# TYPES OF STRUCTURE OF POLYPEPTIDE CHAIN

**SUBMITTED BY-**

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# TYPES OF STRUCTURE OF POLYPEPTIDE CHAIN

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# TYPES OF STRUCTURE OF POLYPEPTIDE CHAIN

INTRODUCTION

- All protein polymers are constructed from the same set of 20 monomers, called amino acids.
- Polymers of proteins are called polypeptides.
- A protein consists of one or more polypeptides folded and coiled into a specific conformation.
- A polypeptide is a polymer of amino acids connected to a specific sequence.
- A protein's function depends on its specific conformation.

# TYPES OF STRUCTURE OF POLYPEPTIDE CHAIN

AMINO ACID

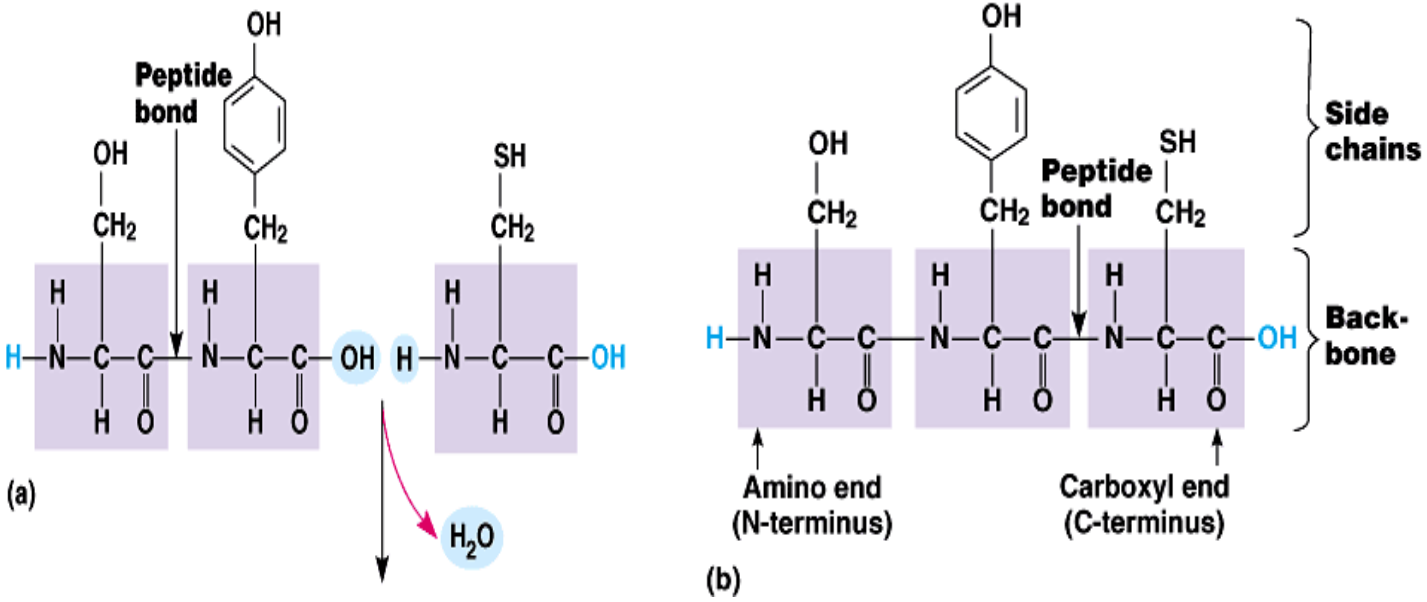
- **Amino acids consist of four components attached to a central carbon, the *alpha carbon*.**
- **These components include a hydrogen atom, a carboxyl group, an amino group, and a variable R group (or side chain).**
- **Differences in R groups produce the 20 different amino acids.**
- **The twenty different R groups may be as simple as a hydrogen atom (as in the amino acid glutamine) to a carbon skeleton with various functional groups attached.**
- **The physical and chemical characteristics of the R group determine the unique characteristics of a particular amino acid.**

# TYPES OF STRUCTURE OF POLYPEPTIDE CHAIN

AMINO ACID

- Amino acids are joined together when a dehydration reaction removes a hydroxyl group from the carboxyl end of one amino acid and a hydrogen from the amino group of another.

- The resulting covalent bond is called a peptide bond.



# TYPES OF STRUCTURE OF POLYPEPTIDE CHAIN

AMINO ACID

- **Repeating the process over and over creates a long polypeptide chain.**
- **At one end is an amino acid with a free amino group (the N-terminus) and at the other is an amino acid with a free carboxyl group (the C-terminus).**
- **The repeated sequence (N-C-C) is the polypeptide backbone.**
- **Attached to the backbone are the various R groups.**

# TYPES OF STRUCTURE OF POLYPEPTIDE CHAIN

- **A protein can be made up of a single polypeptide chain, or a protein can be made up of many polypeptide chains joined together.**

- **The main difference between a polypeptide and a protein is their level of structure.**

- **A polypeptide chain has three levels of structure:**

1. **Primary structure**
2. **Secondary structure**
   - **Alpha helix**
   - **Beta pleated sheet**
   - **Triple helix**
3. **Tertiary structure**
4. **Quaternary structure**

# TYPES OF STRUCTURE OF POLYPEPTIDE CHAIN

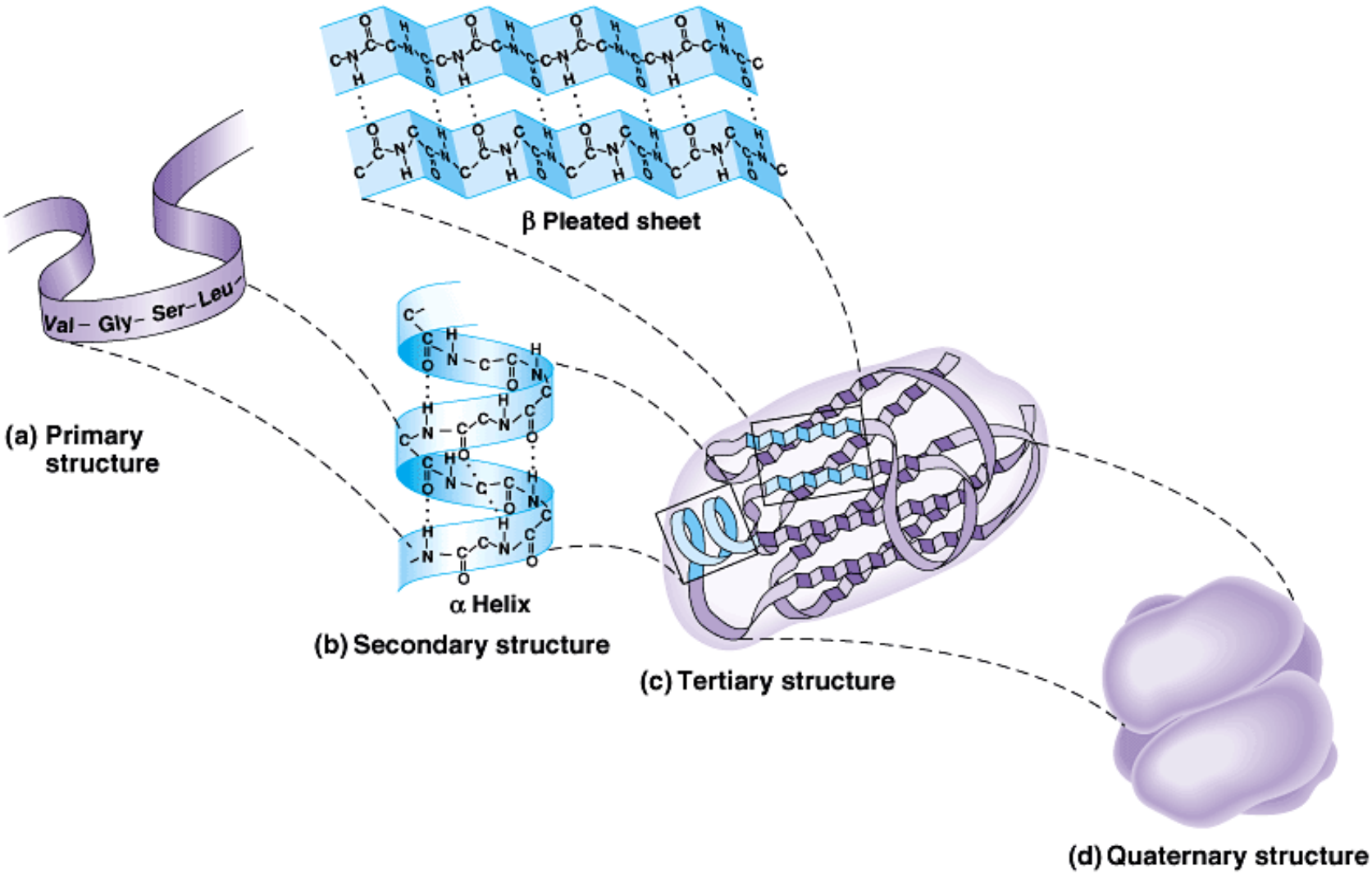
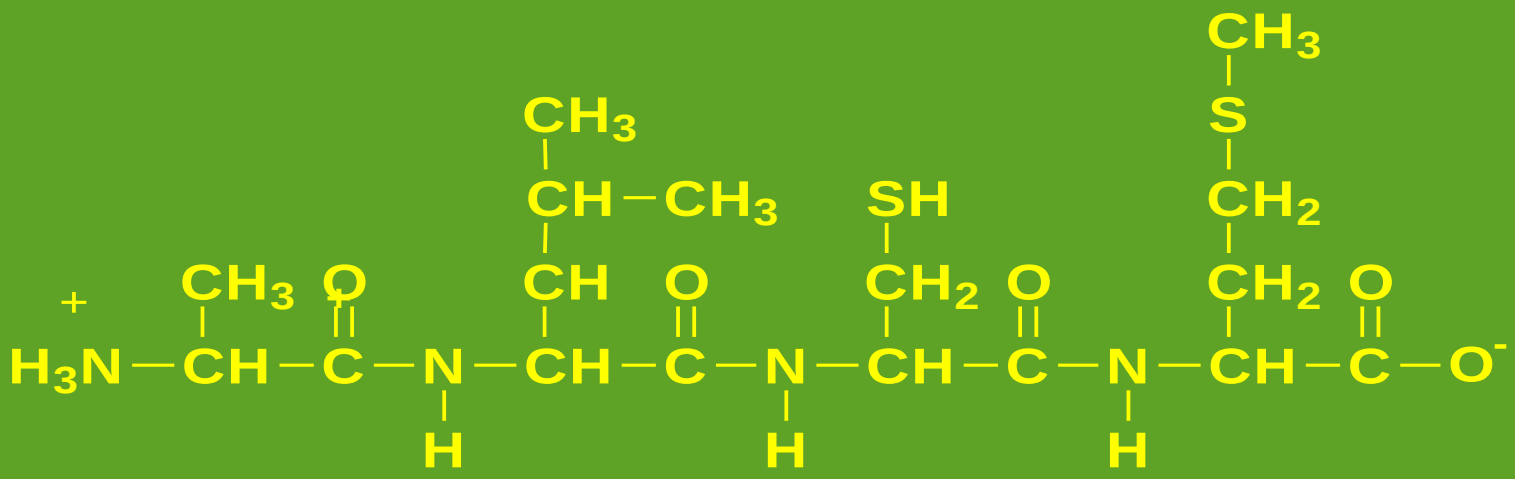



FIG: 1 TYPES OF STRUCTURE OF POLYPEPTIDE CHAIN

# TYPES OF STRUCTURE OF POLYPEPTIDE CHAIN

PRIMARY STRUCTURE

- The particular sequence of amino acids that is the backbone of a peptide chain or protein



Ala-Leu-Cys-Met

# TYPES OF STRUCTURE OF POLYPEPTIDE CHAIN

**PRIMARY STRUCTURE**

- **Primary structure is the structure formed when amino acid groups bond together (peptide bonds) to form a polypeptide chain.**
- **The primary structure of a protein is the level of protein structure which refers to the specific sequence of amino acids**
- **The precise primary structure of a protein is determined by inherited genetic information.**
- **Even a slight change in primary structure can affect a protein's conformation and ability to function.**

# TYPES OF STRUCTURE OF POLYPEPTIDE CHAIN

SECONDARY STRUCTURE

## Alpha Helix

- Three-dimensional arrangement of amino acids with the polypeptide chain in a corkscrew shape
- Held by H bonds between the H of –N-H group and the –O of C=O of the fourth amino acid along the chain
- Looks like a coiled “telephone cord”
- Helices can form bundles, coiled coils, *etc*.

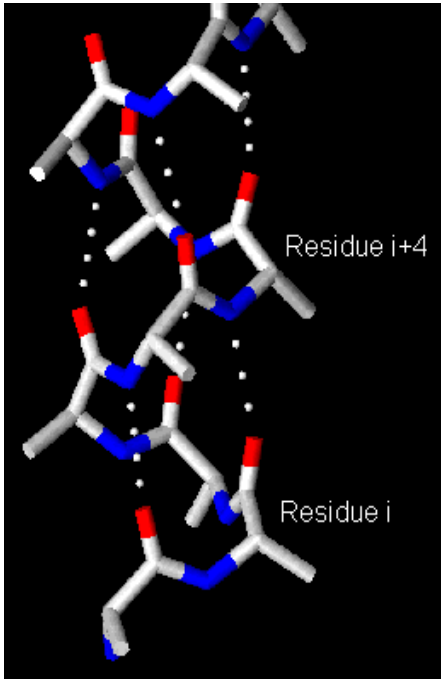



Fig: 2 Alpha helix

# TYPES OF STRUCTURE OF POLYPEPTIDE CHAIN

SECONDARY STRUCTURE

## Beta Pleated Sheet

- Polypeptide chains are arranged side by side
- Hydrogen bonds form between chains.
- R groups of extend above and below the sheet.
- β-sheet regions are more extended than an α-helix, and the distance between adjacent amino acids is 3.5 Å.

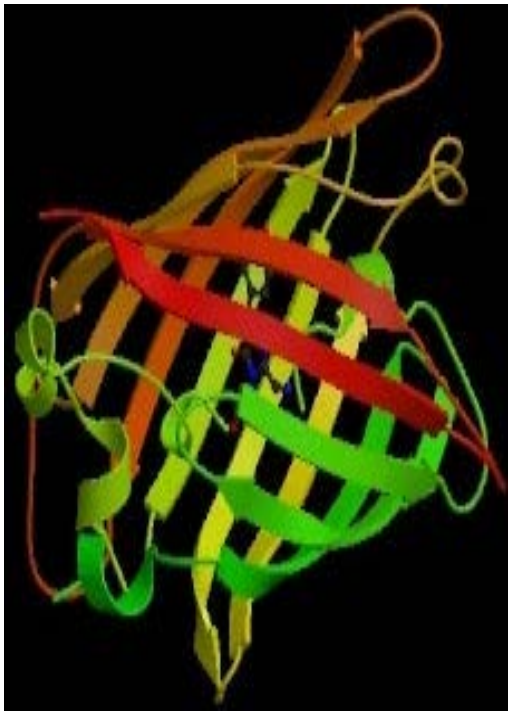


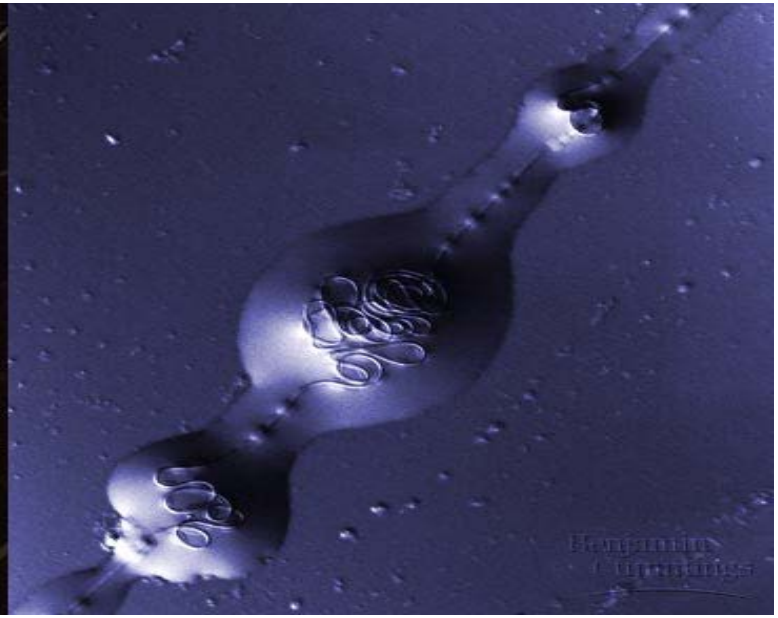
Fig: 3 Beta sheet

# TYPES OF STRUCTURE OF POLYPEPTIDE CHAIN

SECONDARY STRUCTURE

- Pleated sheets makes up the core of many globular proteins and also are dominant in some fibrous proteins such as a spiders web

- The structural properties of silk are due to beta pleated sheets.



# TYPES OF STRUCTURE OF POLYPEPTIDE CHAIN

SECONDARY STRUCTURE

## β Turns

- Poly peptide chains can change direction by making reverse turns and loops. Loop regions that connect two anti-parallel β-strands are known as reverse turns or β-turns.
- The turn is stabilized by hydrogen bond between the backbone of carbonyl oxygen and amine hydrogen.
- These loop regions have irregular lengths and shapes and are usually found on the surface of the protein.

# TYPES OF STRUCTURE OF POLYPEPTIDE CHAIN

**TERTIARY STRUCTURE**

- **Specific overall shape of a protein.**
- **Tertiary structure is determined by a variety of interactions among R groups and between R groups and the polypeptide backbone.**
- **These interactions include hydrogen bonds among polar and/or charged areas, ionic bonds between charged R groups, and hydrophobic interactions and van-der Waals interactions among hydrophobic R groups.**
- **While these three interactions are relatively weak, disulfide bridges, strong covalent bonds that form between the sulfhdryl groups (SH) of cysteine monomers, stabilize the structure.**

# TYPES OF STRUCTURE OF POLYPEPTIDE CHAIN

TERTIARY STRUCTURE

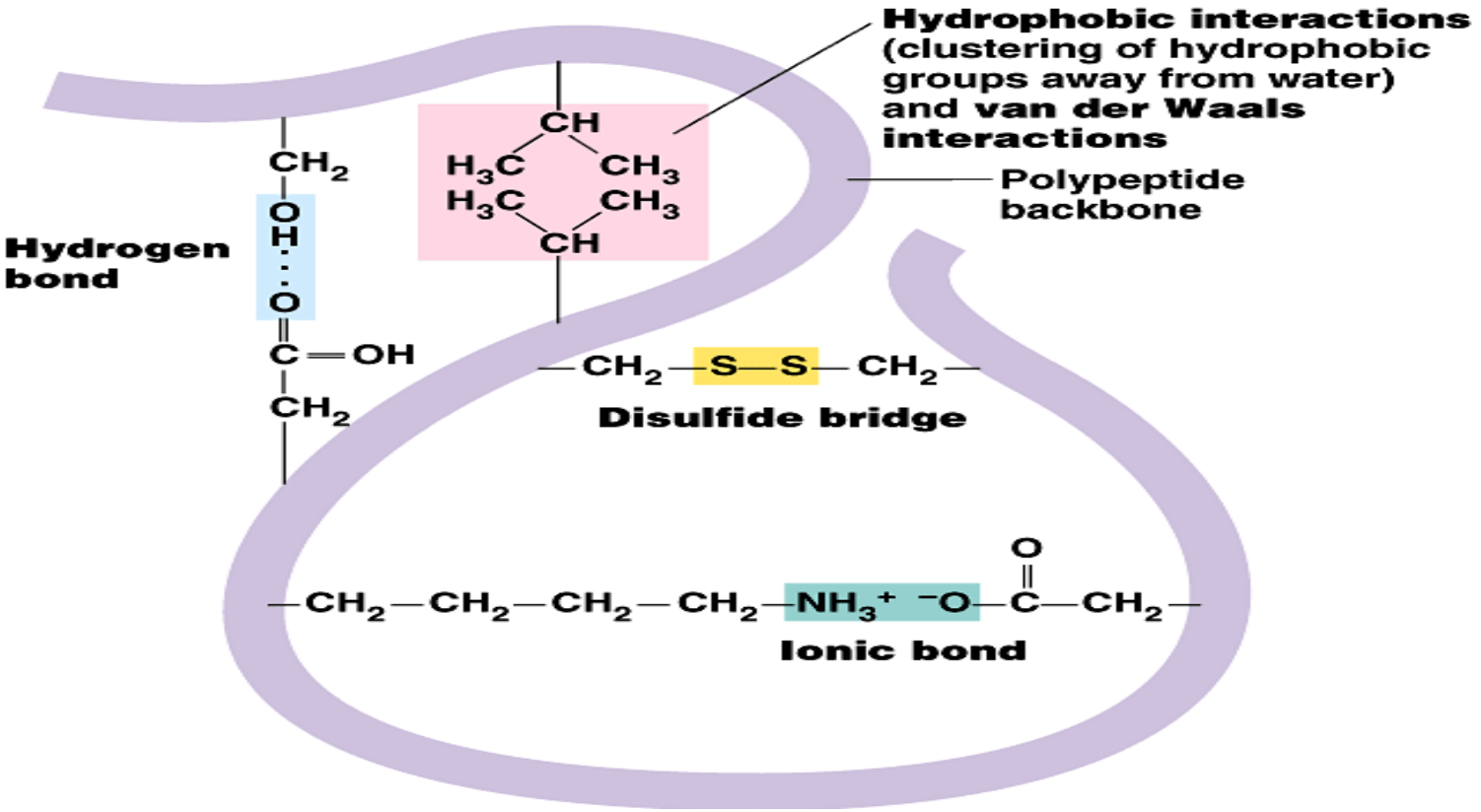



FIG: 4 TERTIARY STRUCTURA

# TYPES OF STRUCTURE OF POLYPEPTIDE CHAIN

**QUATERNARY STRUCTURE**

- **Proteins with two or more chains.**
- **Example is hemoglobin Carries oxygen in blood Four polypeptide chains Each chain has a heam group to bind oxygen.**
- **Quaternary structure results from the aggregation of two or more polypeptide subunits.**
- **Collagen is a fibrous protein of three polypeptides that are super coiled like a rope.**

# TYPES OF STRUCTURE OF POLYPEPTIDE CHAIN

QUATERNARY STRUCTURE

- This provides the structural strength for their role in connective tissue.
- Hemoglobin is a globular protein with two copies of two kinds of polypeptides.

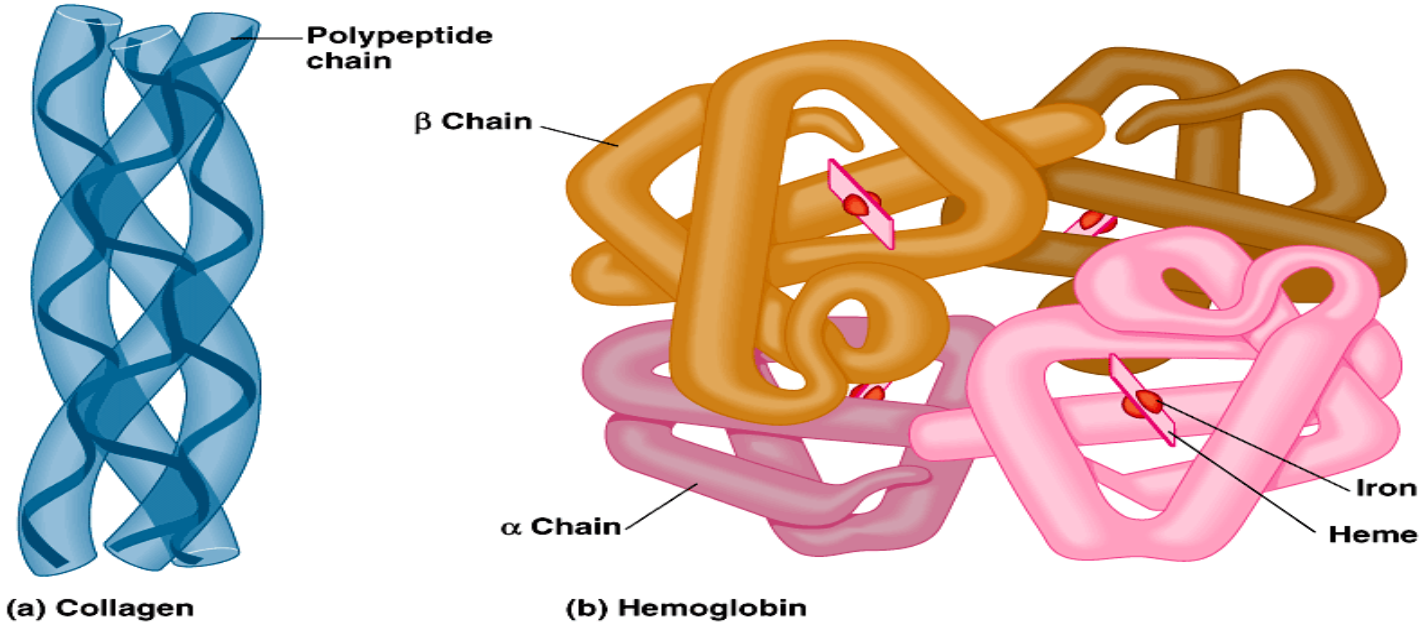



FIG: 5 QUATERNARY STRUCTURE

# TYPES OF STRUCTURE OF POLYPEPTIDE CHAIN

SIGNIFICANCE

•Haemoglobin is a protein with quaternary structure.

•Skin, bones, corneas and other body part depend on collegen strength. Collegen proteins are ex. Of quaternary structure.

•Hair is composed of keratin  protein. Keratin protein is comprised of polypeptide chains.

# TYPES OF STRUCTURE OF POLYPEPTIDE CHAIN

CONCLUSION

- **A protein can be made up of a single polypeptide chain, or a protein can be made up of many polypeptide chains joined together.**
- **The main difference between a polypeptide and a protein is their level of structure.**
- **A polypeptide chain has three levels of structure: primary structure, secondary structure, and tertiary structure.**

# TYPES OF STRUCTURE OF POLYPEPTIDE CHAIN

REFERENCES


| | | |
|---|---|---|
| L.Lehninger | 2008 | Biochemistry<br>Kalyani publication<br>2nd Edition |
| J.L Jain | 2008 | Fundamentals of Biochemistry<br>S.Chand &company<br>5th Edition |
| L. Nelson &<br>M. Cox | 2009 | Principle of Biochemistry<br>S.Chand &company<br>5th Edition |
| U.Satyanarayan | 2010 | Biochemistry<br>Books & Allied (P)Ltd<br>3rd Edition |
| Class notes | 2012 | |
| Internet | | |


THANK YOU….