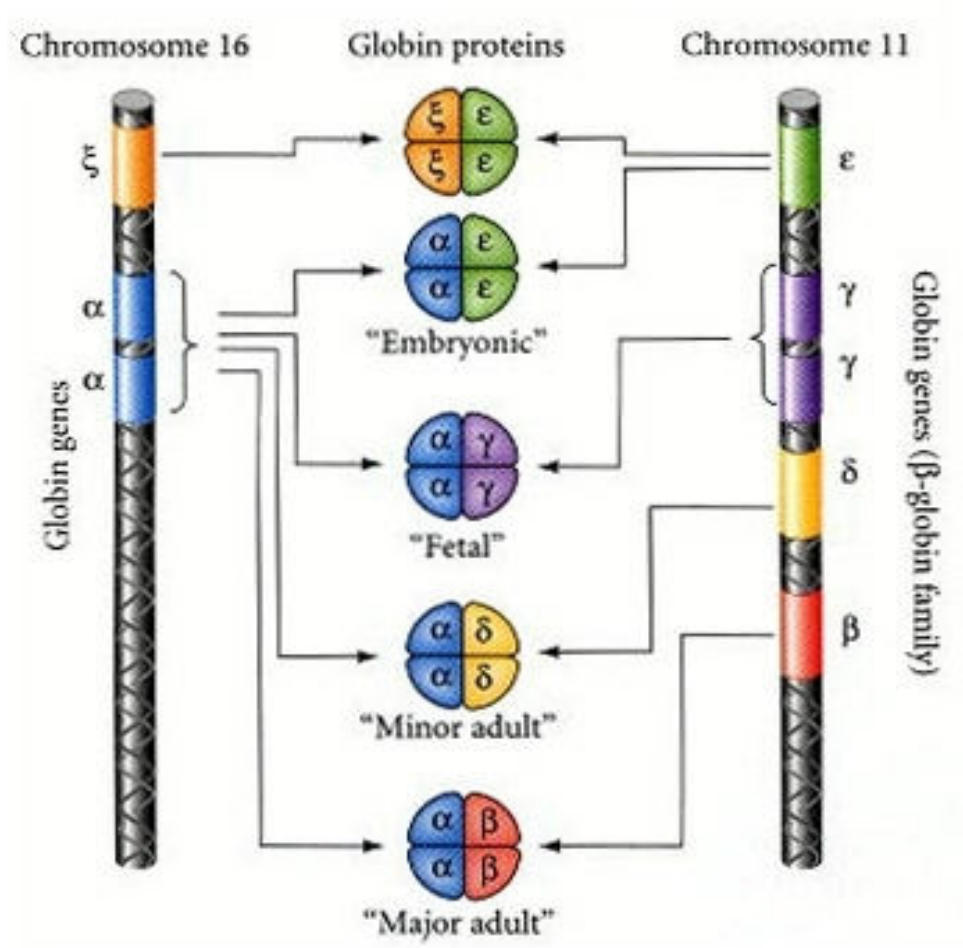
Hemoglobin Variation



Learning Objectives

- Different Hemoglobin variants
- Characteristics of Hemoglobin variants and Hb
- Different Hemoglobin combinations

Hemoglobin Variants

Hemoglobin Variants

- There must be 2 Alpha and 2 non alpha for oxygen carrying function, which differs at different stages of foetal and early neonatal life

- Normal adult hemoglobin (HbA) consists of four polypeptide chains $\alpha_2\beta_2$
- Normally in adult blood, small quantities of two other varieties of hemoglobins i.e. HbA_2 and HbF are found.

Normal Hemoglobin Variants

Type	Embryonic Hb	Fetal Hb	Adult Hb	
	Hbε Gower-1	Hb F	Hb A	Hb A_2
structure	$\zeta_2\varepsilon_2$	$\alpha_2\gamma_2$	$\alpha_2\beta_2$	$\alpha_2\delta_2$
Normal %	Primary Hb in embryonic life ≈ 8 wks	0.5-0.8 %	96-98 %	2.0-3.0 %

Normal Hemoglobin Variants

HbA ($\alpha_2\beta_2$)

96% to 98 %

This is basic form of Hb which is important in transport of gases O_2 and CO_2.

HbA_2 ($\alpha_2\delta_2$)

After 6 months to 1 year = 02% to 03 %

Normal Hemoglobin Variants

Fetal hemoglobin ($\alpha_2\gamma_2$)

α - 141 amino acids

Lifespan of RBC containing HBF is decreased to **80 days** only

Embryonic Hb

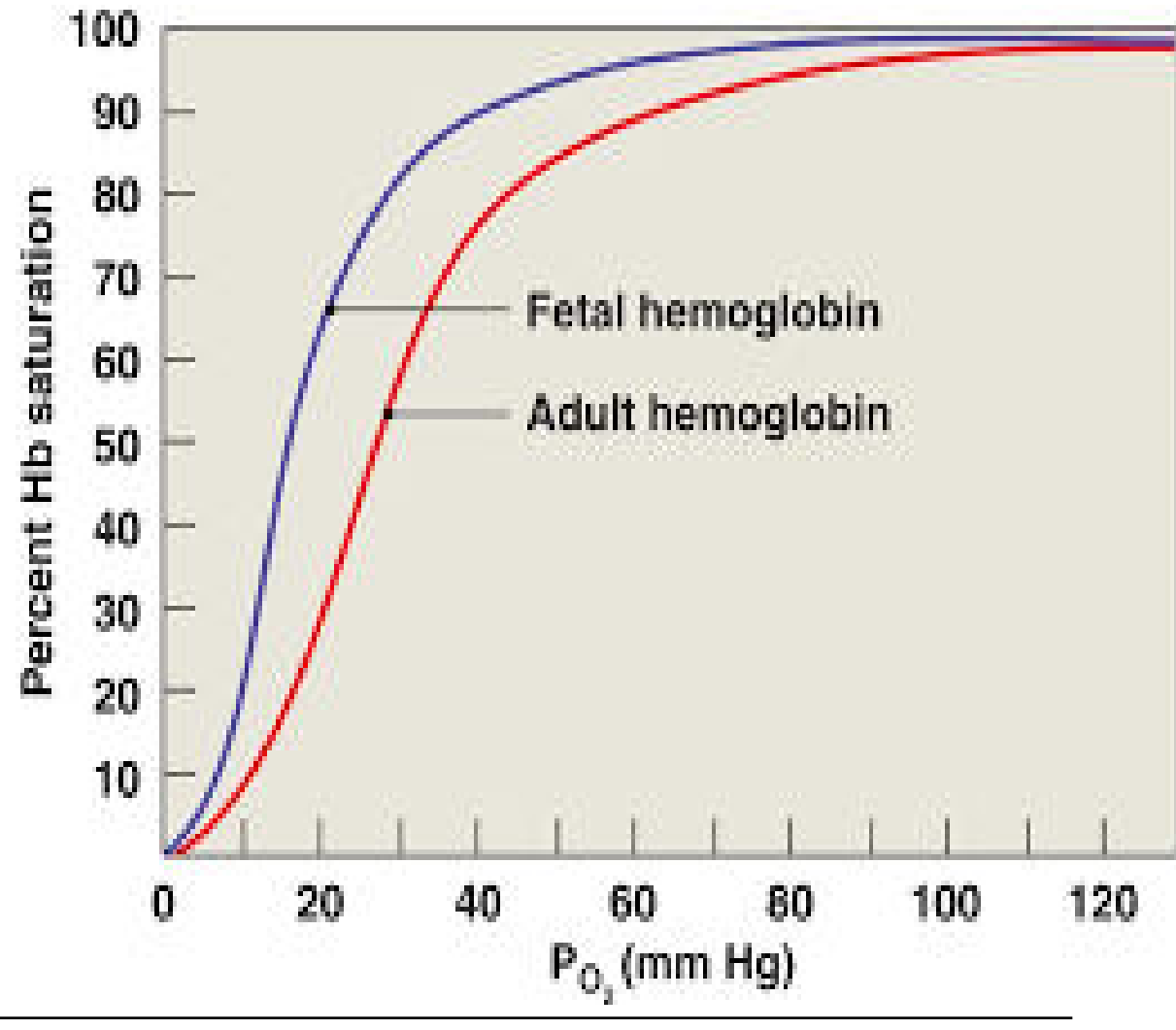
Hbε Gower-1 ($\zeta_2\varepsilon_2$) Primary Hb in embryonic life ≈ 8 wks

Portland-1 ($\zeta_2\gamma_2$) is the ζ-substituted counterpart of fetal HbF ($\alpha_2\gamma_2$) (By 12 weeks of gestation, embryonic Hb changes into HbF.

Hb Portland-2 ($\zeta_2\beta_2$) since it occurs only in cases of an extreme type of α-thalassemia.

Importance of Fetal hemoglobin ($\alpha_2\gamma_2$) in fetal life

- HbF can take up large volume of oxygen at lower PO_2.



Abnormal hemoglobin Variants - Hemoglobinopathies

GLOBIN CHAINS

The genes for the synthesis of globin are present on chromosome 16 (α) and chromosome 11 (β).

This determines the different variants of hemoglobin (Normal and abnormal) present at different ages.

Globin genes and hemoglobin molecules

Sickle Cell Disease (HbS)

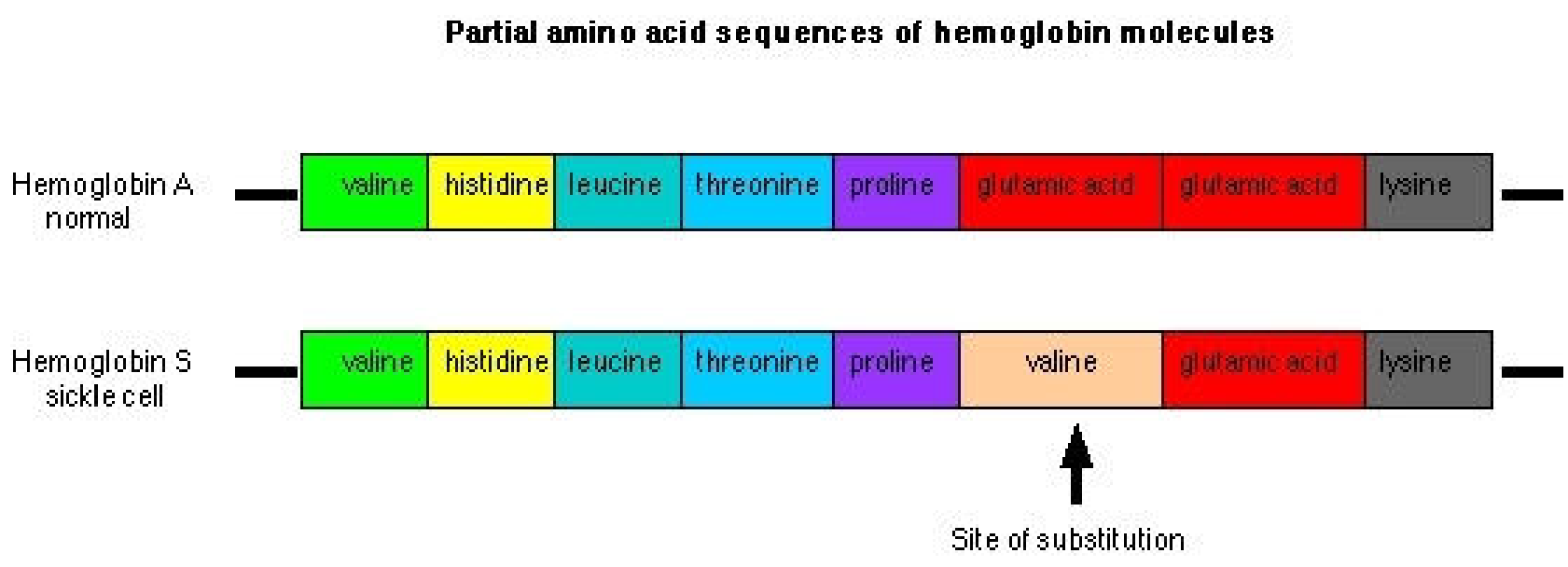
- First molecular disease to be recognized.
- α chains are normal and basic abnormality is in beta chain due to a point mutation.

- SICKLE CELL DISEASE
Homozygous -HBSS

- SICKLE CELL TRAIT
Heterozygous - HbAS

Sickle Cell Disease

- Most common Hb variant



Sickle Cell Disease

Hb S molecules are only 20% as soluble as Hb A in deoxygenated blood,

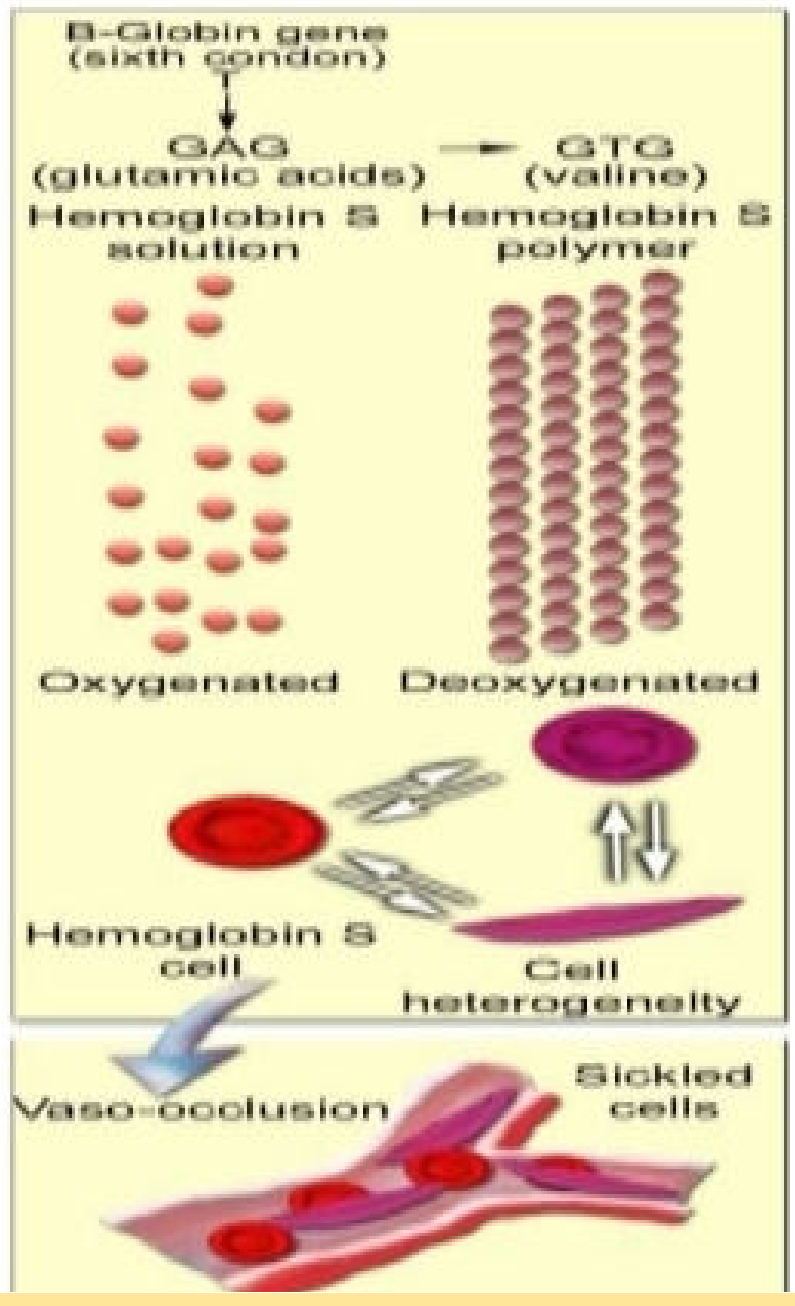
↓

low oxygen tension, Hb S molecules polymerize

↓

causing sickle shaped RBCs

↓



Self Assessment

Jaundice is also called as ----------**when serum** bilirubin is above ----------

The baby at birth has ---------- and excessive RBCs destruction

80% of ---------- is excreted in feces as ----------, which gives brown color of stool and 20% through enterohepatic circulation is excreted in urine as ----------, which gives yellow color of urine

Pre-hepatic Jaundice is caused by an increased rate of ----------

Physiological Jaundice in newborns occurs due to ----------

Hepatic cause of **physiological jaundice in newborns** ----------

Kernicterus may occur in new born because ----------and when ----------

Thank you