

By lecturer:

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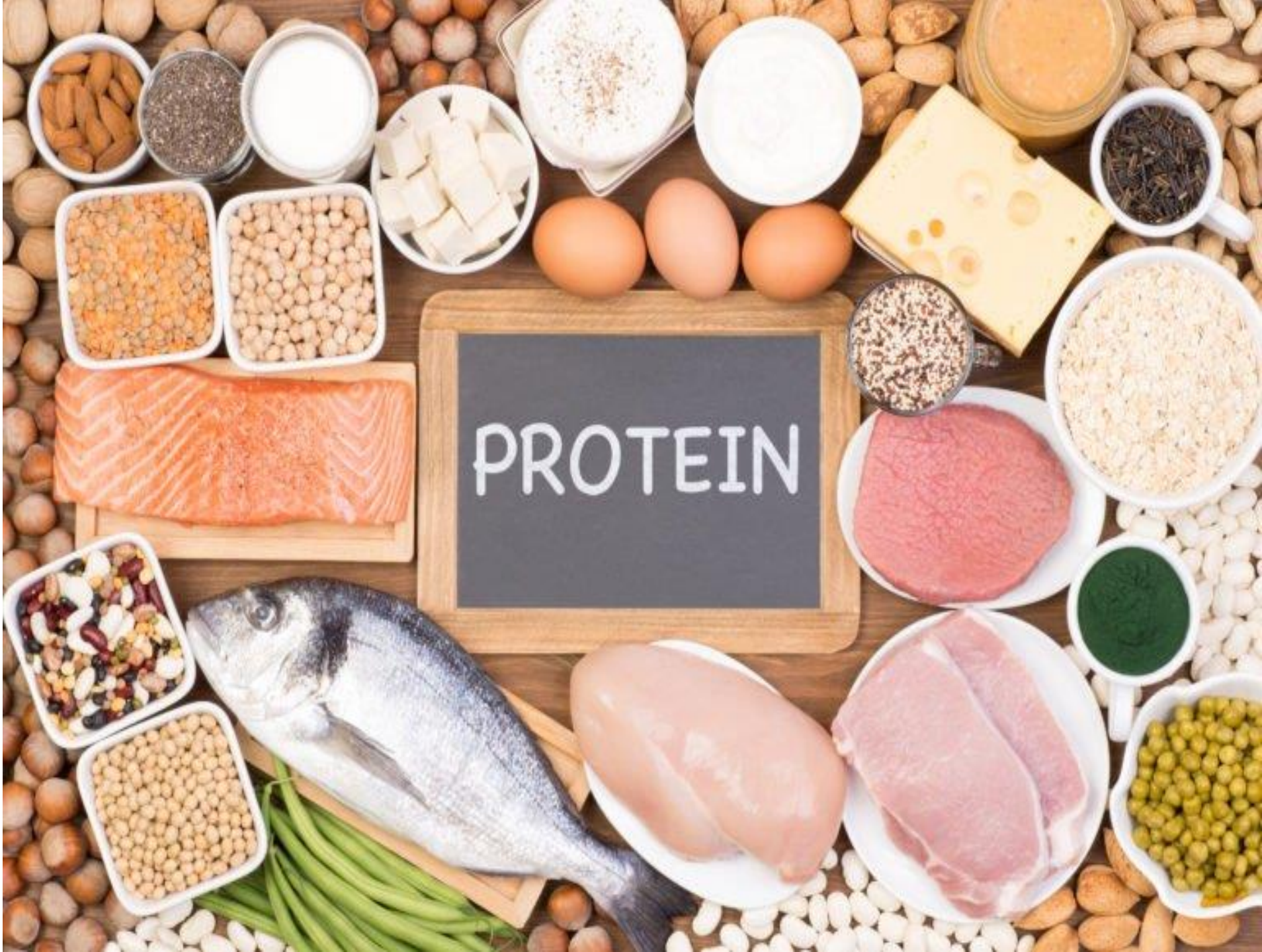
M.sc Biochemistry and Molecular Biology

Introduction

- **The proteins are described as being the power horses of living organisms**
- **They carry out almost all the tough work required by the organism.**

Definition

- **Proteins are polymers of amino acids linked by peptide bond.**
- **Found in meat, beans, & dairy.**


PROTEIN

HIGH PROTEIN VEGETABLES

RANKED FROM HIGHEST TO LOWEST



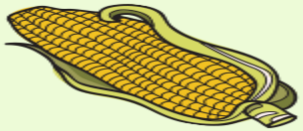
GREEN PEAS
1 cup: 8.6g



SPINACH*
1 cup: 5.2g



ARTICHOKES
1 cup: 4.8g



CORN
1 cup: 4.7g



AVOCADO
1 cup: 4.6g



ASPARAGUS
1 cup: 4.3g



BRUSSELS SPROUTS
1 cup: 4g



MUSHROOMS*
1 cup: 4g



KALE
1 cup: 3.5g



POTATOES
1 cup: 3g

* - Cooked

EatingWell

Size of proteins

- **Proteins are molecules having a very high molecular weight, ranging from 5,000 - several millions.**
- **Protein: molecules greater than 50 amino acids.**
- **Molecules contain less than 50 amino acids are termed: peptides.**

Functions of Proteins

1. As **enzymes** they are needed for every reaction.

2. **Structural proteins:** support every living cell.

Skin and bone: **e.g. contains proteins in the form of collagen.**

3. **Contractile proteins** are behind every cellular motion.

Functions of Proteins

4**. Transport** and **storage** of nutrients in aqueous fluids needs certain proteins

1. Hemoglobin , lipoproteins.
2. Storage: ferritin

7. Buffers (resist change in pH)

Functions of Proteins

5. Hormonal regulation:

1. Some **hormones** are protein in nature e.g. growth hormone.

2. Cellular **receptors** that recognise hormones are proteins.

Functions of Proteins

6. Defense mechanisms: immunoglobulins & complements. **Keratin** found in skin and other tissues is protein that protect against mechanical and chemical injury.

7. Blood clotting: Coagulation factors are proteins.

8. Control of genetic expression: many regulators of genes are protein in nature.

Conformation of proteins (protein structure)

Every protein has a 3-dimensional structure (primary, secondary and tertiary) which is known as conformation.

Conformation is essential for the functions of each protein.

Any change in protein conformation may lead to a disease.

Levels of proteins organization (protein structure)

The conformation or shape of a protein is described at (up to) four levels:

1. **Primary structure.**
2. **Secondary structure.**
3. **Tertiary structure.**
4. **Quaternary structure.**

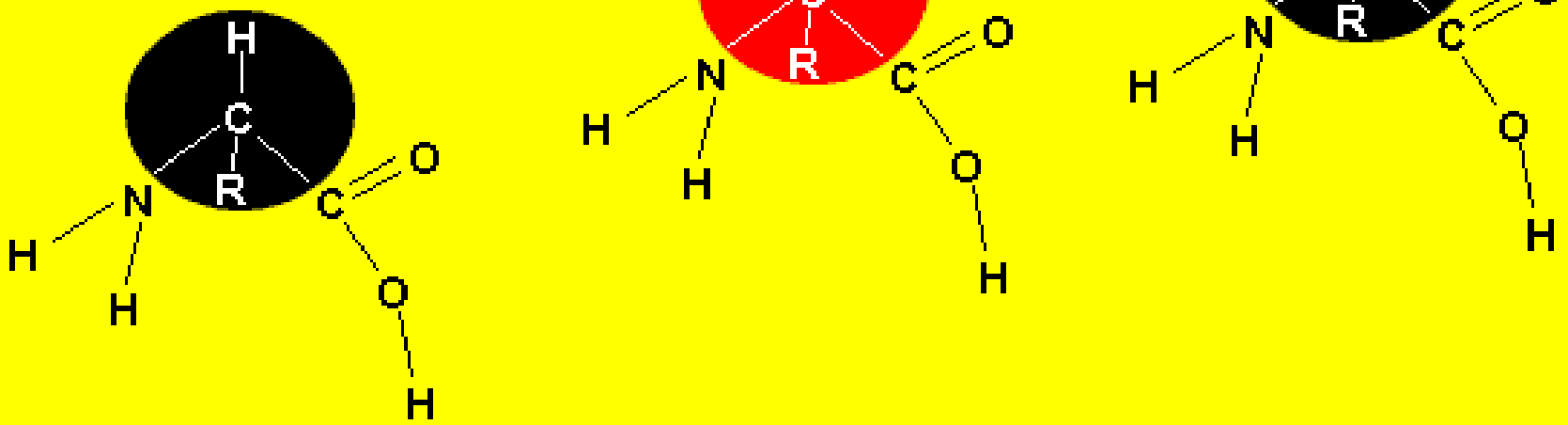
Primary structure

- **The sequence of amino acids in the polypeptide chain.**
- **It is stabilized by peptide bonds**
- Higher levels of protein structure are determined by the primary structure.
- Protein function is also, determined by its structure.

Primary structure

- Polypeptide chain starts on the **left side** by free amino group of the first amino acid. It is termed **N-terminal**
- Polypeptide chain ends on the **right side** by free carboxyl group of last amino It is termed **C-Terminal**

Formation of peptide bond



amino acids

Secondary structure

- The folding of short segments of polypeptide through H-bonding into ordered units.
- H-bonding: the bond between the **hydrogen of -NH group of** one amino acid residues and the **carbonyl oxygen (**C=O) of the fourth one.
- **H-bonding stabilizing this level. (maintain the protein's folded shape)**

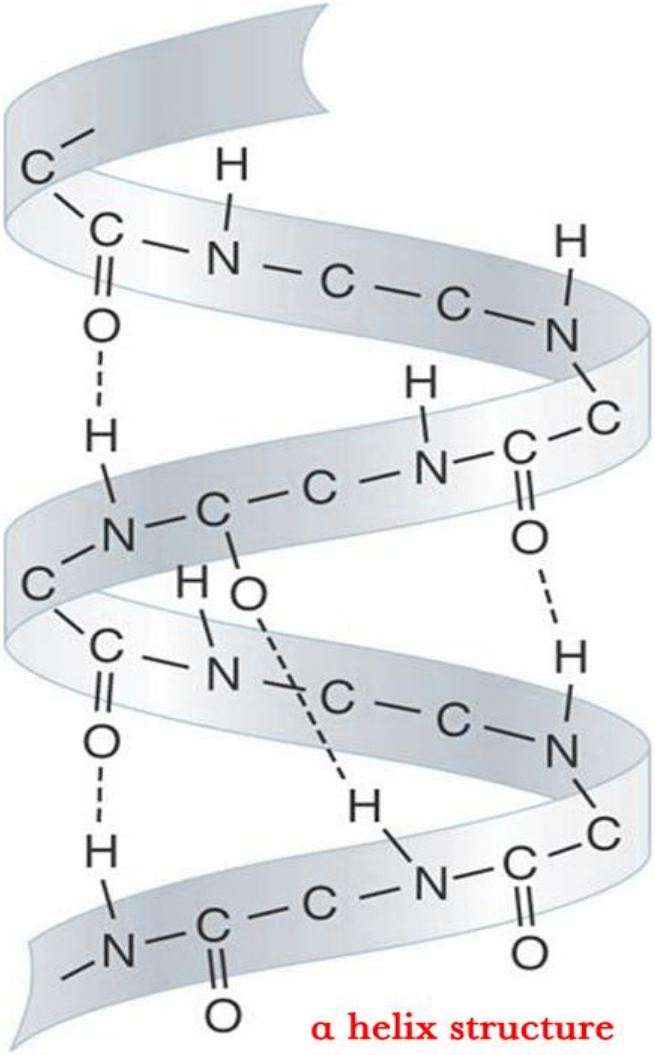
Secondary structure

- **Secondary structure exists in two forms :-**

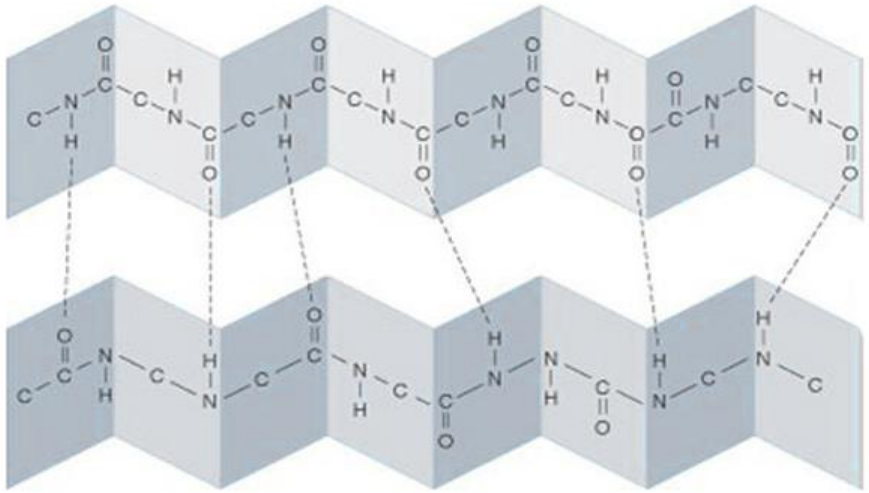
1- α-helix.

2- β-sheets.

Alpha helix & Beta sheet



α helix structure

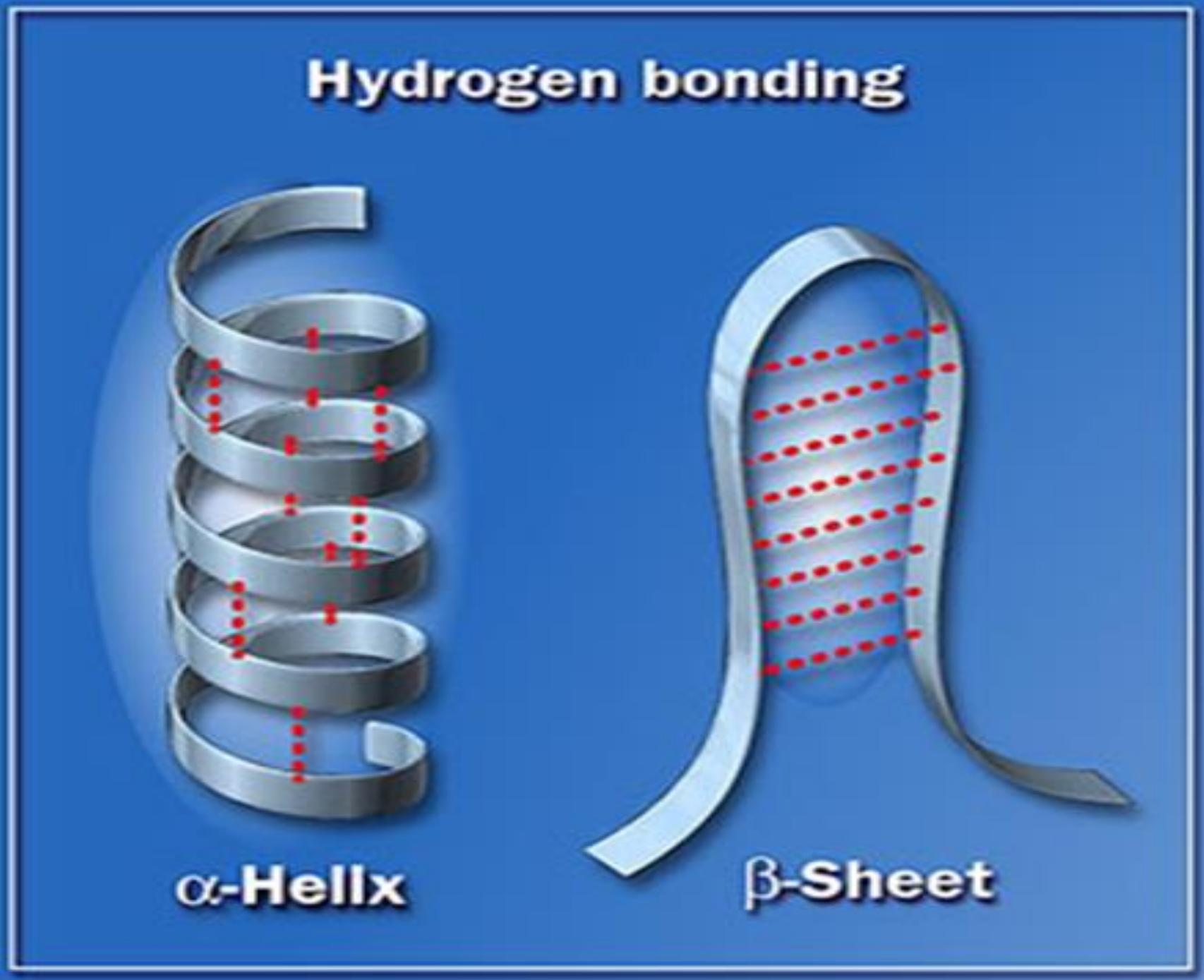


β- pleated structure

= hydrogen bonds

Alpha helix

- α-helix is composed of a **single linear array** of helically disposed amino acids
- The α-helix is a common secondary structure in **Globular proteins** are water-soluble (forming colloids in water).


Hydrogen bonding
α-Hellx
β-Sheet

Beta sheets

- **β-sheets composed of 2 or more different regions of stretches of at least 5-10 amino acids.**

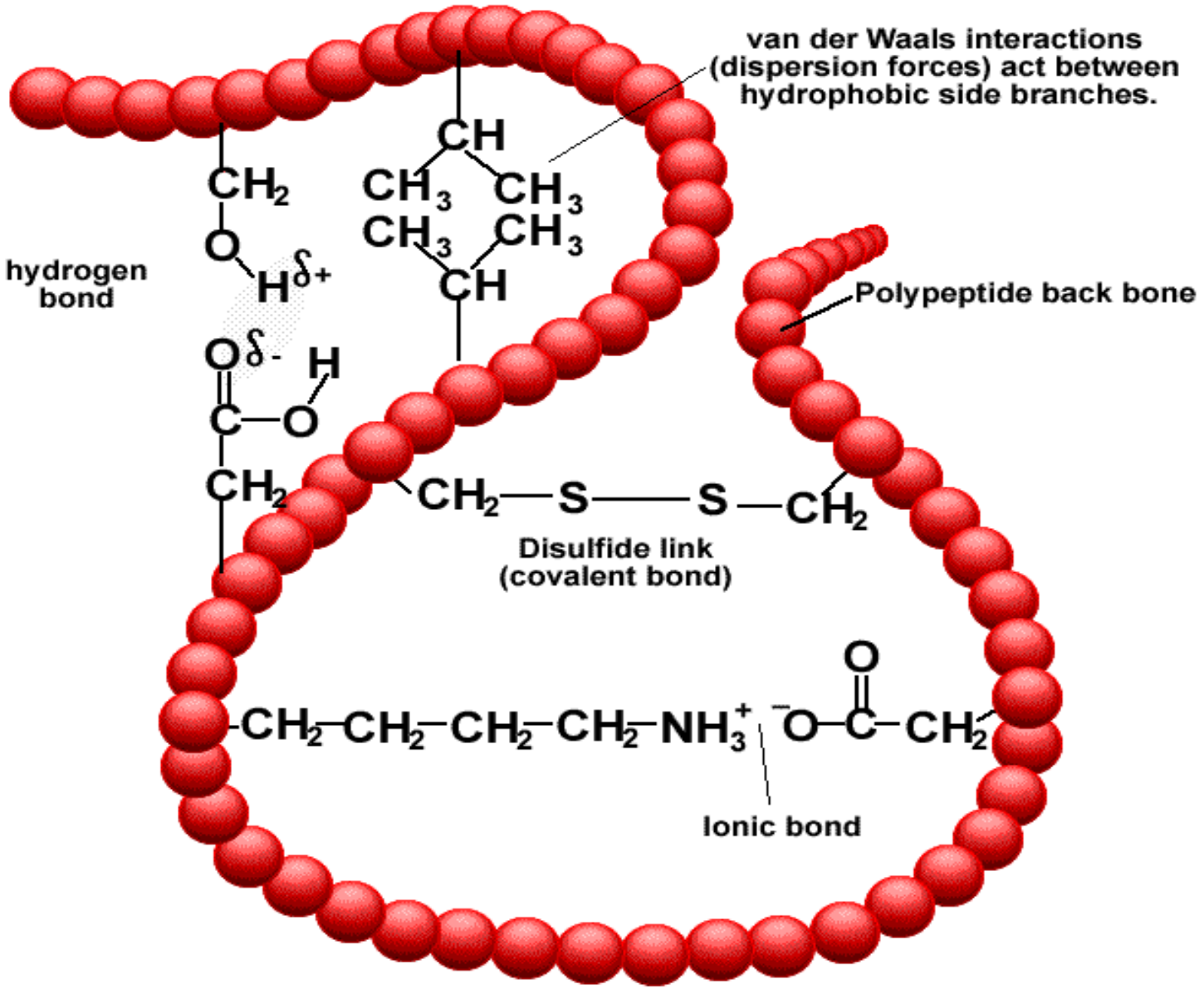
Tertiary structure

- **Tertiary structure describes the relationship of different domains within a protein chain.**
- Secondary structures of proteins → **domain.**
- **A domain** is a section of protein structure sufficient to perform **a particular chemical or physical task**

Forces controlling tertiary structure

1. **Hydrogen Bonding**
2. **Hydrophobic Forces**
3. **Electrostatic Forces**
4. **Disulfide bonds**
5. **Van der Waals Forces**

Forces controlling tertiary structure

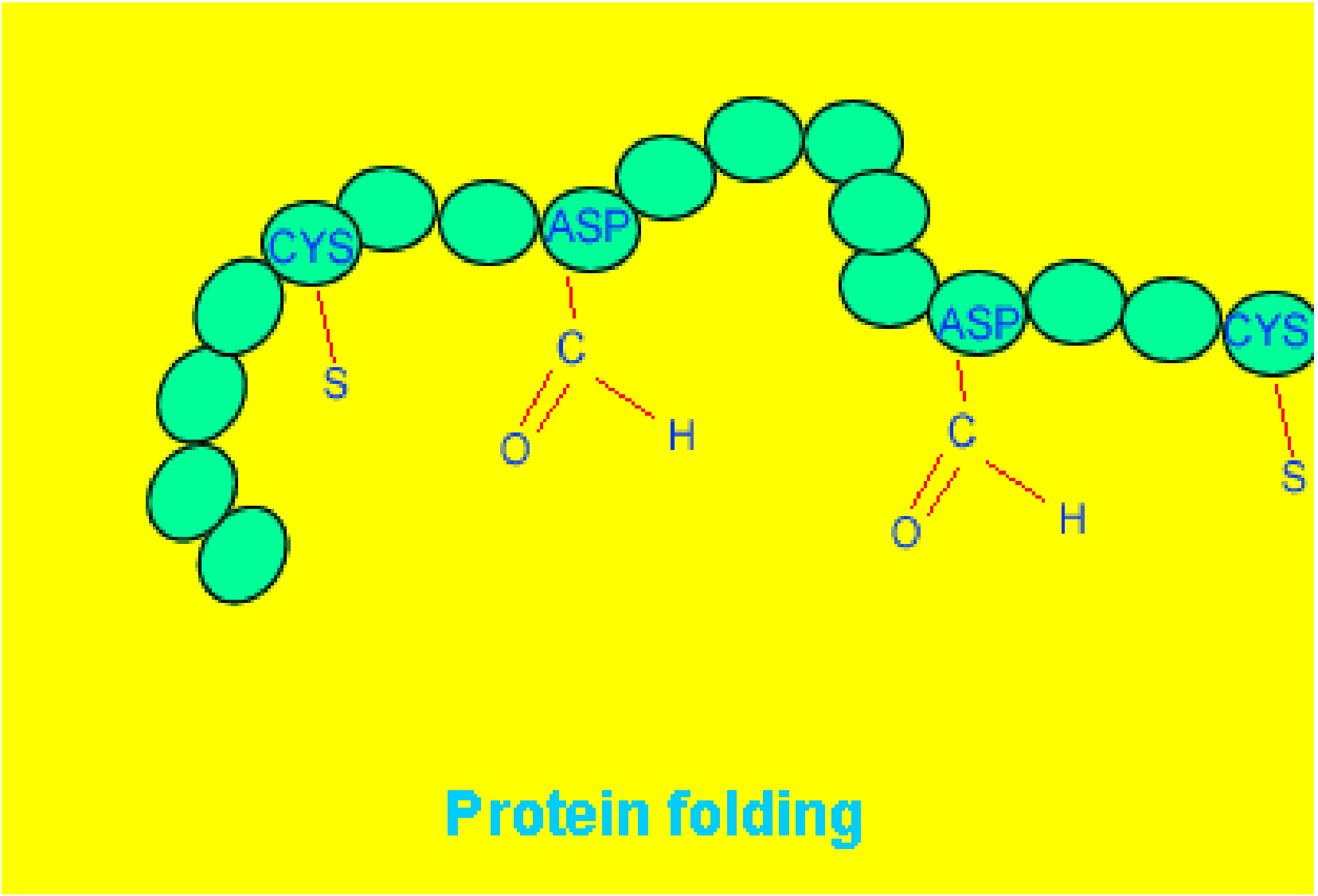


1. Hydrogen bonding

- **Functional groups of polypeptide form H-bonding, within the chain or between chains and also with the surrounding aqueous medium**
- **How?**



Protein folding



2. Hydrophobic Forces

- **Non-polar (hydrophobic) amino acid side chains cluster in the interior of the protein to minimize their contact with water.**
- **polar amino acid side chain remain on the exterior.**

3. Electrostatic Forces
Ionic bond

- **Interactions between oppositely charged R-groups**

4. Disulfide bonds

- **Are strong covalent bonds.**
- **They form between the sulfur atoms of two cysteine amino acid residues.**

5. Van der Waals Forces

- **These forces involve the weak, short-range attractions between adjacent uncharged non-bonded atoms.**

Tertiary structure



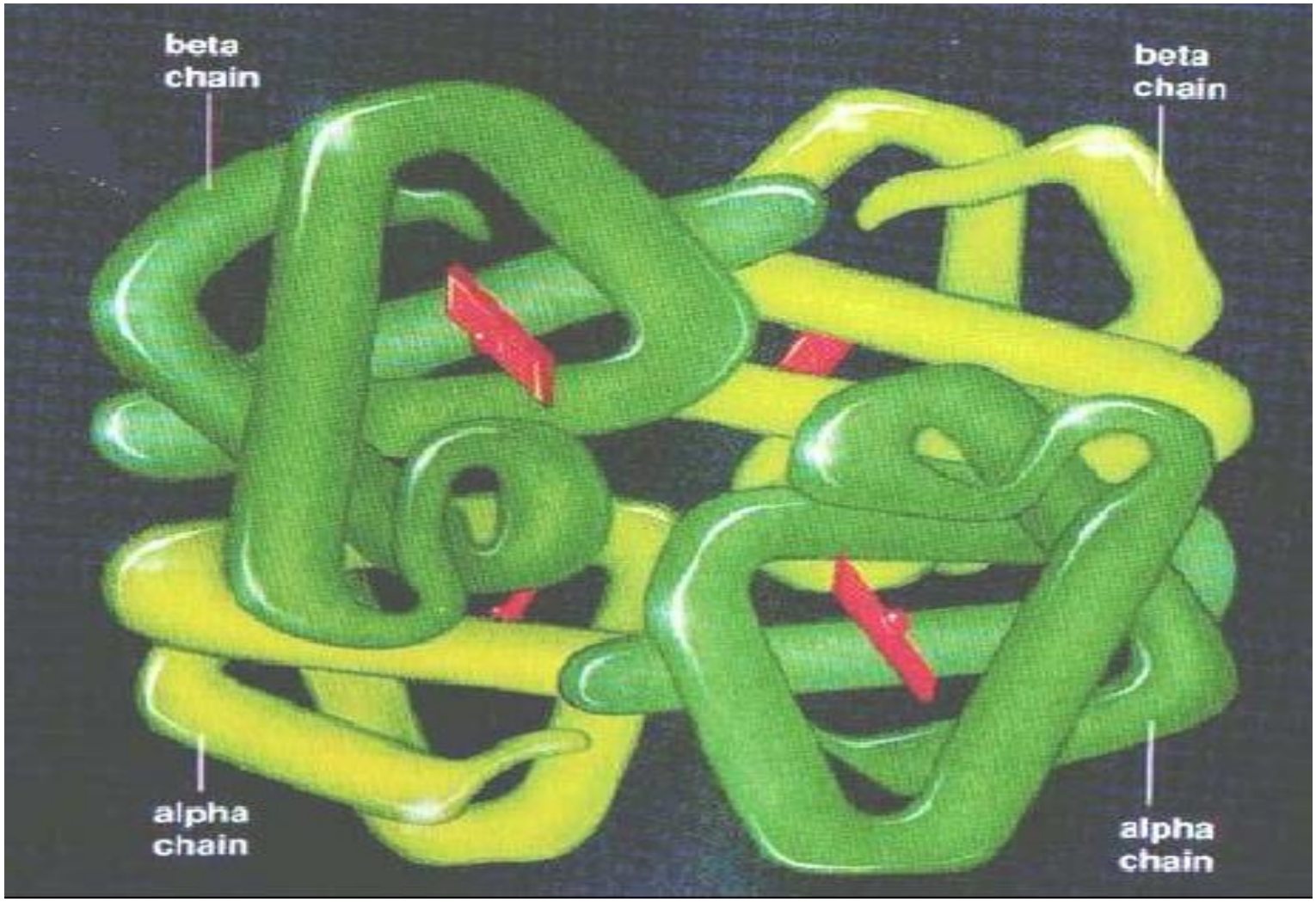
Quaternary structure

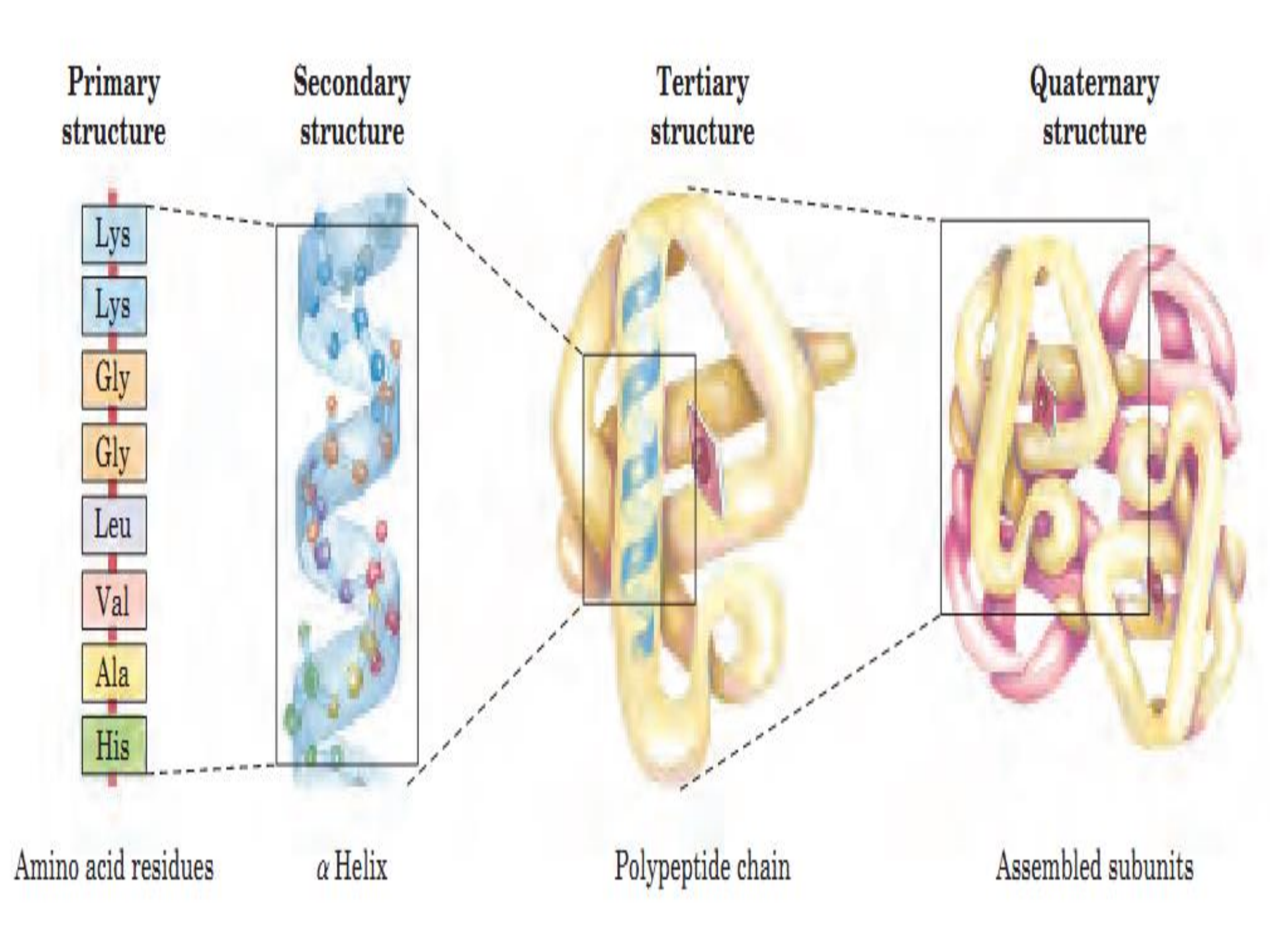
- **It is the relationship between multiple, separate polypeptide chains (subunits) to form a single, multi-subunit protein complex.**
- **According to number of subunits the protein may be:**

Dimeric , trimeric, tetrameric…. Oligomeric protein.

- **Examples:**
- **Insulin: 2 subunits.**
- **Lactate dehydrogenase enzyme: 4 subunits.**
- **Hemoglobin: 4 subunits.**

Hemoglobin




Primary structure
Secondary structure
Tertiary structure
Quaternary structure
Lys
Lys
Gly
Gly
Leu
Val
Ala
His
Amino acid residues
α Helix
Polypeptide chain
Assembled subunits

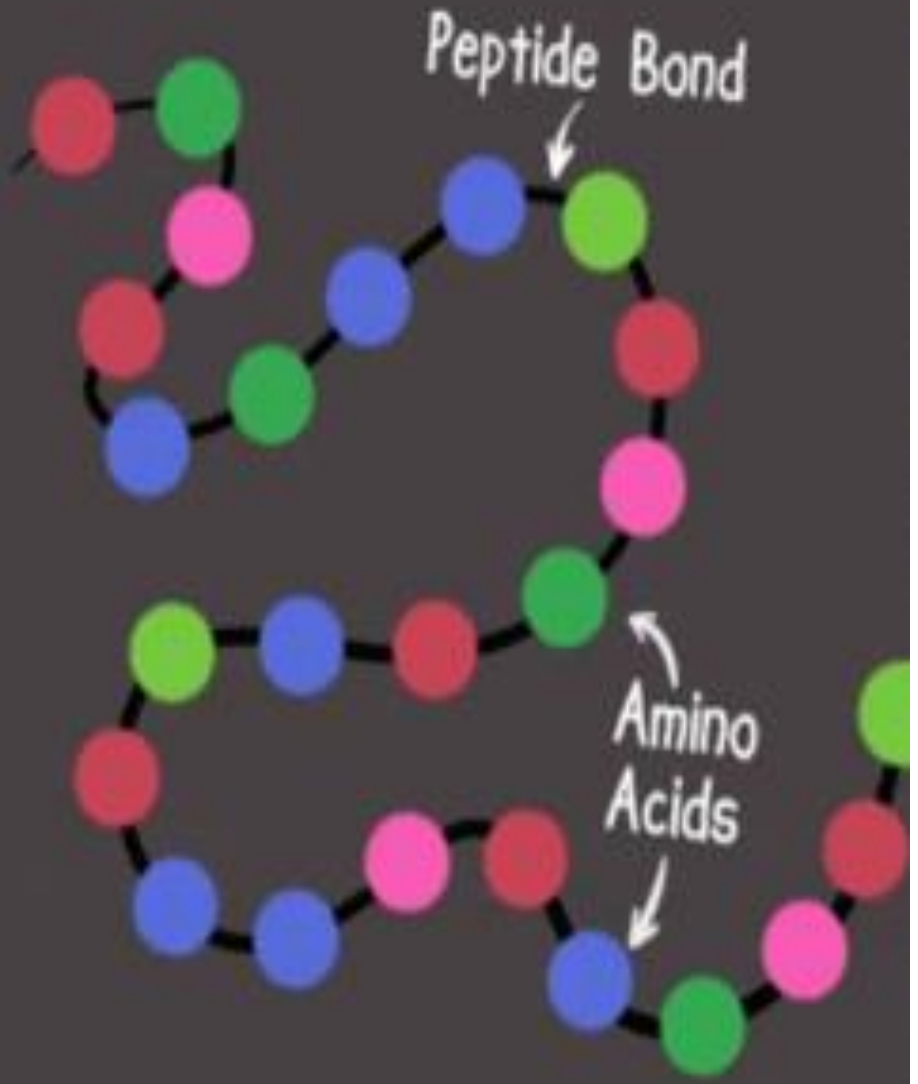
PROTEIN STRUCTURE LEVELS

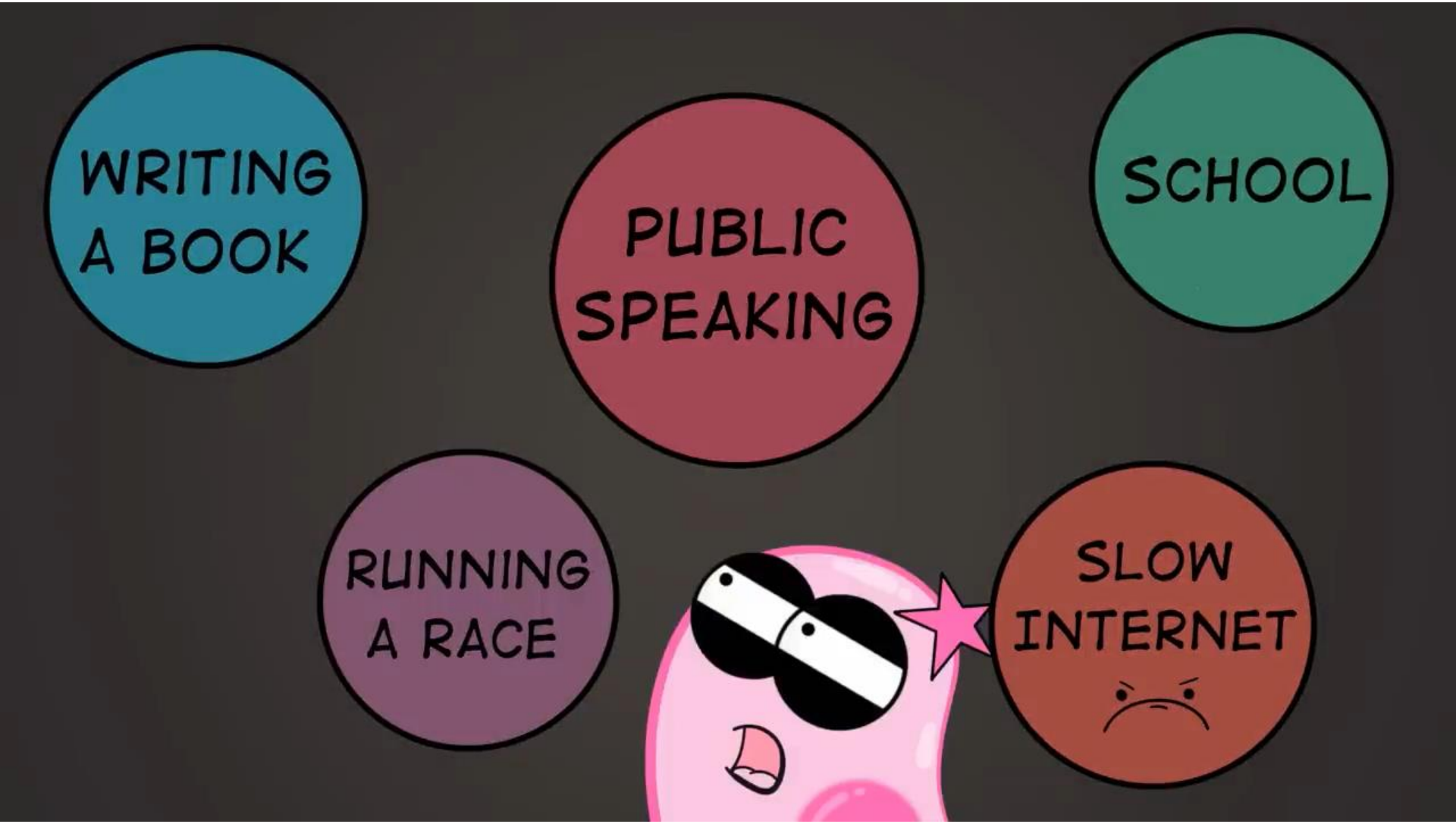
@AmoebaSisters

1. PRIMARY STRUCTURE
2. SECONDARY STRUCTURE
3. TERTIARY STRUCTURE

@AmoebaSisters

4. QUATERNARY STRUCTURE




WRITING A BOOK
PUBLIC SPEAKING
SCHOOL
RUNNING A RACE
SLOW INTERNET


THE
END