General Physiology

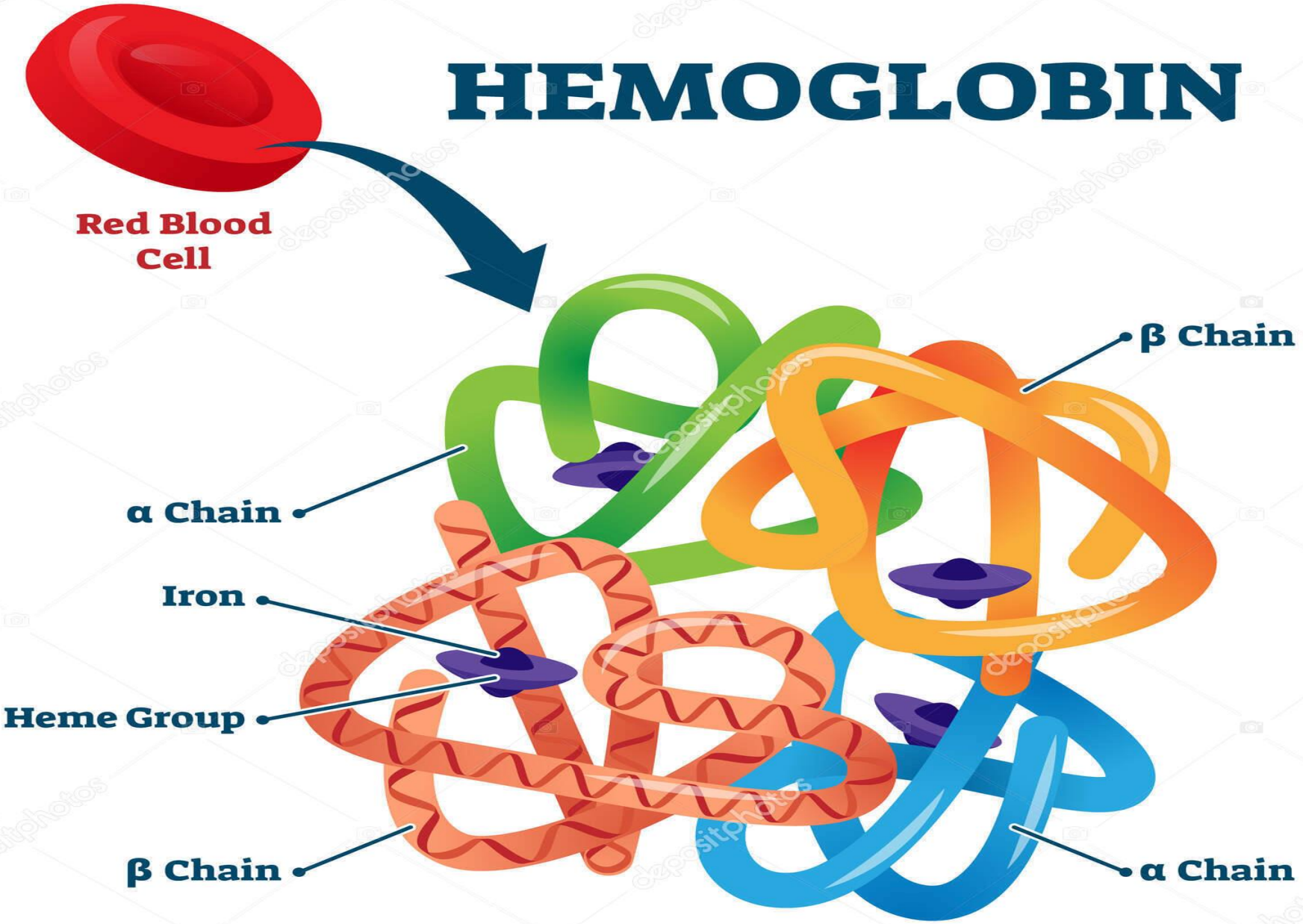
Hemoglobin

Hemoglobin

- Hb is a pigment in R.B.C.
- The normal value of Hb is 14-16 gm/dl blood, every 1 gm of Hb can combine with 1.39 ml O2 .
- Synthesis of Hb begins in the erythroblasts and continues through the normoblast and reticulocyte stage.
- Heme portion of Hb is synthesized mainly from acetic acid and glycine and that most of this synthesis occur in mitochondria.

- Each erythrocyte contains about 280 million molecules of Hb.
- Hemoglobin consists of four protein chain called globins, two of these, the alpha chain (α), are 141 amino acids long, and other two, the beta (β) chains are 146 amino acids long.
- Each chain is conjugated with a nonprotein moiety called the heme group.
- Each heme can carry one molecule of O2, the Hb molecule as a whole can transport up to 4 O2 .
- About 20% of carbon dioxide in the bloodstream is also transported by Hb.

HEMOGLOBIN

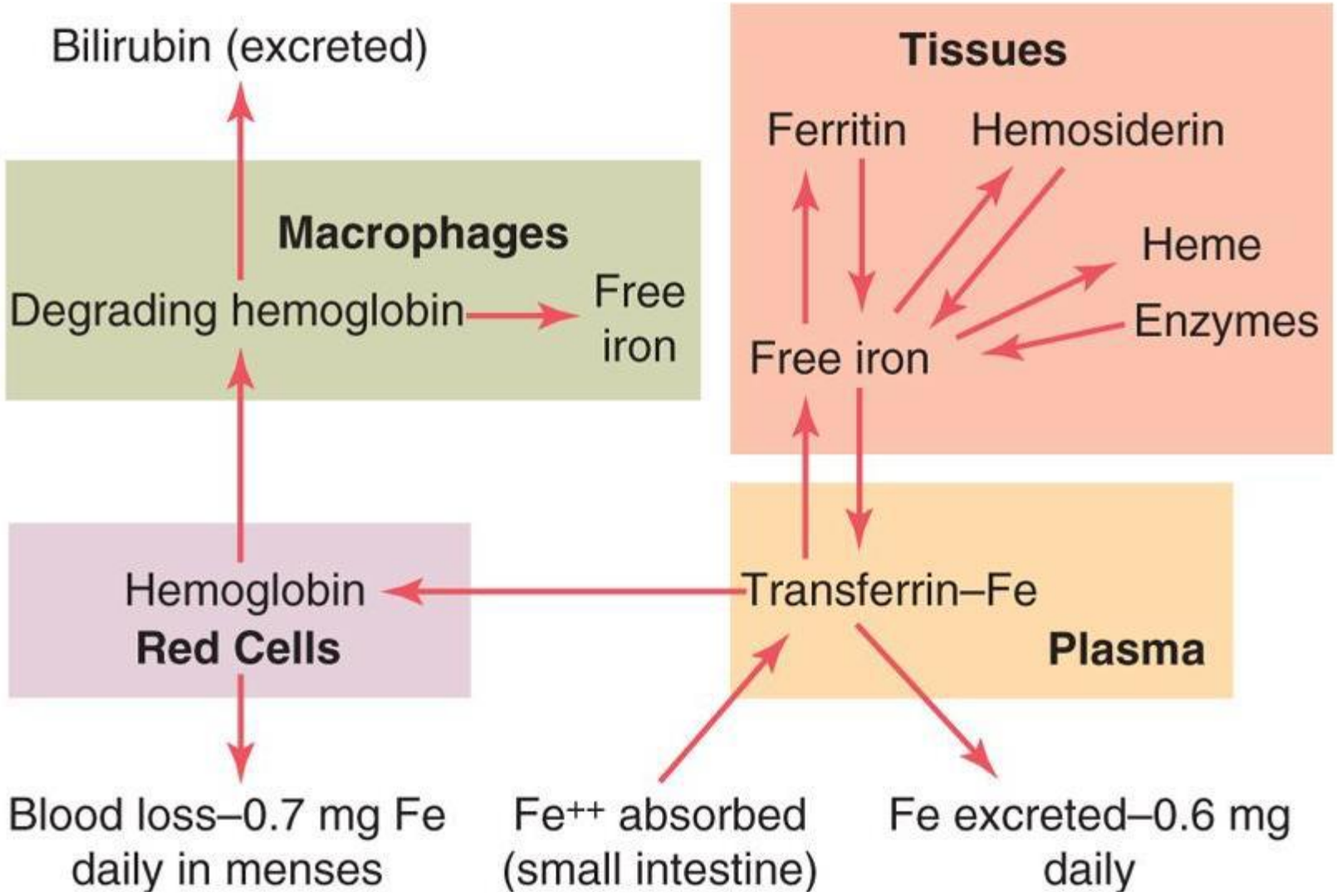


- Hemoglobin exists in several forms that display slight differences in the globin chains, the form adult Hb (HbA).
- About 2.5% of (HbA), however, is of a form called HbA2, which has a two delta (δ) chains in place of the β chains.
- The fetus produces a form called fetal Hb or (HbF), which has two Gamma (γ) chains in the place of the adult β chains.
- The delta (δ) and gamma (γ) chains are the same length as the (β) chains, but differs in amino acid sequence.
- HbF has a higher oxygen-binding capacity than adult HbA and enables the fetus to extract oxygen from the mother's bloodstream.
- HbF is converted into HbA, but in some cases is not converted.

Iron Metabolism

- The total quantity of iron in the body average 4-5 grams, about 65% of which is in the form of Hb.
- About 4% is in the form of myoglobin, 1% is in the form of the various heme compounds, 0.1% is combined with the protein transferrin in the blood plasma, and 15-30% is stored mainly in the reticuloendothelial system and liver parenchymal cells, principally in the form of ferritin.
- A man excretes about 1 mg of iron each day, mainly into the feces
- When iron is absorbed from the small intestine, it immediately combines in the blood plasma with beta globulin, apotransferria to form transferrin, which is then transported in the plasma.

- The iron is loosely combined with the globulin molecule and consequently, can be released to any of tissue cells at any point in the body.
- Excess iron in the blood is deposited in all cells of the body, but especially in liver hepatocytes.
- In the cell cytoplasm, it combines mainly with a protein, apoferritin to form ferritin. The iron stored as ferritin is called ***storage iron***.
- Smaller quantities of the iron in the storage pool are stored, insoluble form called ***hemosiderin***.
- When the quantity of iron in plasma falls very low, iron is removed from ferritin quite easily, but much less easily from hemosiderin.
- When red blood cells have lived their life span and are destroyed, the Hb released from the cells is ingested by the cells of the monocytes-macrophage system. Free iron is liberated, and it is mainly stored in the ferritin pool or formation of new Hb.


Bilirubin (excreted)
Tissues
Ferritin
Hemosiderin
Heme
Enzymes
Free iron
Macrophages
Degrading hemoglobin
Free iron
Hemoglobin
Red Cells
Transferrin–Fe
Plasma
Blood loss–0.7 mg Fe daily in menses
Fe++ absorbed (small intestine)
Fe excreted–0.6 mg daily

Hb Compounds

- There are different compounds of Hb:
- 1. ***Oxyhemoglobin:*** this results from combination of O2 with Hb.
- 2. ***Carboxy Hb:*** this results from union of Co gas with Hb, Co gas is a very poisonous gas even if it is present in very small amount it displaces O2 in OxyHb so that carboxy Hb is produced, this is because of Co gas is about 250 times greater affinity to Hb than O2 .
- 3. ***Sulfa Hb:*** this compound results from the combination of Hb with sulpher compounds.
- 4. ***Carbamino Hb:*** this results from the combination of CO2 gas with Hb.
- 5. ***Methemoglobin:*** if Hb subjected to O2 in the presence of an oxidizing agent, oxidation occurs and a new compound is produced is called Meth Hb.

Destruction of Hb

- The Hb released from the cells when they burst is phagocytosed almost immediately by macrophages in many parts of the body, but especially in liver (Kupffer cells), spleen and bone marrow. During the next few hours to days, the macrophage release the iron from the Hb back into the blood to be carried by transferrin either to bone marrow for production of new R.B.C. or to the liver and other tissues for storage in the form of ferritin.
- The porphyrin portion of the Hb molecule is converted by the macrophages, through a series of stages, into bile pigment bilirubin, which released into the blood and later secreted by the liver into the bile. A high level of bilirubin in the blood causes Jaundice***, a yellowish cast in light-colored skin and the whites of eyes***.


thank
you