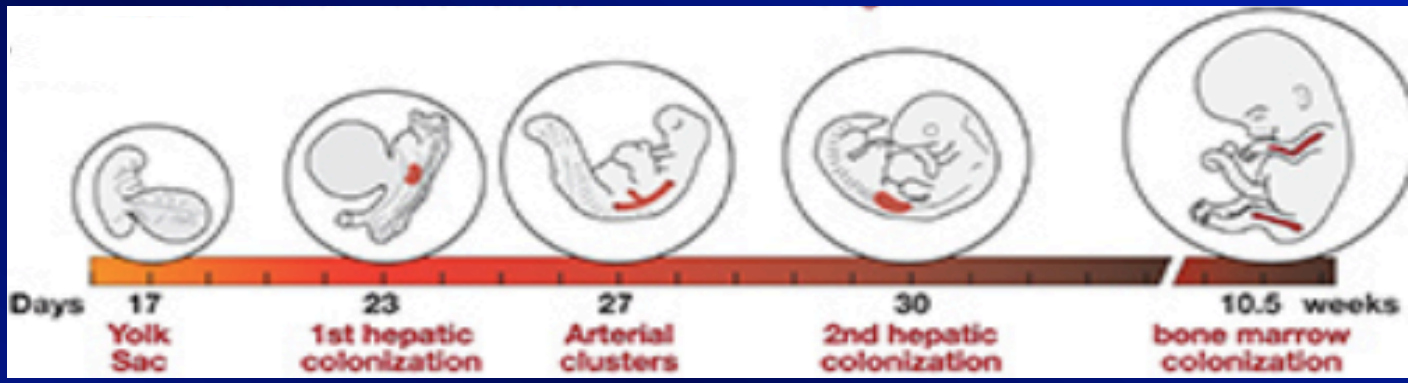
# Anaemia

| Intermediate Objectives | Broad Content Areas |
| --- | --- |
| **General Aspects of Anaemia** | |
| • Define anaemia & describe the following general aspects of anaemia<br>• classification<br>• clinical features with their pathological basis<br>• use of laboratory investigations | Morphological & aetiological classification<br><br>To confirm – in institutions & in the community |

# Haemopoiesis

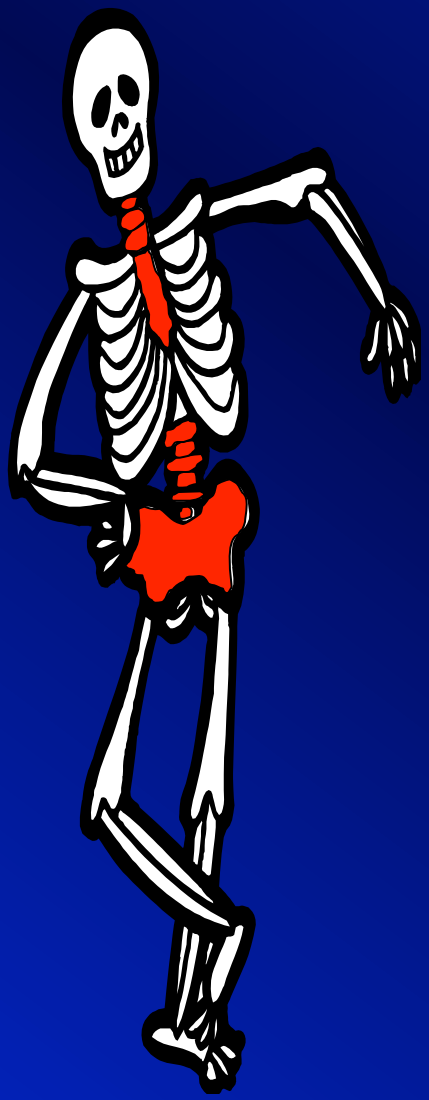
- Site

Embryo - Yolk sac as blood islands




Upto **3** weeks - yolk sac

**6** wks to **6** months - fetal liver & spleen



# Haemopoiesis

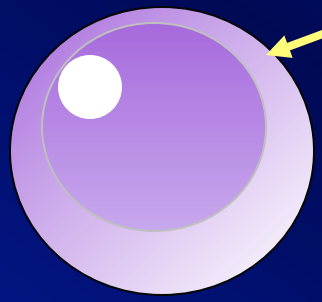
From 6 months

of fetal life

Onwards

Extra medullary haemopoiesis if a need arises

# Haemopoiesis



Pluripotent
Stem cell

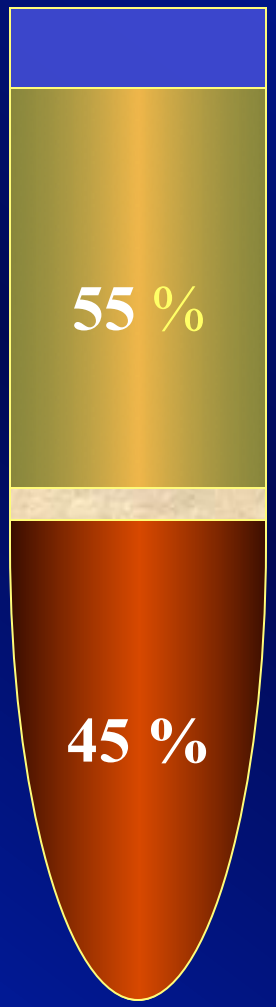
Micro environment
Stroma
Matrix
Growth factors

*The most important cell in haemopoiesis*

# The pluripotent stem cell

- Ability for self renewal
- Undifferentiated
- Resembles small lymphocytes
- Large fraction is quiescent in $G_0$ phase
- Maintained by transforming growth factor β
- TGF – β activity mediated by p53 tumour suppressor

# What is Blood ?

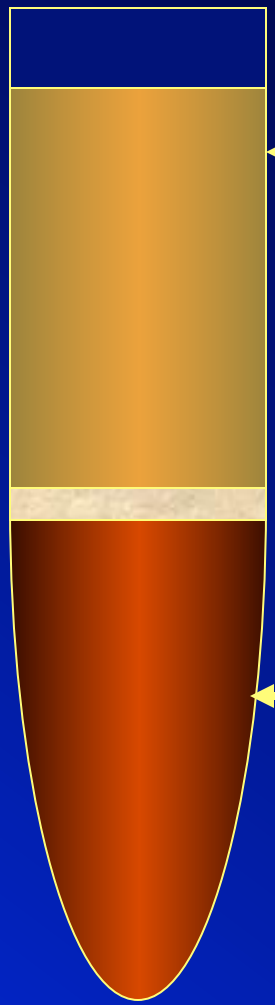



Plasma
- proteins
- electrolytes
- water
- macro molecules

Buffy coat
WBCs & Platelets

RBC s

# Haematology



Coagulation factor deficiency / thrombosis

Thrombocytopenia / thrombocytosis

Leucopenia / Leukaemia

Anaemia / Polycythaemia

Blood Transfusion

# Haemopoiesis

Inhibited by TNF & TGF β

Erythropoiesis

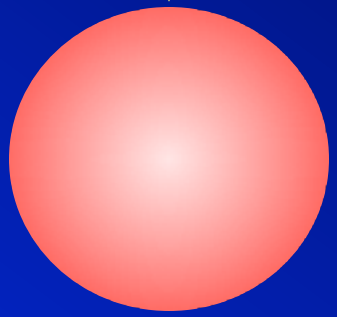
Granulopoiesis

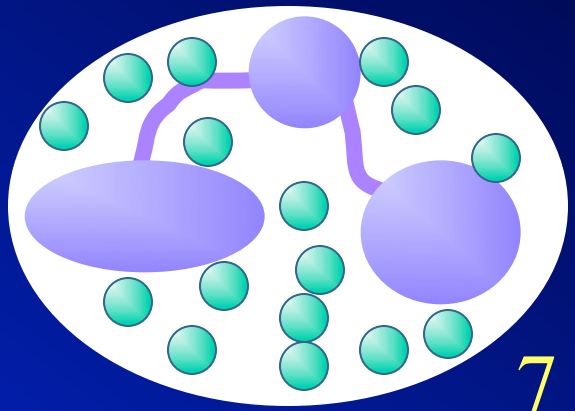
Thrombopoiesis

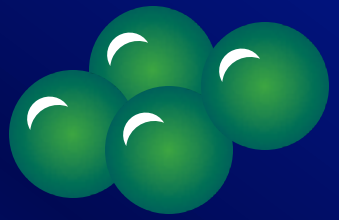
Epo

CSF GM

Tpo



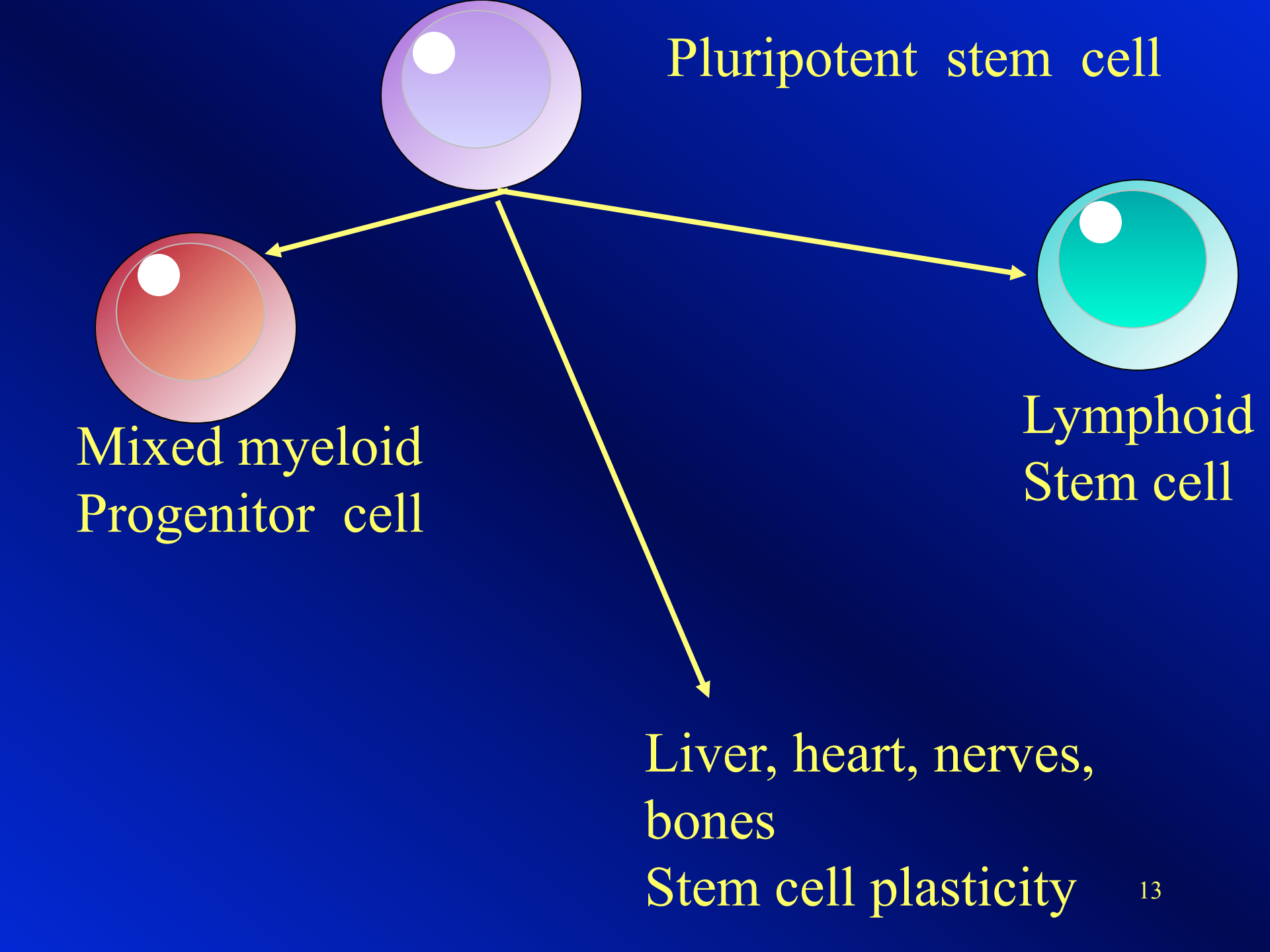


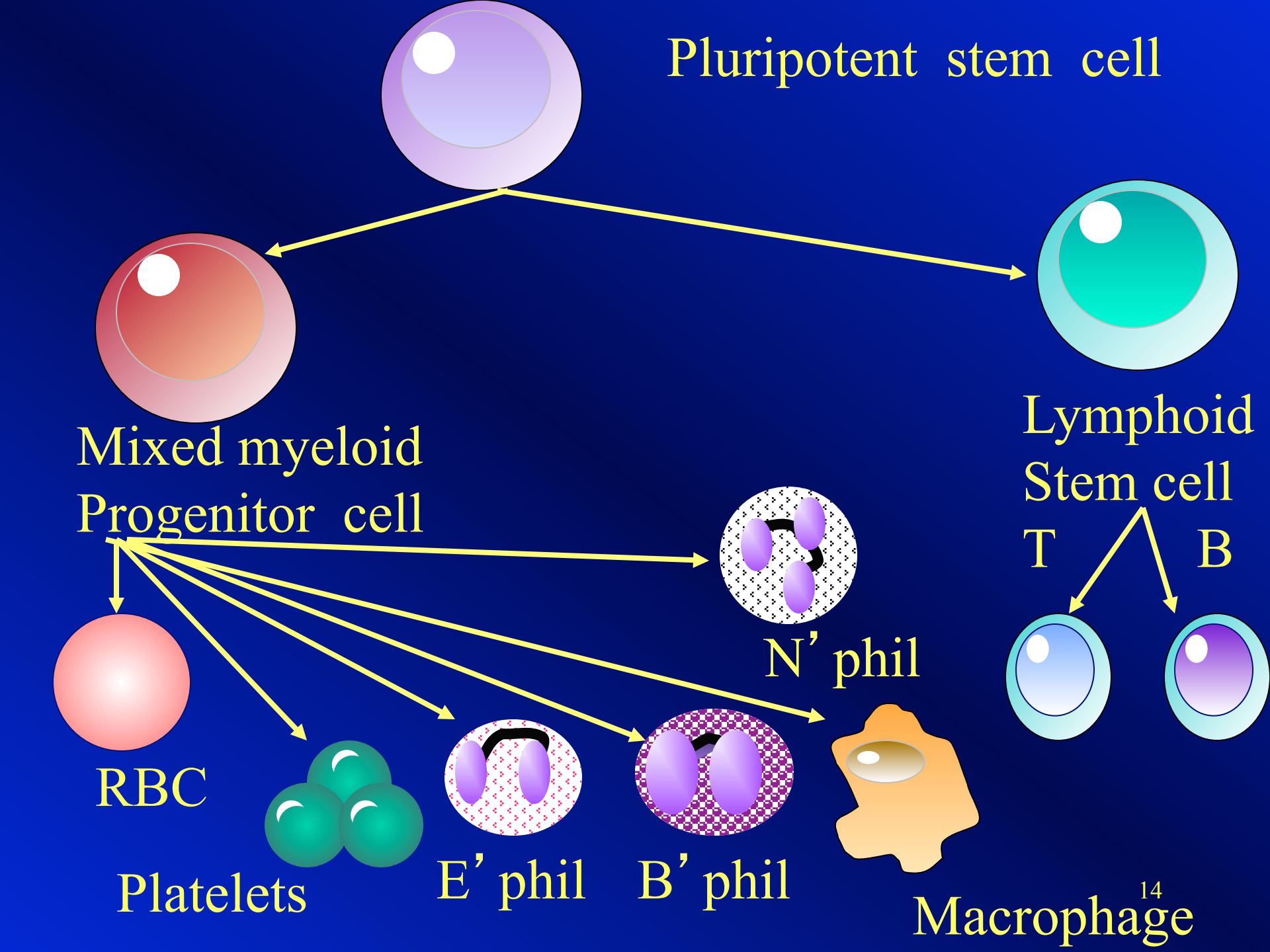


120 days

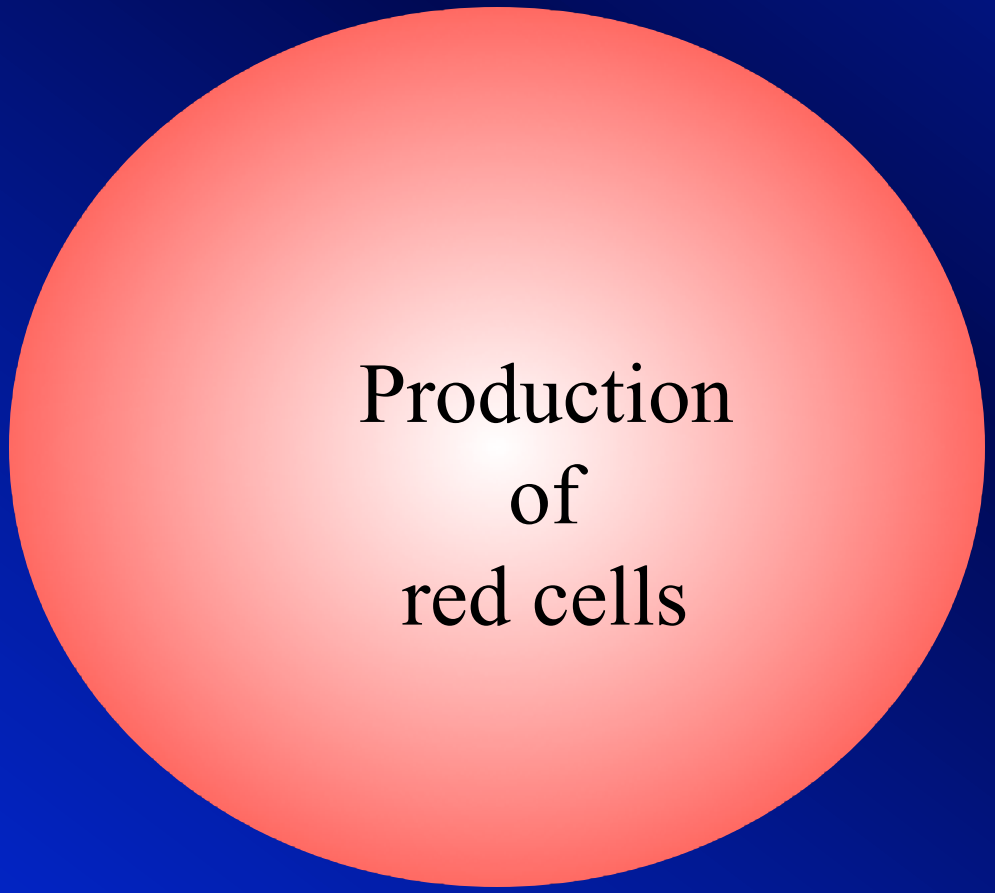
7 hours

7 days


Pluripotent stem cell
Mixed myeloid
Progenitor cell
Lymphoid
Stem cell
Liver, heart, nerves,
bones
Stem cell plasticity


Pluripotent stem cell
Mixed myeloid
Progenitor cell
Lymphoid
Stem cell
T
B
N' phil
RBC
Platelets
E' phil
B' phil
Macrophage

# Erythropoiesis




Stimuli

↓ $pO_2$

↑ Erythropoietin

↑ RBC production

# Factors Necessary for Haemopoiesis

**$Fe^{2+}$, $B_{12}$**

**Folate, Vit. C**

**Pyridoxime, $T_4$**

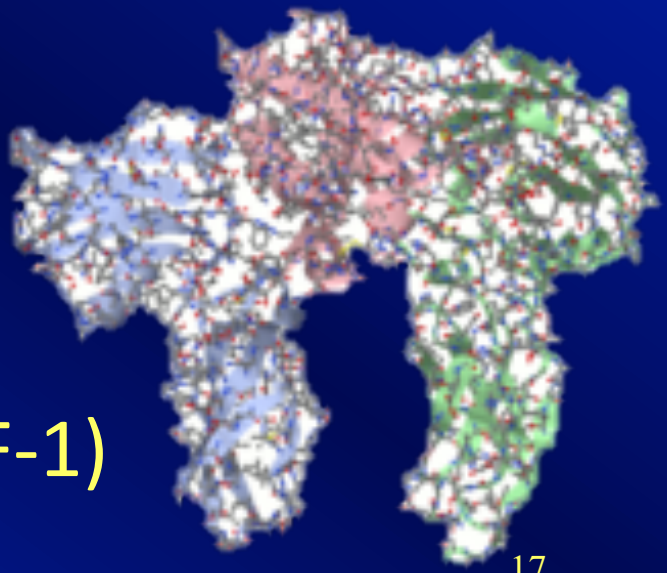
**Zn, Androgens**

**Erythropoietin**

**Protein**

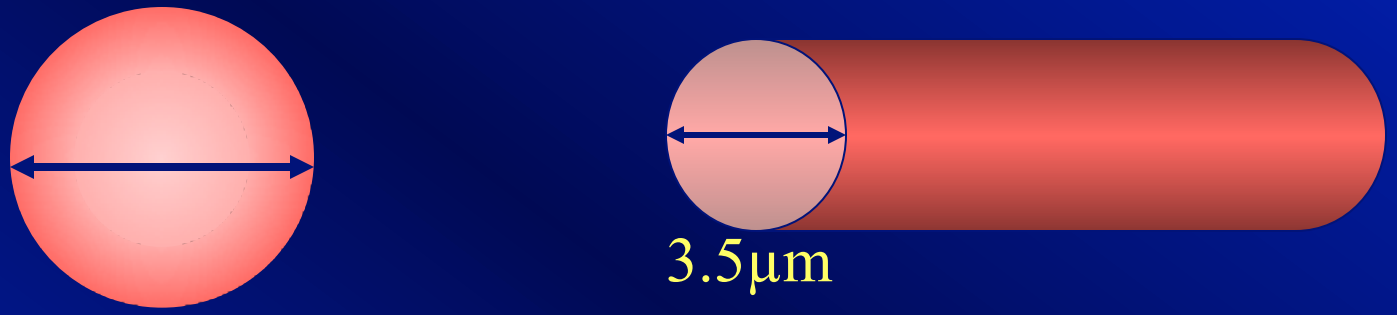
# Erythropoietin

- Glycoprotein synthesized by peritubular cells of kidney and liver
- Production is regulated by tissue oxygen tension - regulated by the hypoxic sensor pathway - a hypoxic response element.



- Hypoxia-inducible factor 1 (HIF-1)

# Red Cells

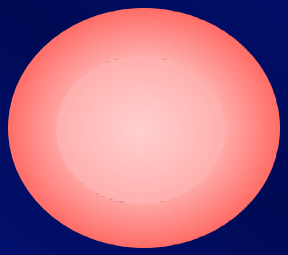



8 µm

* 300 miles in 120 days

* 64 million molecules of haemoglobin

* No nucleus - more pliable



# The Red Cell

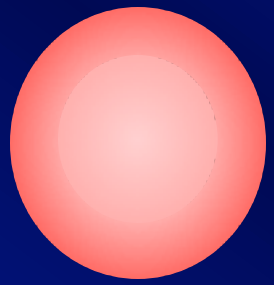
Maintains

- biconcave shape

- osmotic equilibrium despite high [Hb]

- $Fe^{2+}$ state by generating NADH

- adequate ATP by E - M pathway



# The Red Cell

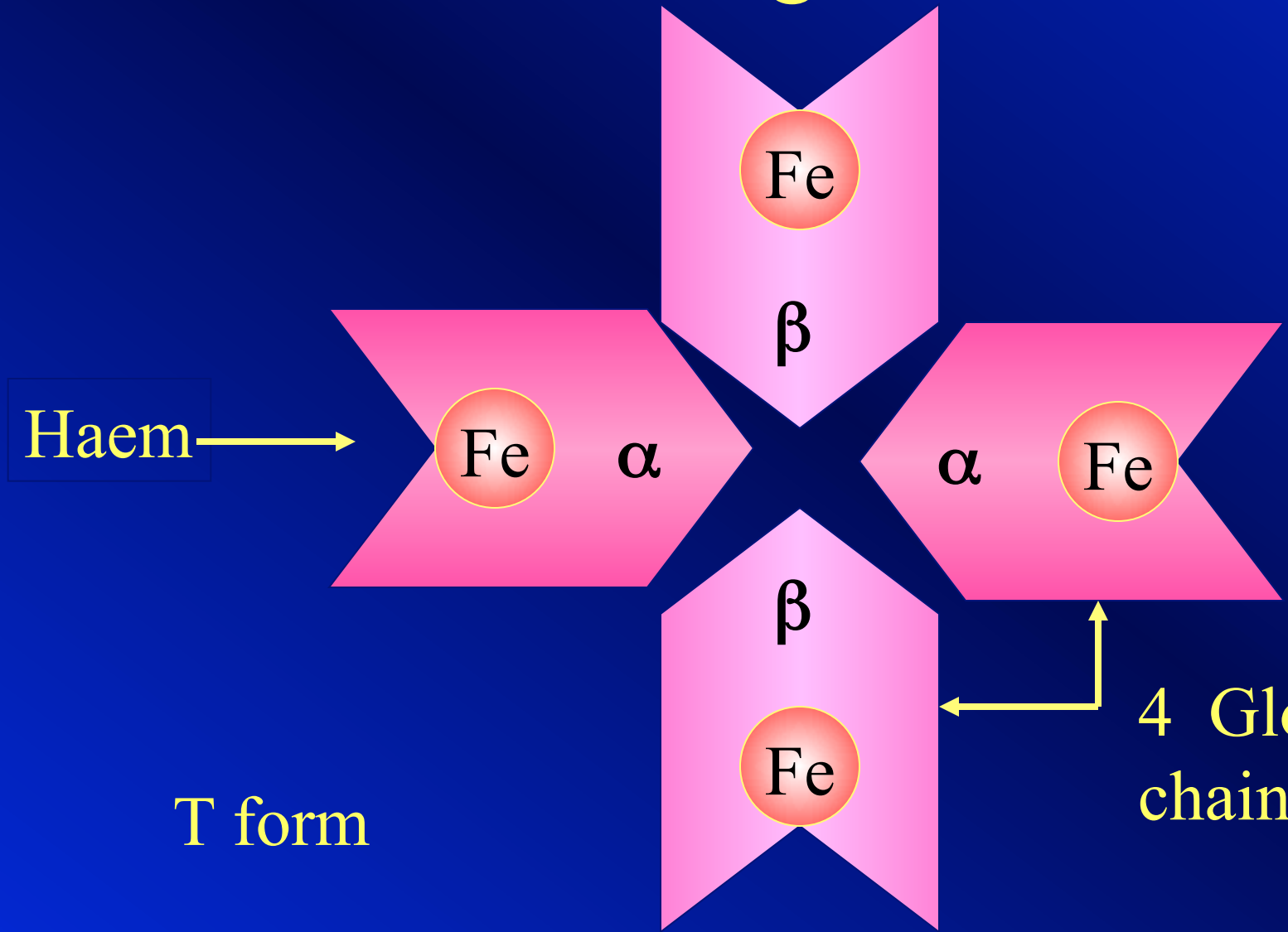
Maintain

- energy against oxidants NADPH from HMP shunt

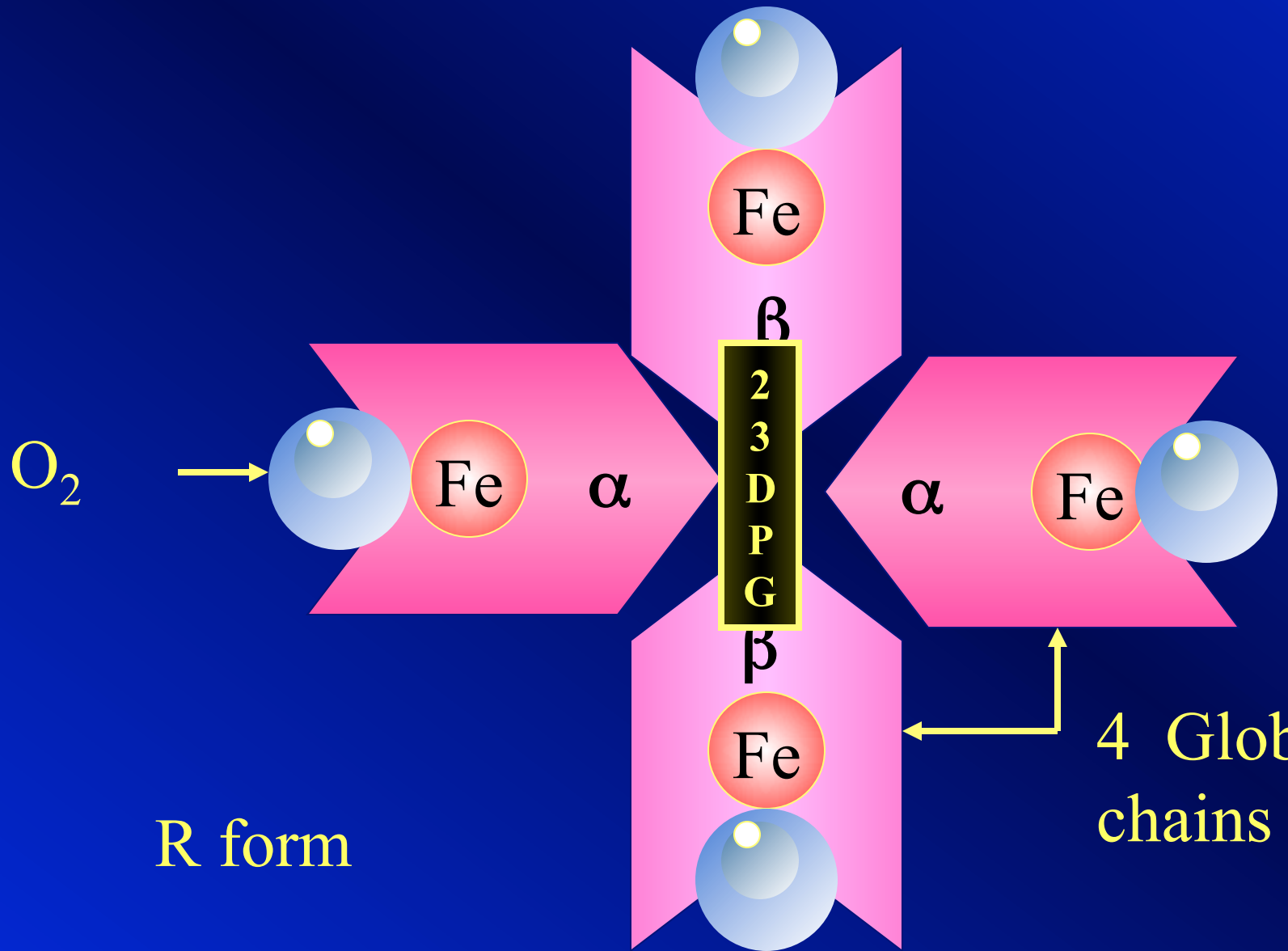
- $O_2$ & $CO_2$ carrying capacity

- $O_2$ releasing ability - 2, 3 DPG
  L - R shunt

# Haemoglobin



# Haemoglobin



# Types of Haemoglobin

- Foetal - HbF $\alpha_2 \gamma_2$ 97%

- Adult - HbA $\alpha_2 \beta_2$

  $HbA_2$ $\alpha_2 \delta_2$

# Anaemia

- What is anaemia ?
- - A reduced Hb value for that age and sex
- < 13.5 g/dl - adult male
- < 11.5 g/dl - adult female
- < 11.0 g/dl - 3 /12 to puberty
- < 15.0 g/dl - in a new born

# Anaemia

- Usually accompanied with
  - reduced RBC count &
  - PCV

- Alteration in plasma volume
  - Hemo dilution - anaemia
  - Hemo concentration - polycythaemia / mask the anaemia

# Anaemia

- Graded according to severity (WHO)
- Mild 9 - 11 g/dl
- Moderate 7.1 – 8.9 g/dl
- Severe < 7 g/dl

# Causes of Anaemia

- Blood loss
- Impaired production
  Malnutrition - Fe, $B_{12}$, Folate deficiency
- Suppressed Erythropoietic activity - CRF, infection, Connective tissue disease, malignancy,
- BM aplasia

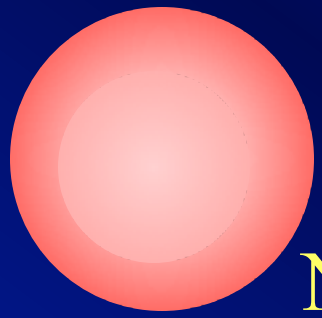
# Causes of Anaemia

- Replacement of BM - Leukaemia, Lymphoma, Myeloma
- Inherited - Thalassaemia
- ↑ Destruction - haemolytic anaemia

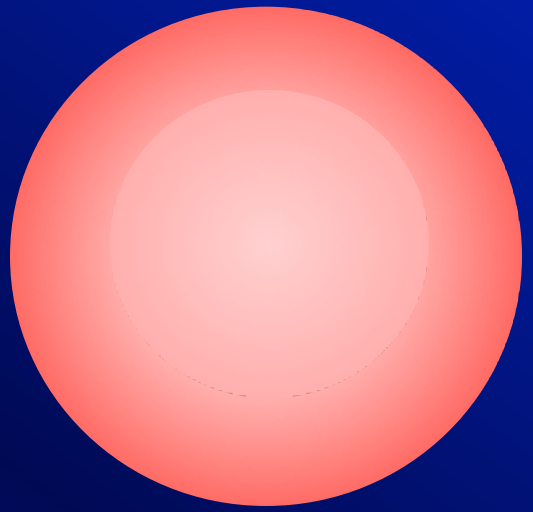
# Clinical Features of Anaemia

- Speed of onset
- Severity
- Age of patient
- Hb - Oxygen dissociation curve

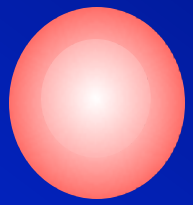
# Classification of Anaemia Morphological



Normocyte
75 - 95 fl



Macrocyte
> 95 fl

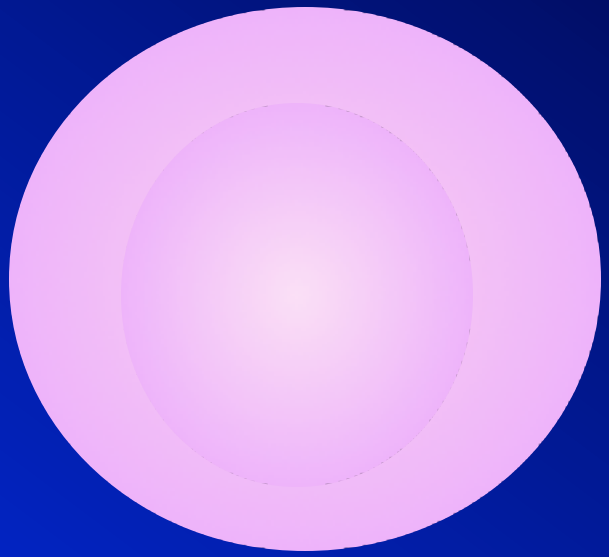


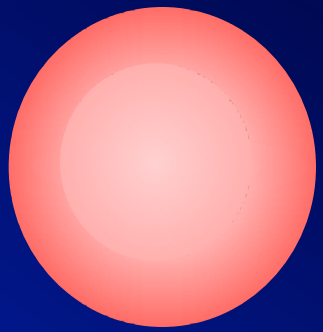
Microcyte
<75 fl

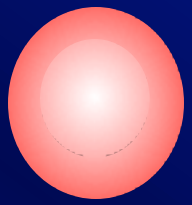
# Anisochromasia

Changes in Red cell colour

Normochromic



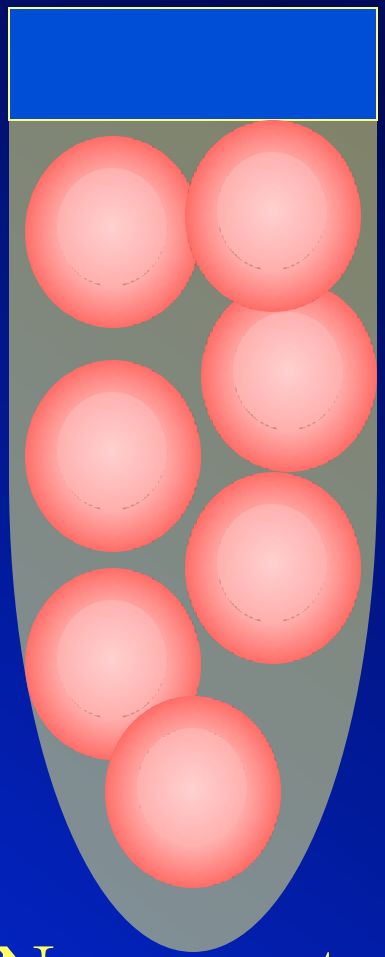




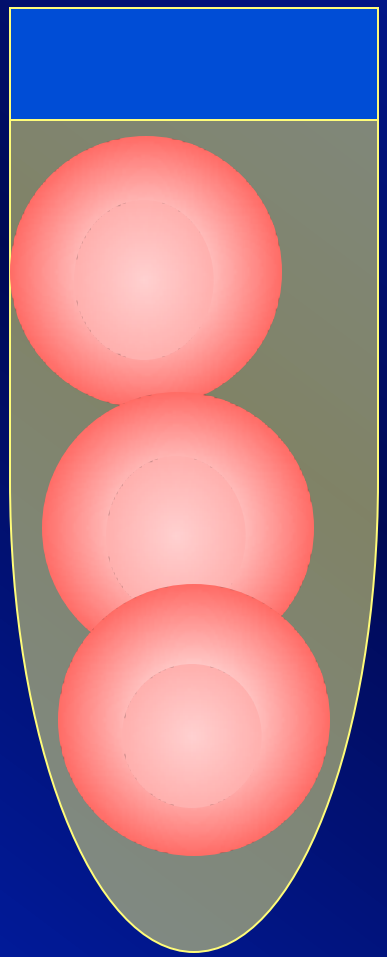
Hypochromic

Polychromatic cell

Eg. - Hb 6 g/dl

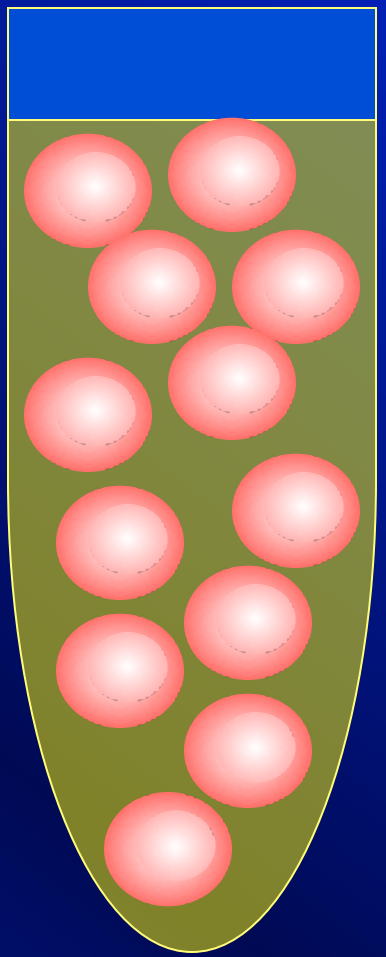


Normocytes



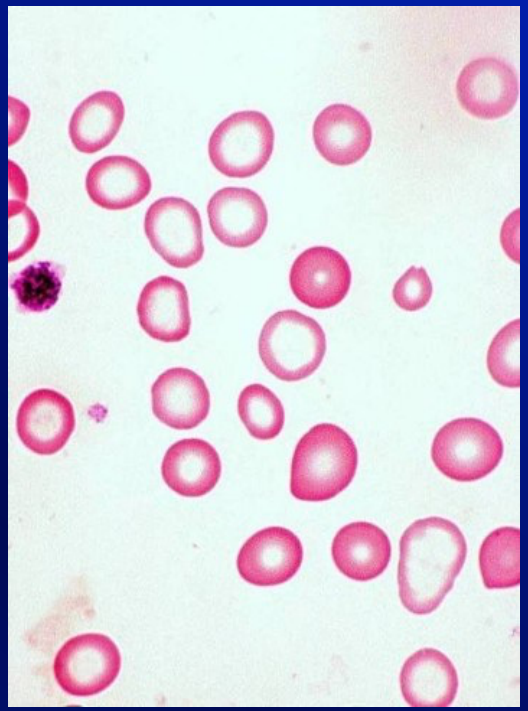
Macrocytes

Microcytes



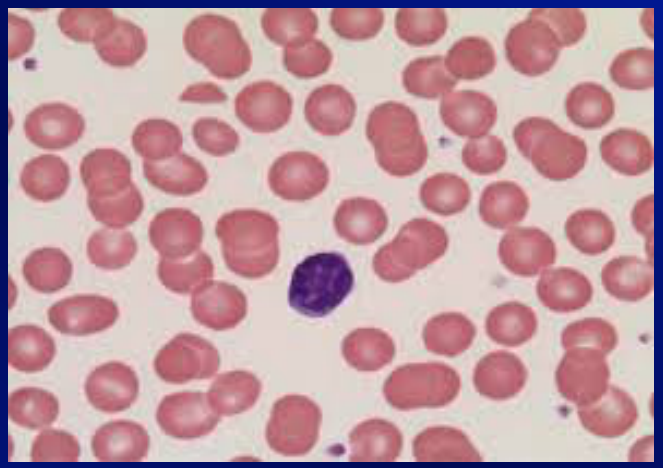
# Hypochromic anaemia

- Fe  deficiency
- Thalassaemia
- Anaemia of chronic disease
- Pb poisoning
- Sideroblastic anaemia



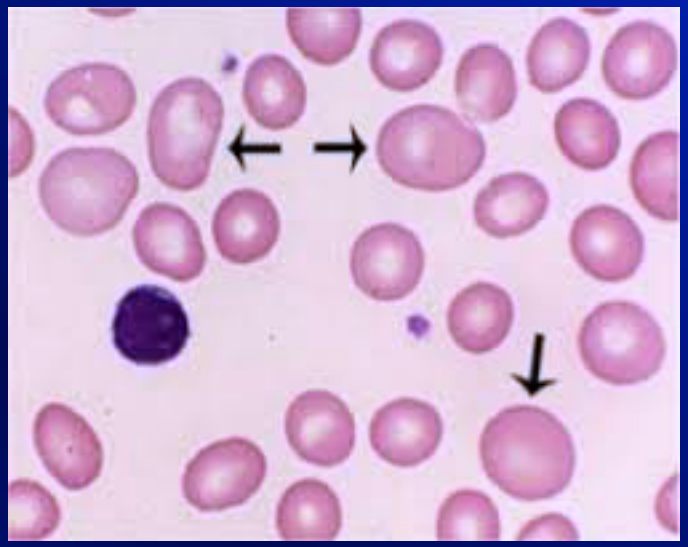
# Normochromic anaemia

- Mixed deficiency
- Bone marrow failure
- Acute haemorrhage



# Macrocytic anaemia

- $B_{12}$ deficiency
- Folate deficiency
- Alcohol abuse
- Liver disease
- Hypothyroidism



Home work

Symptoms & signs of anaemia