

Four levels of protein structure

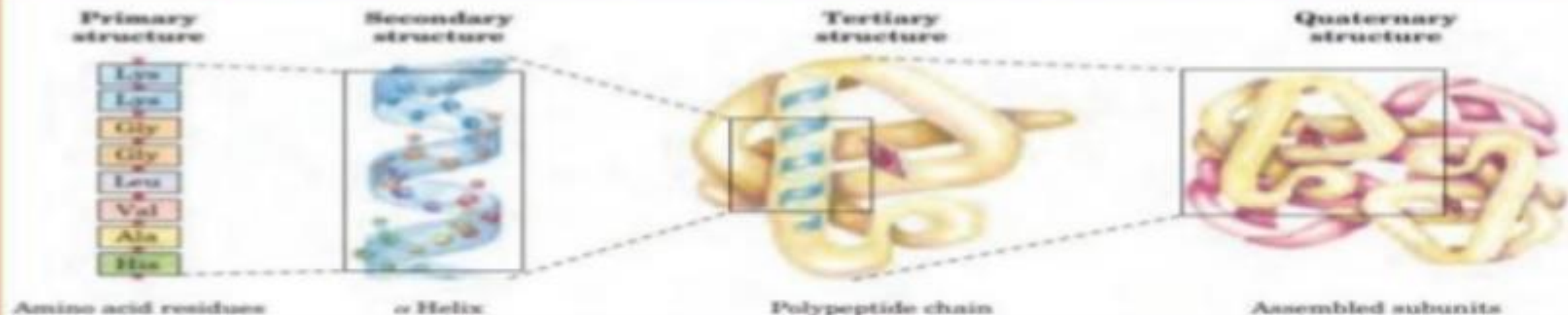
Structure of proteins

- ❖ **Proteins are** polymers of amino acids and made up of one or more polypeptide chains .
- ❖ Every protein in its native state has a unique three dimensional structure which is referred to as its **conformation**.
- ❖ The number and sequence of these amino acids in the protein are different in different proteins.
- ❖ The function of a protein arises from its conformation.
- ❖ Protein structure can be classified into four levels of organization.

Four levels of protein structure

FOUR ORDERS OF PROTEIN STRUCTURE

Proteins: polypeptide with more than 50 amino acid residues



www.facebook.com/roshanurafal

Proteins are the polymers of L- α -amino acids. The structure of proteins is rather complex which can be divided into four levels of organization.

Four levels of structural organization of proteins

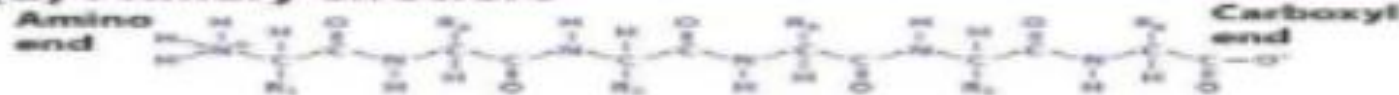
❖ **Proteins are** polymers of amino acids and made up of one or more polypeptide chains .

❖ Four levels of structural organization can be recognized in proteins:

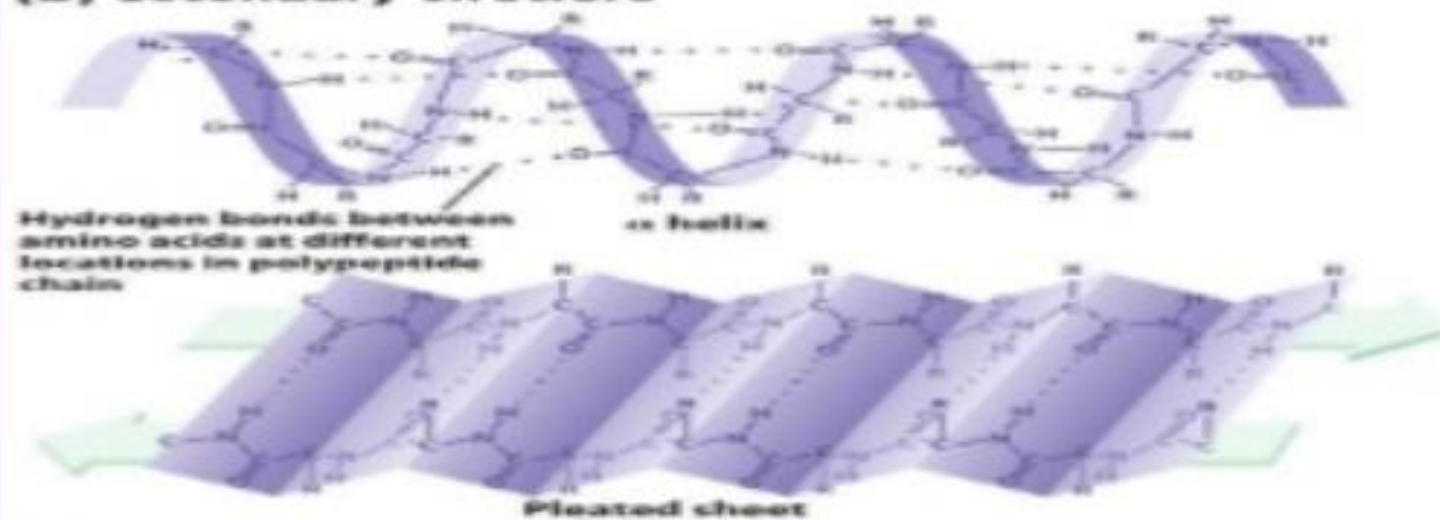
1. **Primary structure:** is determined by the number and sequence of amino acids in the protein.
2. **Secondary Structures:** is the conformation of polypeptide chain formed by twisting or folding . It occurs when amino acids are linked by hydrogen bonds to form α -helix and β -sheets .
3. **Tertiary Structure :** is the three dimensional arrangement of protein structure. It is formed when alpha-helices and beta-sheets are held together by weak interactions.
4. **Quaternary structure:** occurs in protein(oligomers) consisting of more than one polypeptide chain where certain polypeptides aggregate to form one functional protein.

Four orders of protein Structure

(a) Primary structure



(b) Secondary structure



(c) Tertiary structure



(d) Quaternary structure



← **Primary structure** is determined by the sequence of amino acids.

← **Secondary Structures:** the number and sequence of amino acids in the protein. It occurs when amino acids are linked by hydrogen bonds to form α -helix and β -sheets.

↑ **Tertiary Structure** : is the three-dimensional arrangement of protein structure.

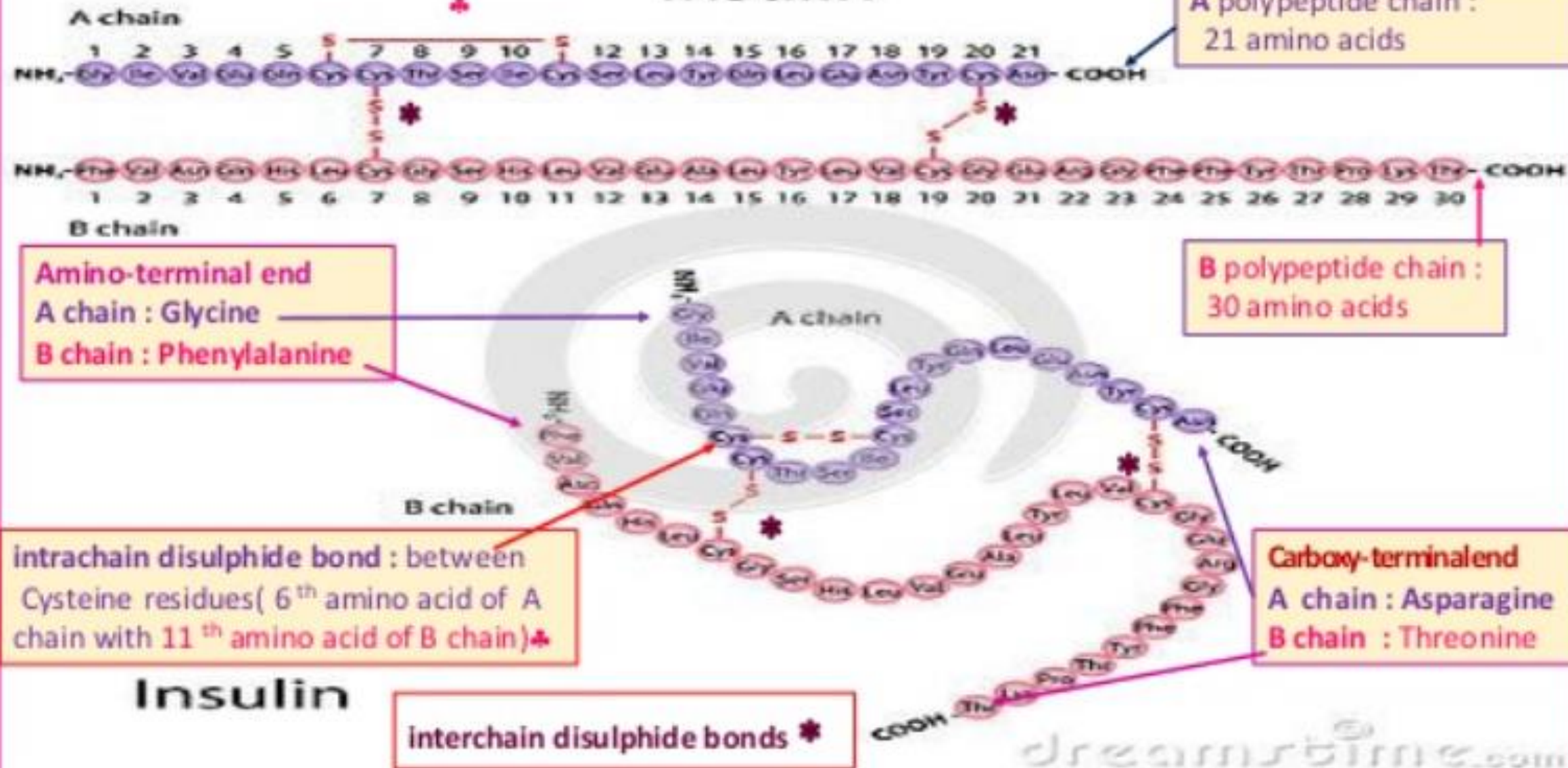
↑ **Quaternary structure:** occurs in protein (oligomers) consisting of more than one polypeptide chain where certain polypeptides aggregate to form one functional protein.

Structural hierarchy of proteins

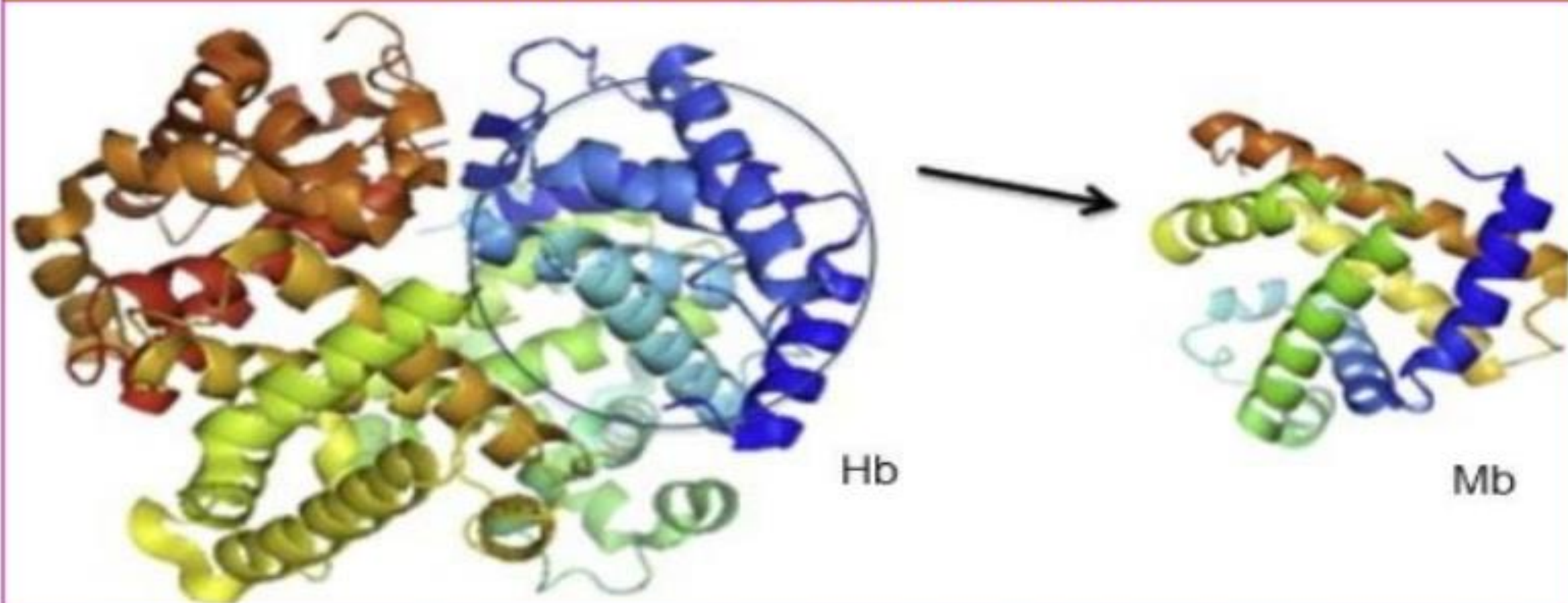
- **Primary structure** : is a linear sequence of amino acids forming a backbone of proteins .It refers to the order in which amino acids are linked together in the peptide chain. e.g. **Glutathione: Tripeptide** : Glutamic acid-Cysteine-Glycine
Methionine Enkephalins : pentapeptide: **Try- Gly- Gly- Phe -Met**
- (N-terminal end) \rightarrow H_2N —●—●—●— COOH \leftarrow (C-terminal end)
- Peptide bond \rightarrow linear , planner ,rigid ,partial double bond character
- ❖ **Secondary Structures** :spatial arrangement of proteins by twisting of polypeptide chain= folding patterns in proteins (alpha-helix ,beta-sheet)
- ❖ **Tertiary Structure** : Three dimensional structure generated by interaction between the amino acid residues of functional proteins.
- ❖ **Quaternary structure** : refers to the spatial arrangement of subunits of proteins which are joined by non-covalent interactions . This is seen in proteins with two or more polypeptides chains(oligomers).
- ❖ **Super secondary Structures** :indicate folding patterns in proteins

Primary and Secondary structure of Human Insulin

Insulin



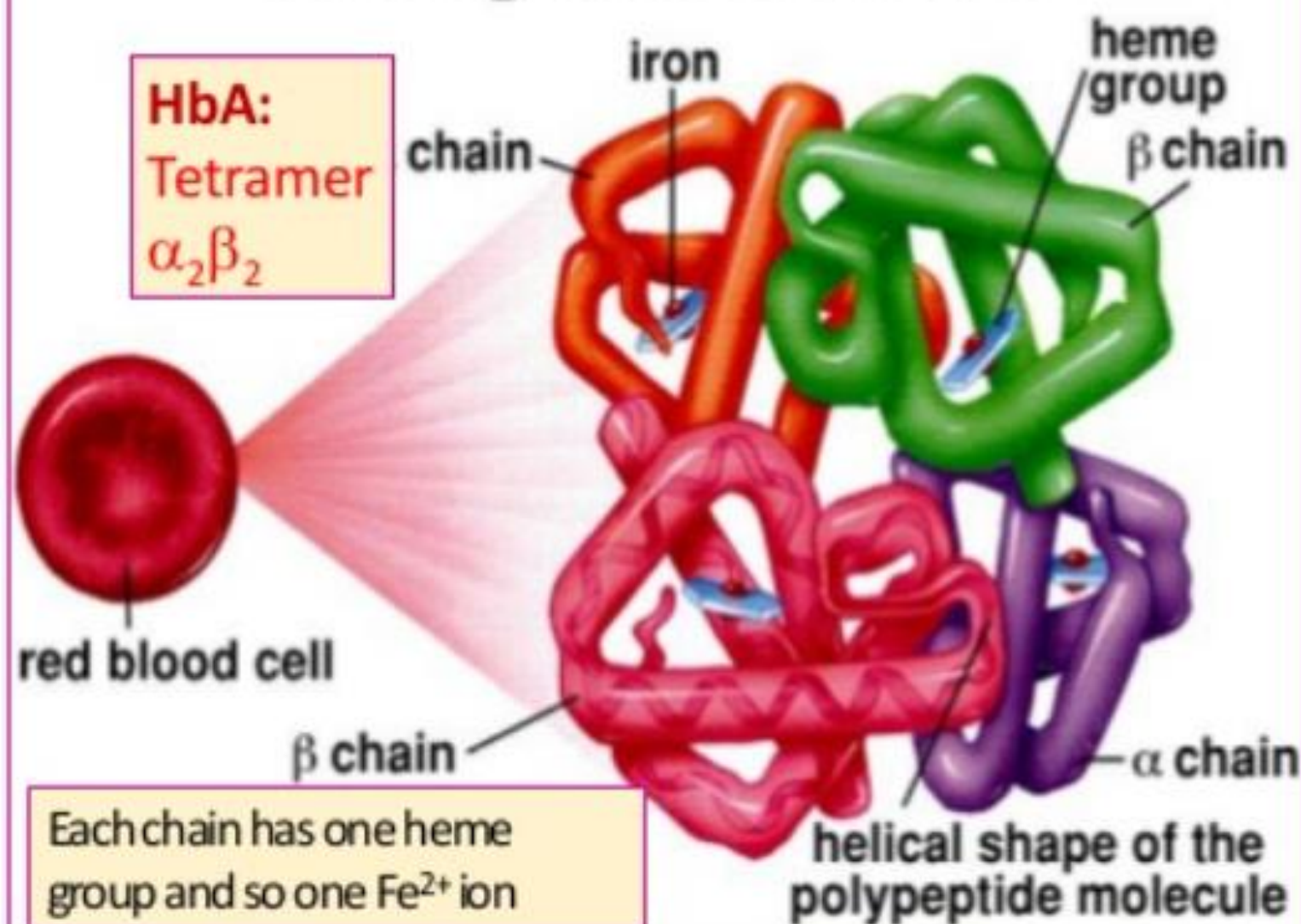
Tertiary Structure of Hemoglobin (Hb)



Hemoglobin : Tetrameric with 4 heme groups. Each polypeptide chain has similar structure to single polypeptide chain of **Myoglobin** . It has a lower affinity for oxygen than Myoglobin. Four subunits of Hb function cooperatively . Tetrameric structure of hemoglobin facilitates saturation with O_2 in the lung and release of oxygen as it travels through the capillary bed.

Quaternary structure of Hemoglobin

Hemoglobin Molecule



Hemoglobin (HbA1) has 4 Polypeptides chains (tetramer) associated by non-covalent bonds :

2 Alpha(α) chains

+

2 Beta(β) chains

It possesses Quaternary structure(oligomeric).

In this , R group contacts are present between similar side chains and there is very little contact between dissimilar side chains.

Four levels of structural organization of proteins

reversible ligand binding of oxygen

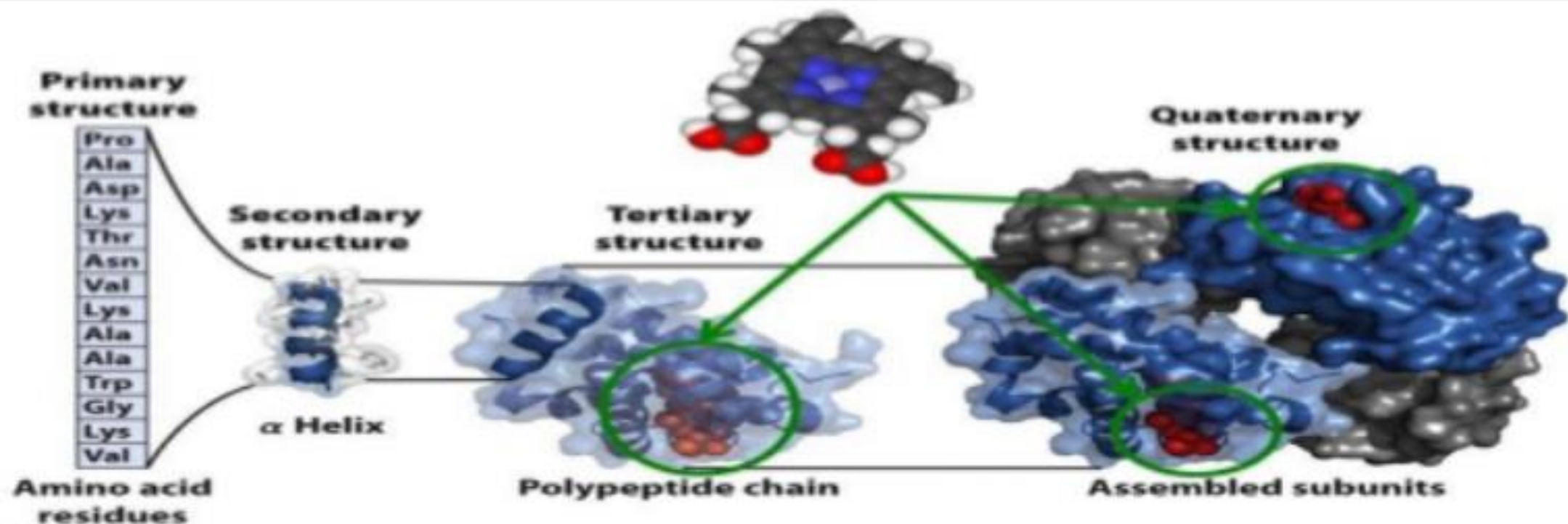


Figure 3-23
Lehninger Principles of Biochemistry, Fifth Edition
© 2008 W. H. Freeman and Company

The overall conformation of a protein, the particular position of the amino acid chains in three dimensional space determines the function/s of the protein.