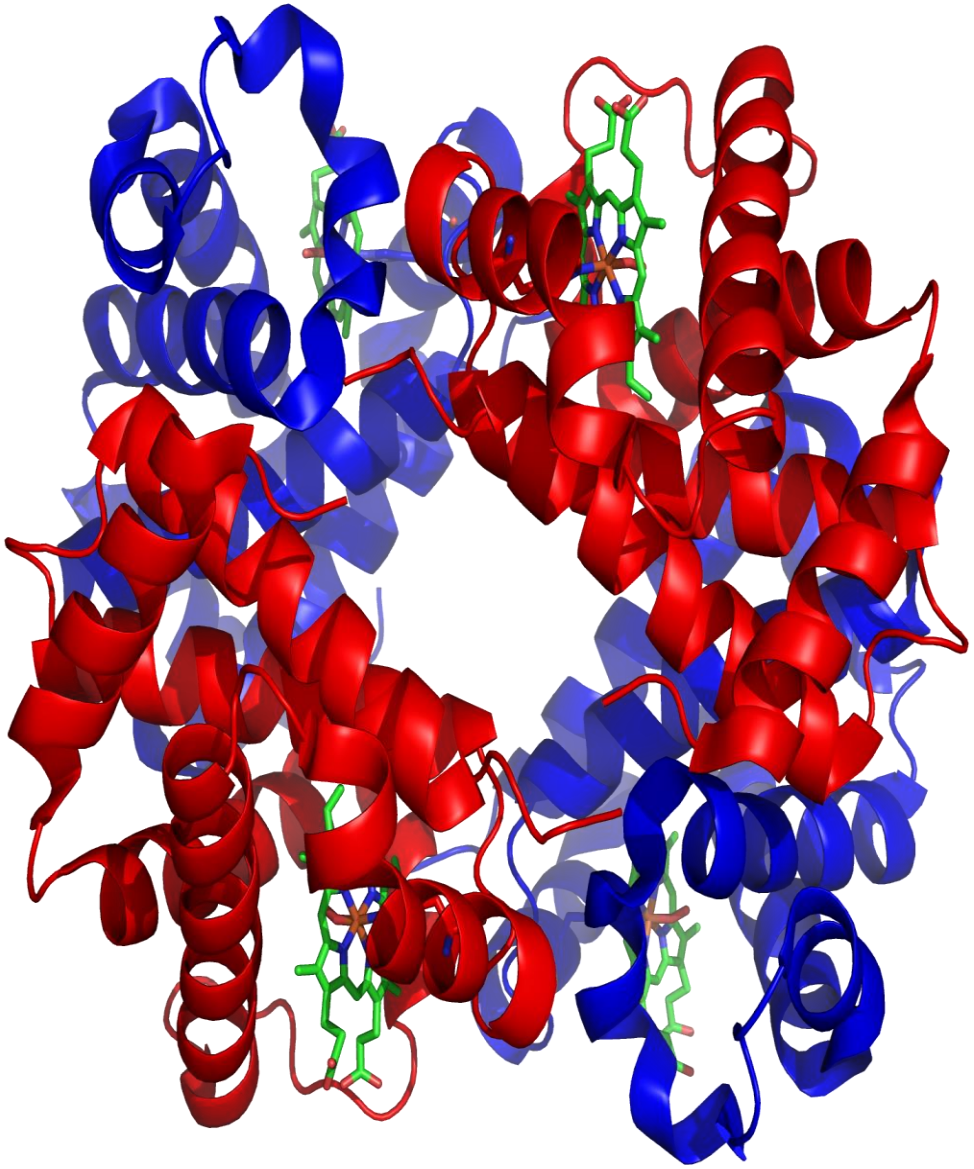
Hemoglobin

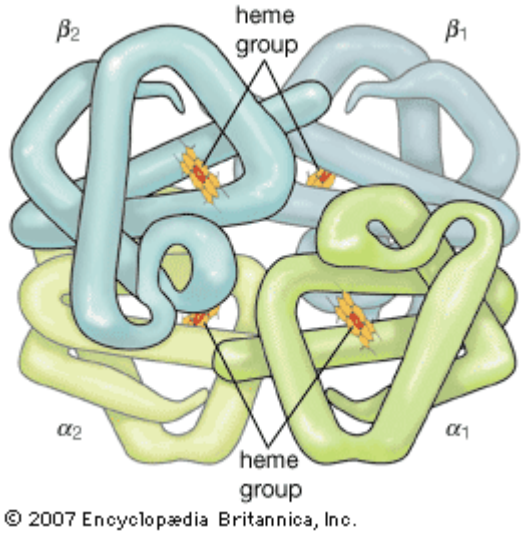


2nd stage

Lec 4

Dr. Rusul H. Hamza

- **Hemoglobin** is a protein (Heme protein)
- Hb is considered of globular proteins.
- Mature RBCs do NOT synthesis Hb, while immature RBCs synthesis Hb.
- Mitochondria is very important for Heme synthesis
- Hemoglobin = Heme + globin (protein)
- Heme = Protoporphyrin + Iron

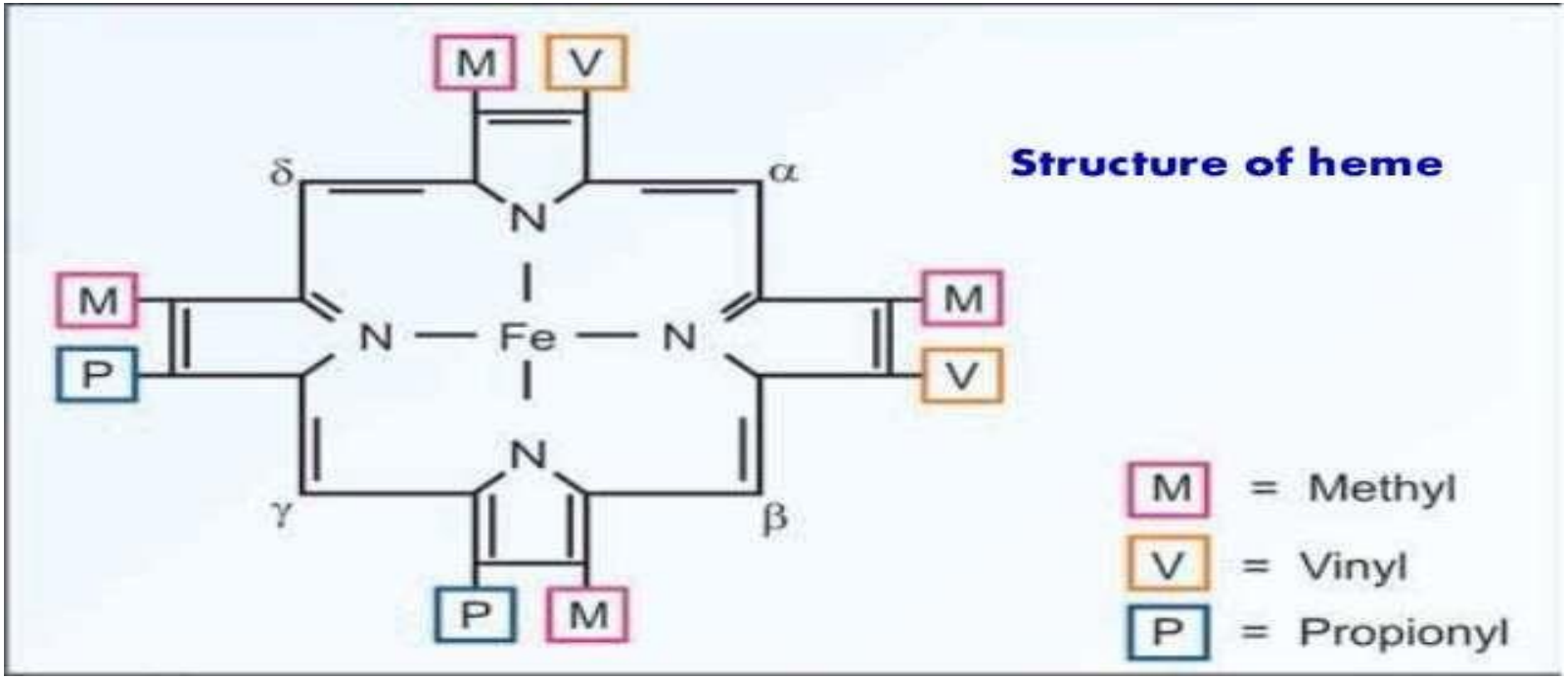


Functions of hemoglobin

- Imparts red color to the blood.
- Helps to carry out the oxygen and other gases assisting the respiratory system.
- It buffers the blood pH and maintains it to the tolerable limits.
- Source of physiological active catabolites.
- Genetic resistance to malaria, etc.

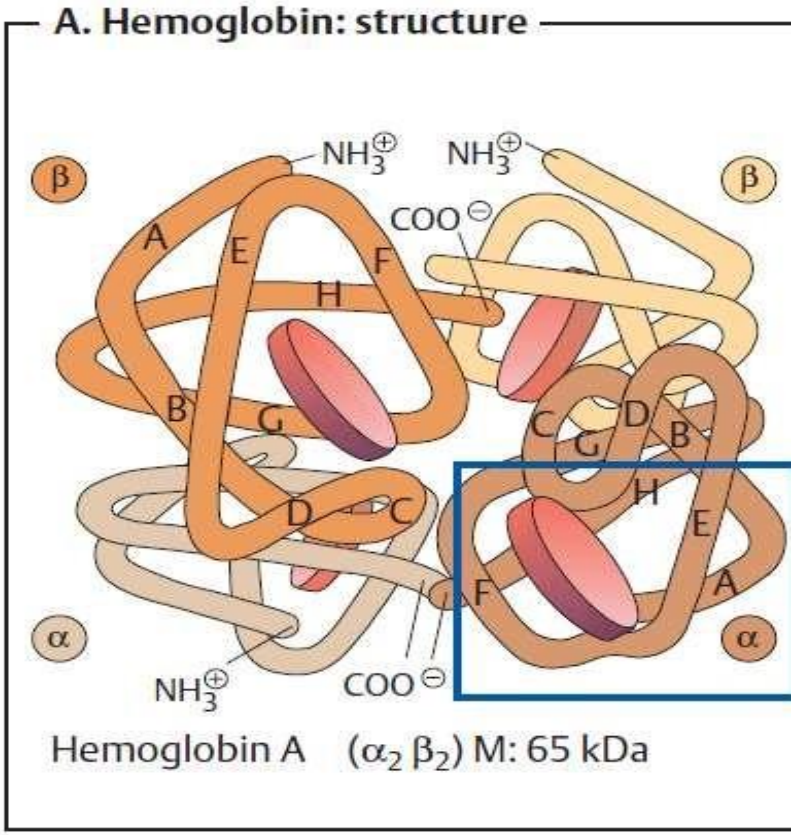
Heme

- Heme = Protoporphyrin + Iron
- Protoporphyrin consist of 4 pyrrol rings.



Each **hemoglobin** molecule (Globular protein) consists of

1. 4 Heme
2. 4 linear proteins



Heme synthesis

1) Heme synthesis start with 2 simple molecules

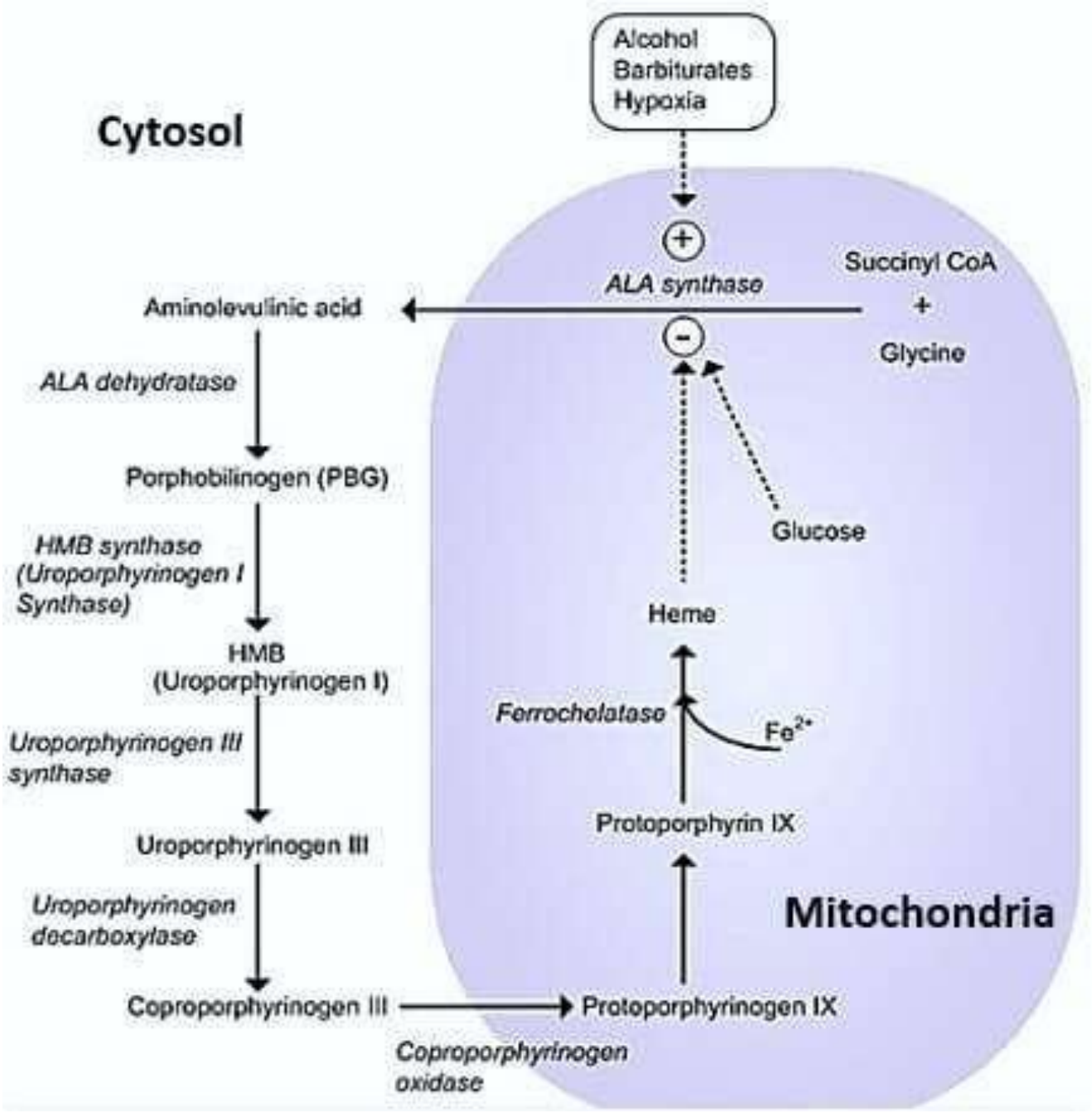
a. Glycine (amino acid)

b. Succinyl Co-A (intermediate of citric acid cycle)

2) Reaction of these 2 simple molecule together with a Vitamin B6 will produce aminolevulinic acid by enzyme aminolevulinic acid synthase (ALA Synthase)

- This step also called (regulatory step)

3. Then some steps will happened in the cytoplasm.
4. Then this molecule will return to mitochondria, when a protoporphyrin formed.
5. Protoporphyrin will bind to Iron (ferrous)
6. At same time, globulin is being synthesized in Rough endoplasmic reticulum (**RER**)
7. **Protoporphyrin + ferrous + globulin** will form **Hemoglobin.**


Alcohol
Barbiturates
Hypoxia
Cytosol
ALA synthase
Succinyl CoA
+
Glycine
Aminolevulinic acid
ALA dehydratase
Porphobilinogen (PBG)
HMB synthase
(Uroporphyrinogen I
Synthase)
HMB
(Uroporphyrinogen I)
Uroporphyrinogen III
synthase
Uroporphyrinogen III
Uroporphyrinogen
decarboxylase
Coproporphyrinogen III
Glucose
Heme
Ferrocholatase
Fe2+
Protoporphyrin IX
Mitochondria
Protoporphyrinogen IX
Coproporphyrinogen
oxidase

Types of Hb:

Hb A or HbA1 (Adult Hb): is the normal Hb in adults represents about 97% of total Hb. it is composed of 2 α and 2 β chains.

HbA2: minor adult Hb, comprised 3% of normal adult Hb. Composed of 2 α and 2 δ chains

HbF(fetal Hb): is the main Hb during fetal life and in newborns then disappear gradually where it is replaced by Hb A shortly after birth.
It is composed of 2α and 2 γ chains.
Hb F has greater affinity for O_2 than HbA so ensure O_2 transfer from maternal circulation to fetus RBCs through placenta.

Note: The overall hemoglobin composition in a normal adult is approximately 97.5% HbA_1, 2% HbA_2 and 0.5% HbF.