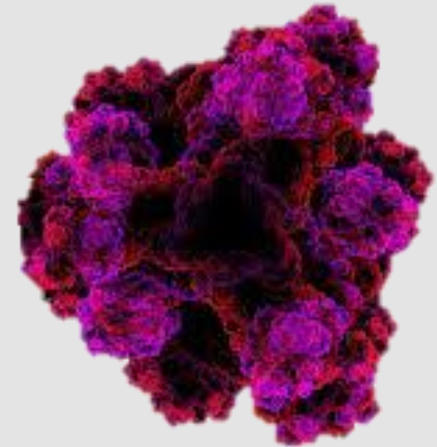
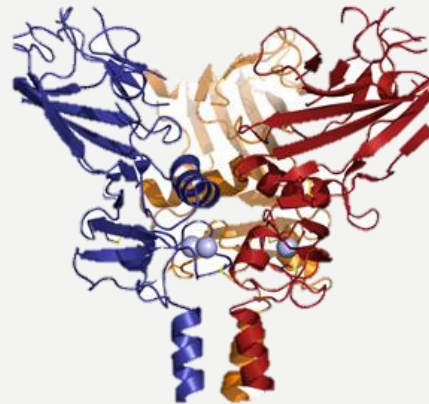
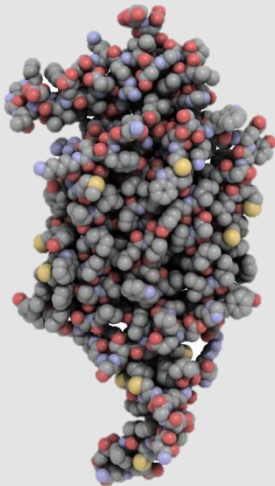




PROTEIN STRUCTURE



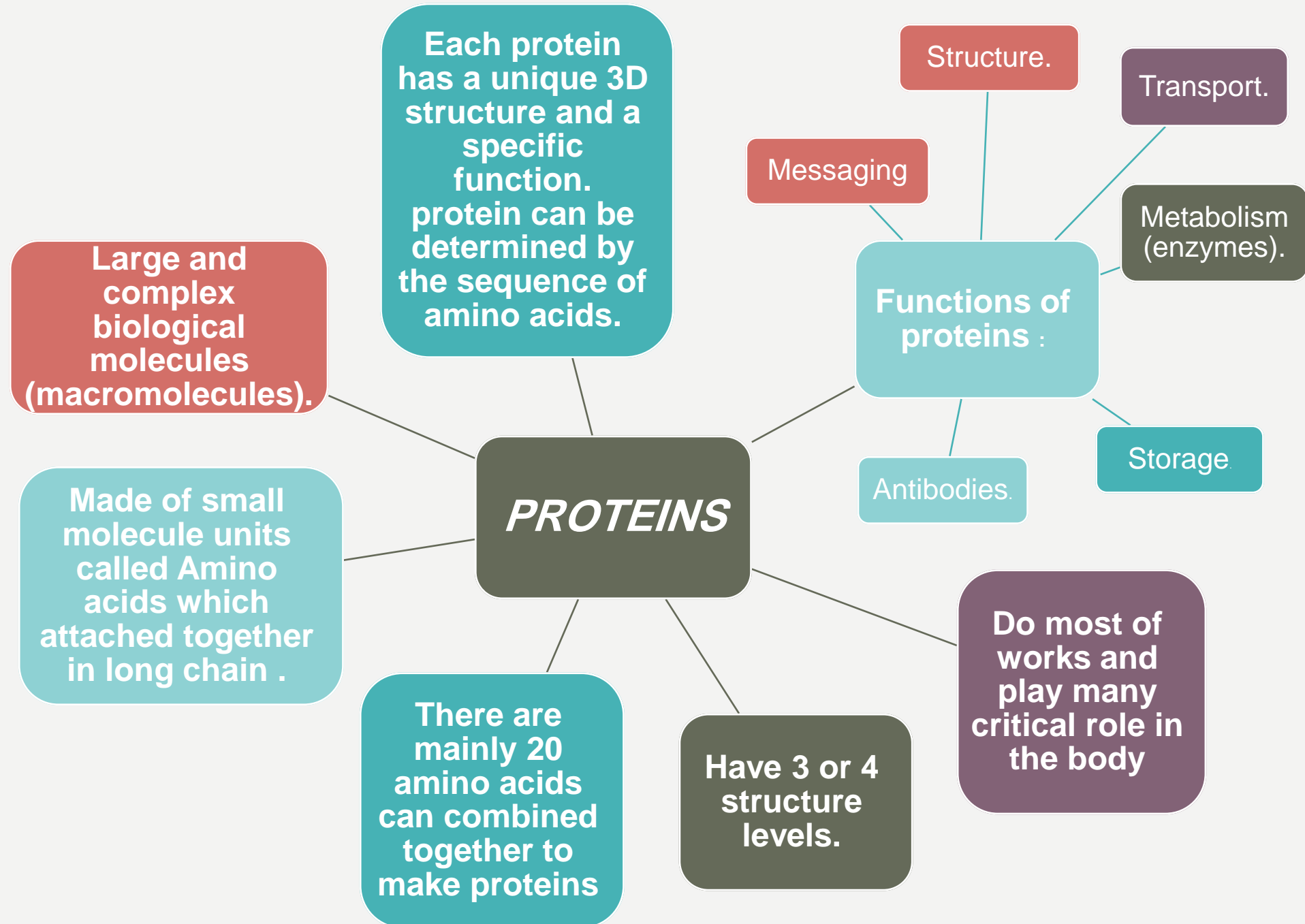
WHEN THEY SAY YOU CAN'T, THEN YOU HAVE TO!!!

هذا العمل لا يغني عن
المذاكرة من المصدر
الأساسي

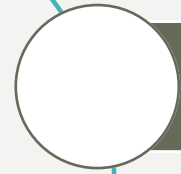
OBJECTIVES:

- WHAT ARE PROTEINS?
- LEVELS OF PROTEINS STRUCTURE:
 - Primary structure.
 - Secondary structure.
 - Tertiary structure.
 - Quaternary structure.
- DENATURATION OF PROTEINS.
- PROTEIN MISFOLDING.

Definition and functions of proteins



■ What are proteins?

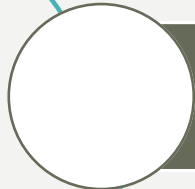


Large and complex biological molecules (macromolecules)

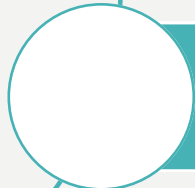


Molecules that are Made of small molecule units called Amino acids which attached together in long

■ What do they do?



They do most of work in cells.



They are required for the structure, function, and regulation of the body's tissues and cells.

■ Building blocks:

○ Made of small molecule units called Amino acids which attached together in long chain by a peptide bond.

■ how can we describe them?

○ According to their large range of functions.

Primary structure:

single amino acids attached by covalent bonds called peptide bonds to form a linear sequence of amino acids

Secondary structure:

Regions stabilized by hydrogen bonds between atoms of the polypeptide backbone.

Examples :

α - helix

β - sheet

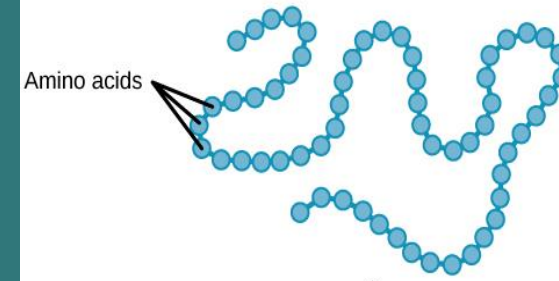
Levels of protein structure

Quaternary structure :

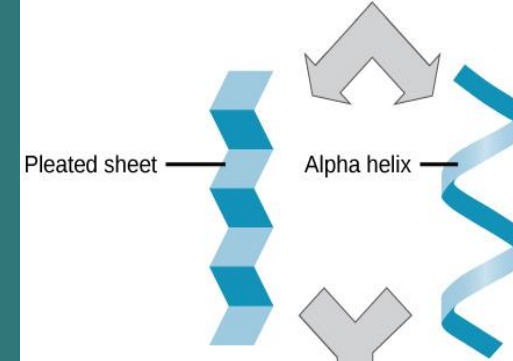
Association of multi polypeptides forming a functional protein.

Tertiary structure:

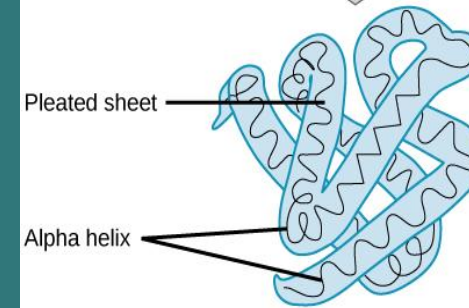
Three - dimensional (3D) shape of entire polypeptide chain including side chains (R group).



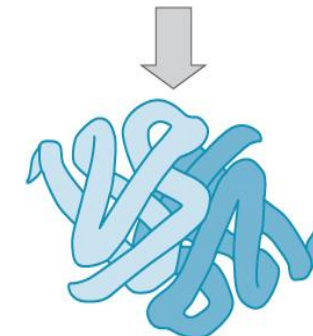
Primary Protein structure
sequence of a chain of amino acids



Secondary Protein structure
hydrogen bonding of the peptide backbone causes the amino acids to fold into a repeating pattern



Tertiary protein structure
three-dimensional folding pattern of a protein due to side chain interactions



Quaternary protein structure
protein consisting of more than one amino acid chain

PRIMARY STRUCTURE

Features:

- **shape:** linear sequence of amino acids.

- **It has Covalent Bonds:**

- 1- Peptide bond by dehydration reaction.
- 2- Disulfide bond.

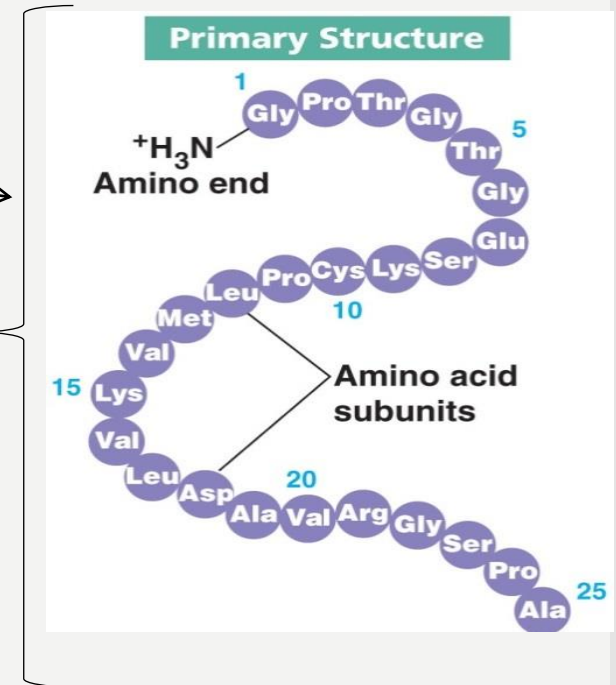
- **Function :**

The protein in this level IS **NOT FUNCTIONAL**.

- **HOW TO DETERMINE THE PRIMARY STRUCTURE SEQUENCE?**

- 1-DNA sequencing
- 2-Direct amino acid sequencing.

شكل السبحة →



PEPTIDE BOND (Amide bond):

What is it?

Amide linkage that is formed between α -carboxyl group of an amino acid and α -amino group of the other amino acid.

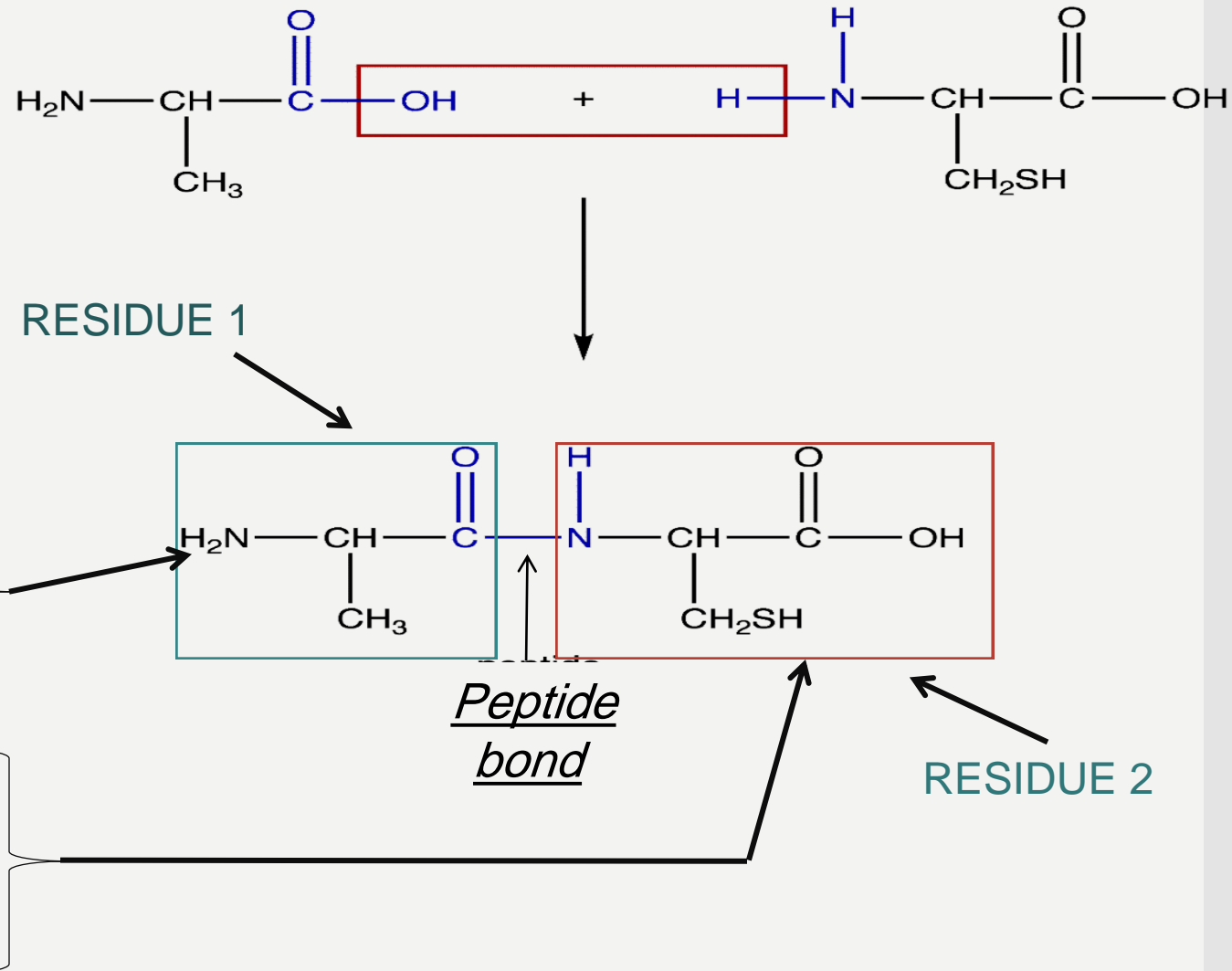
Formed by:

Removal of:

OH from COOH and H from NH₃ Group. (dehydration).

- The amino acid with a free amino group at the end called "N-Terminus" or "–NH₂ Terminus".

- The amino acid with a free carboxylic group at the end called "C-Terminus" Or "–COOH Terminus".



PEPTIDES

Two amino acids

dipeptide

One peptide bond

Three amino acids

tripeptide

Two peptide bonds

Four amino acids

tetrapeptide

Three peptide bonds

Few

2-20 amino acids

oligopeptide

More >20 amino acids

polypeptide

SECONDARY STRUCTURE:

- **What is it ?**

Regular arrangements of amino acids that are located near to each other in the linear sequence.

- **Excluding** the conformation (3D arrangements) of its side chains.

- **Examples** : α -helix , β - sheet and β - bends

SECONDARY STRUCTURE: **α -HELIX**

- **What is α -HELIX ?**

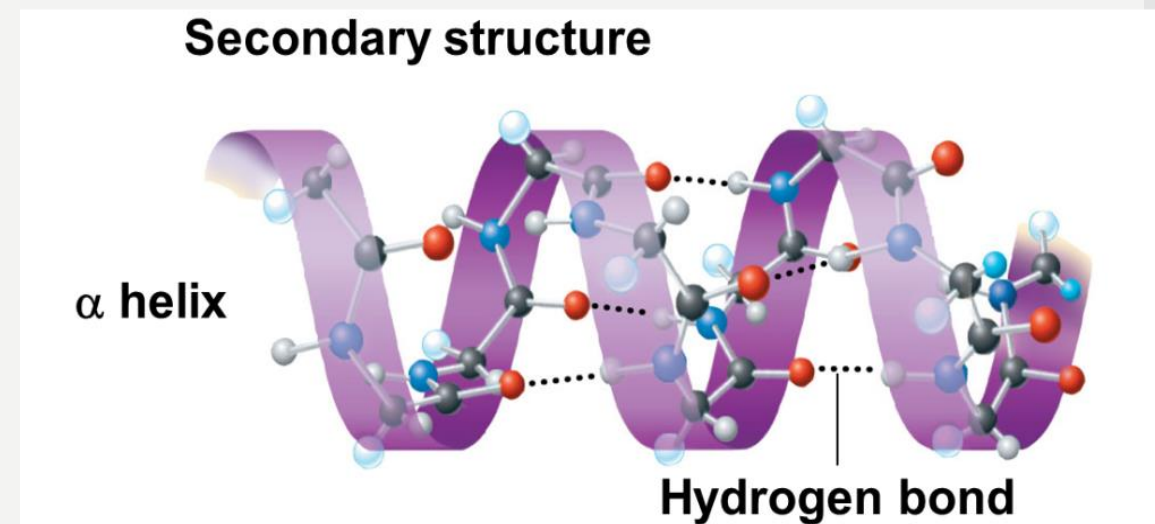
Right-handed spiral , which side chain extended outward

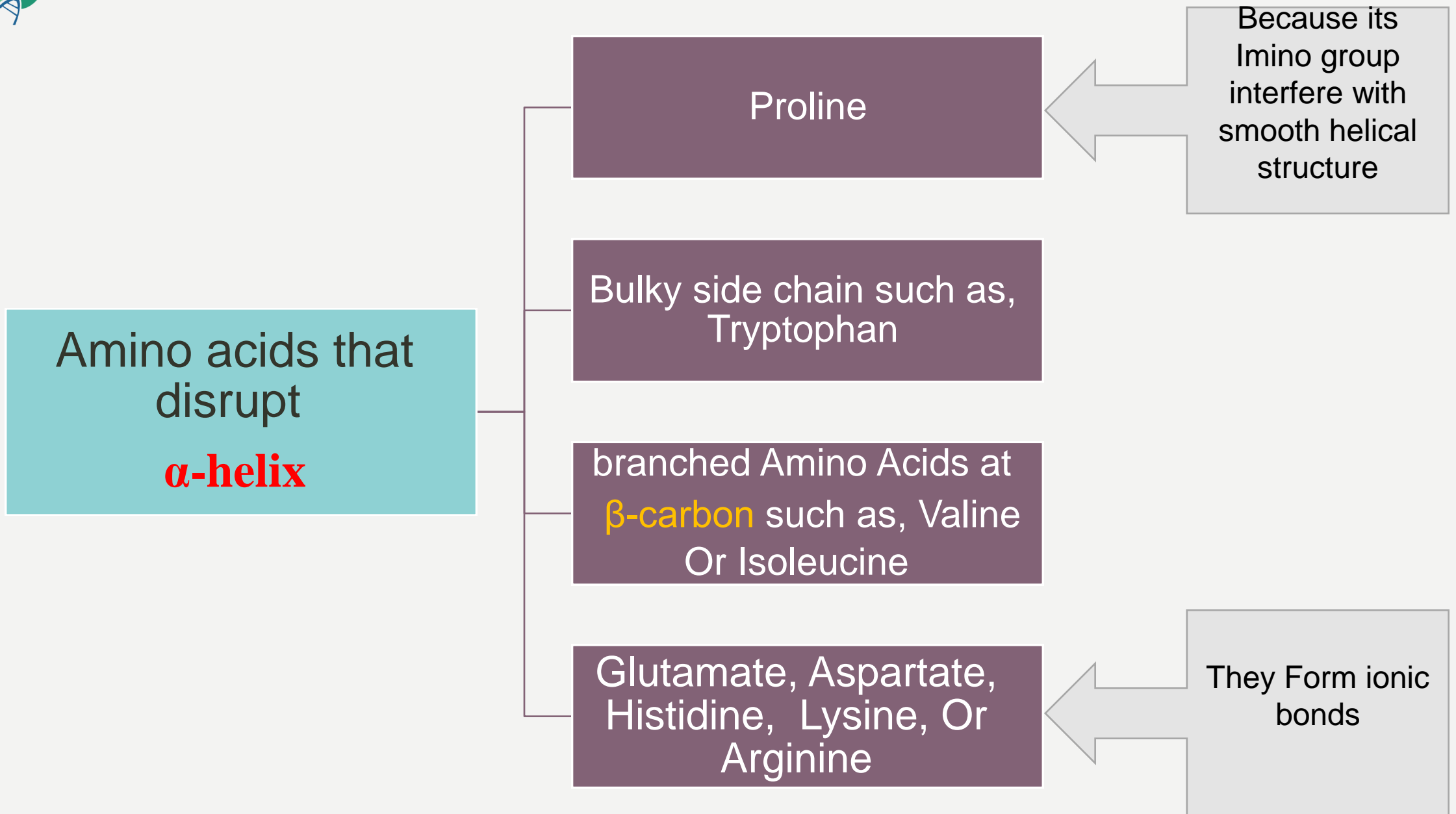
- **How it stabilized ?**

It is Stabilized by **hydrogen bond**; which is formed between the peptide bond **carbonyl Oxygen** and amide Hydrogen.

- **Amino Acids Per turn:**

Each turn contains **3.6** amino acids.





SECONDARY STRUCTURE: β -sheet

■ Composition:

Two or more polypeptide chains make hydrogen bonding with each other.

■ Called **plated sheets** because they appear as folded with edges.

■ β - sheet parallel & anti-parallel sheet :

1. Anti-parallel sheets:

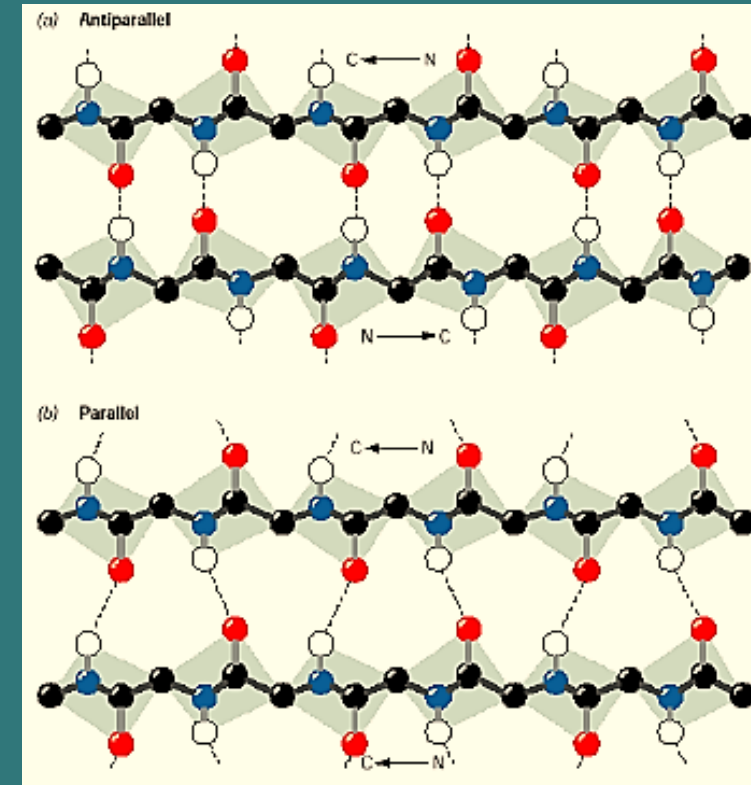
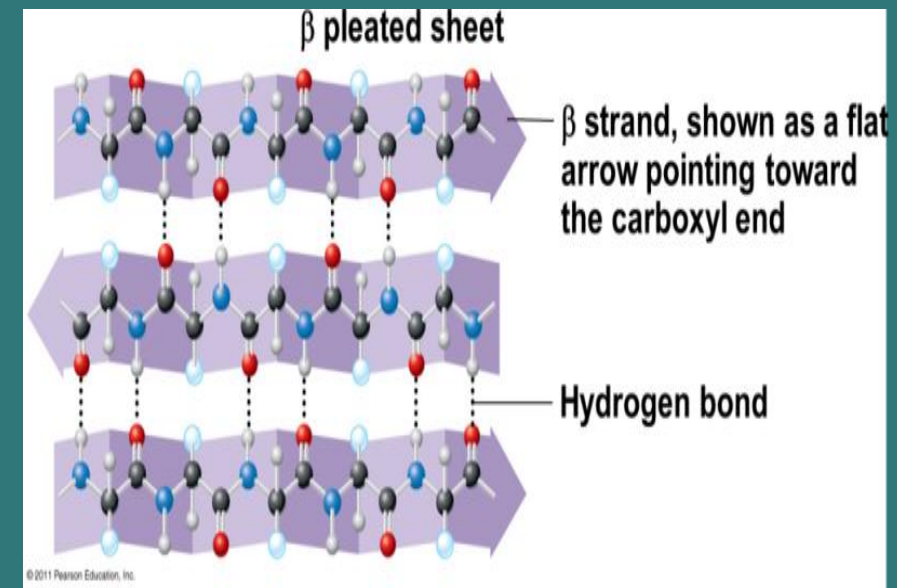
- When the arrows point in opposite directions.

- Hydrogen bond **is more stable** than in parallel sheets.

2. parallel sheets:

- When the arrows point in same direction.

- Hydrogen bond **is less stable** than in anti parallel sheets.



SECONDARY STRUCTURE: β -bends + Nonrepetitive

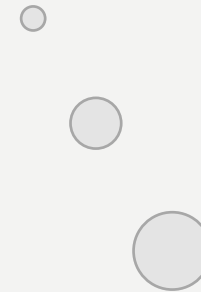
β -bends:

They have less Regular Shape than α -helix and β - sheet .. But that doesn't.

- Reverse direction of the chain.
- Found on : the surface of the molecule.
- generally composed of : 4 amino acids , proline or glycine are frequently found in β - bends

Nonrepetitive secondary structure

- Loop or coil conformation.



They have less Regular Shape that Alpha-helix and Beta helix .. So they occur in those shapes

SECONDARY STRUCTURE: Supersecondary structure(motifs):

- Supersecondary structure(motifs):

A combination of secondary structure elements



α α motif:
two α helices

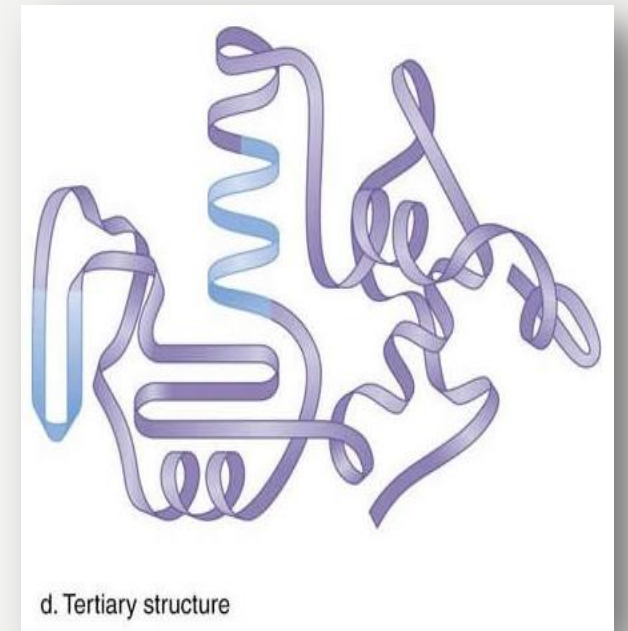
β α β motif

β hairpin
Antiparallel
connected
β-sheets

β barrels
Rolls of
β-sheets

TERTIARY STRUCTURE

- It is **The three dimensional 3D structure** of polypeptide chain including the side chain.
- The protein in this level **is functional**.
- The fundamental functional and 3D structure units of a polypeptide known as **domains**, if the polypeptide chain **>200 amino acids** → folded into two or more clusters.
- The core of a domain is built from : the combination of super secondary elements (motifs) and their side chains.
- Tertiary structure is made up of combination of domains.
- Tertiary structure is made up from at least two combined domains.



*نقدر نقول أن الدوماينز هي وحده التركيب في التيرشاري بروتيز .. إذا اتحدو أو صار بينهم كومبينيشن راح يكونون التيرشاري بروتيز ..

TERTIARY STRUCTURE:

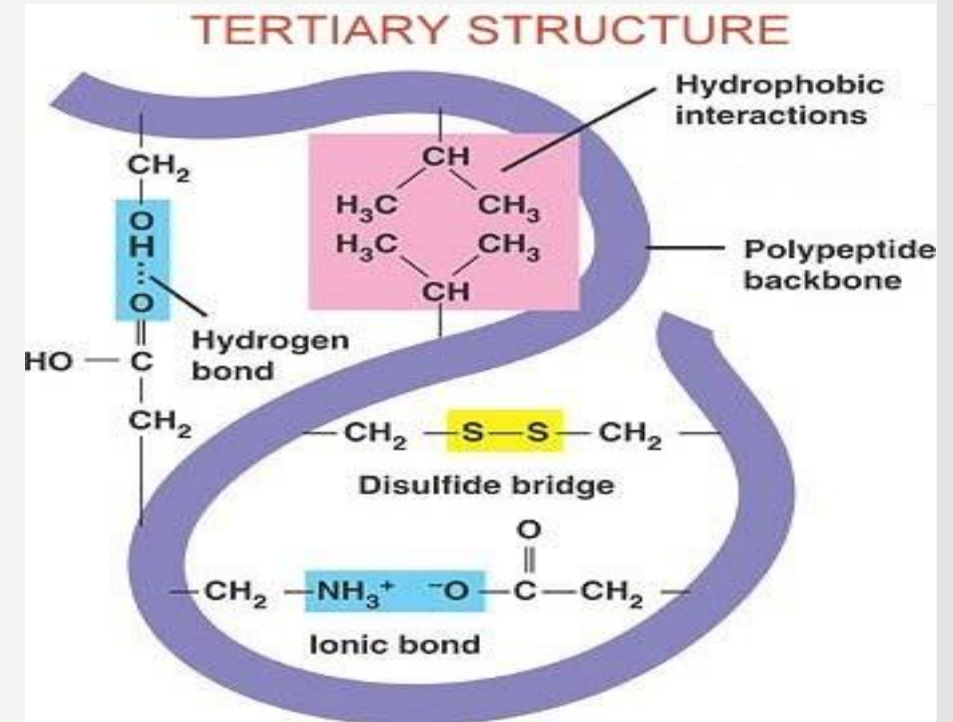
Tertiary structure stabilized interactions

Disulfide bonds

Ionic interactions

Hydrogen bonds

Hydrophobic interactions

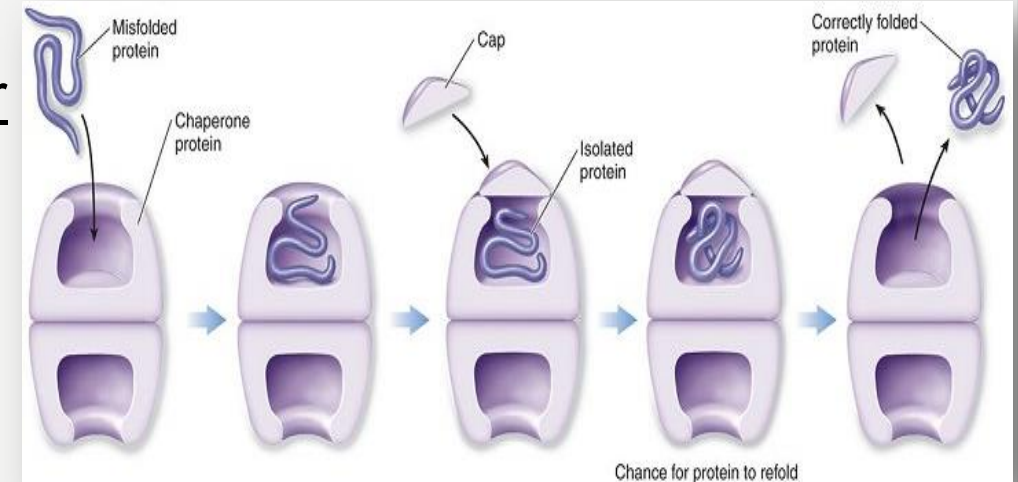


ROLE OF CHAPERONS IN PROTEIN FOLDING AT TERTIARY STRUCTURE:

▪ **What are Chaperons?**

they are specialized group of protein required for the proper folding of many species of proteins.

- They called : heat chock proteins.
- They interact with polypeptide at various stages during the folding process .

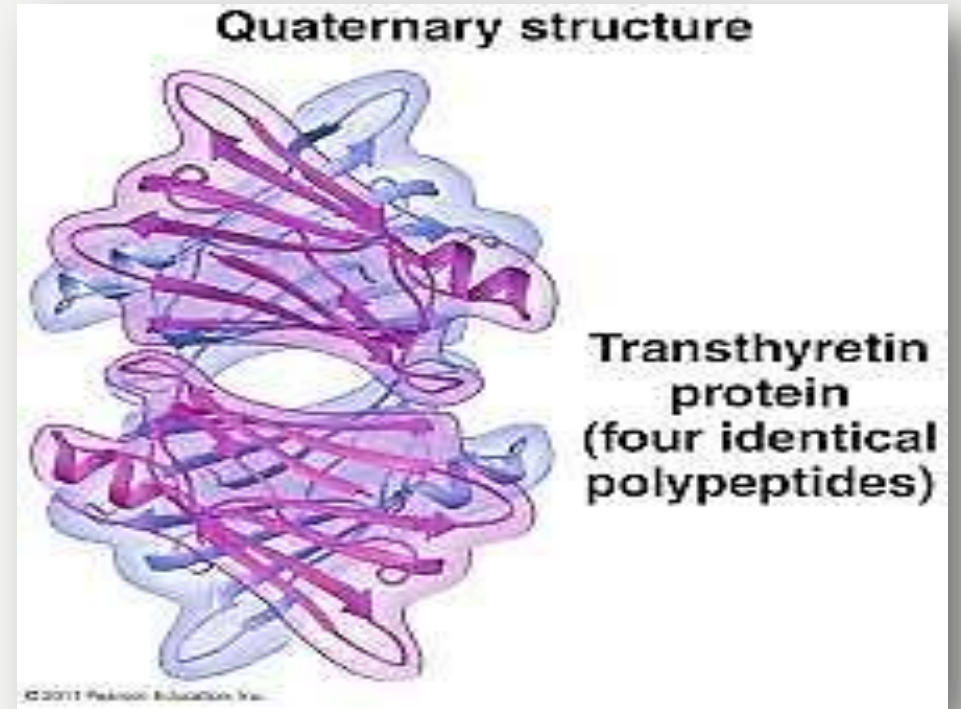


QUATERNARY STRUCTURE:

■ What is it?

proteins contain two or more polypeptide chains that are identical or unrelated .

- Each chain forms a 3D structure called **subunits**.
- **Subunits may work independently of each other or work cooperatively**, such as **hemoglobin** and tranthyretin.
- According to number of subunits : dimeric , trimeric or multimeric



- السب يونتس هي عبارہ عن بولي بيتايد تشاينز .. وهي اللي تكون الكوراتيناري بروتينز
- السب يونتس موب شرط تكون ادينتكال أو لها علاقه بعض!

QUATERNARY STRUCTURE:

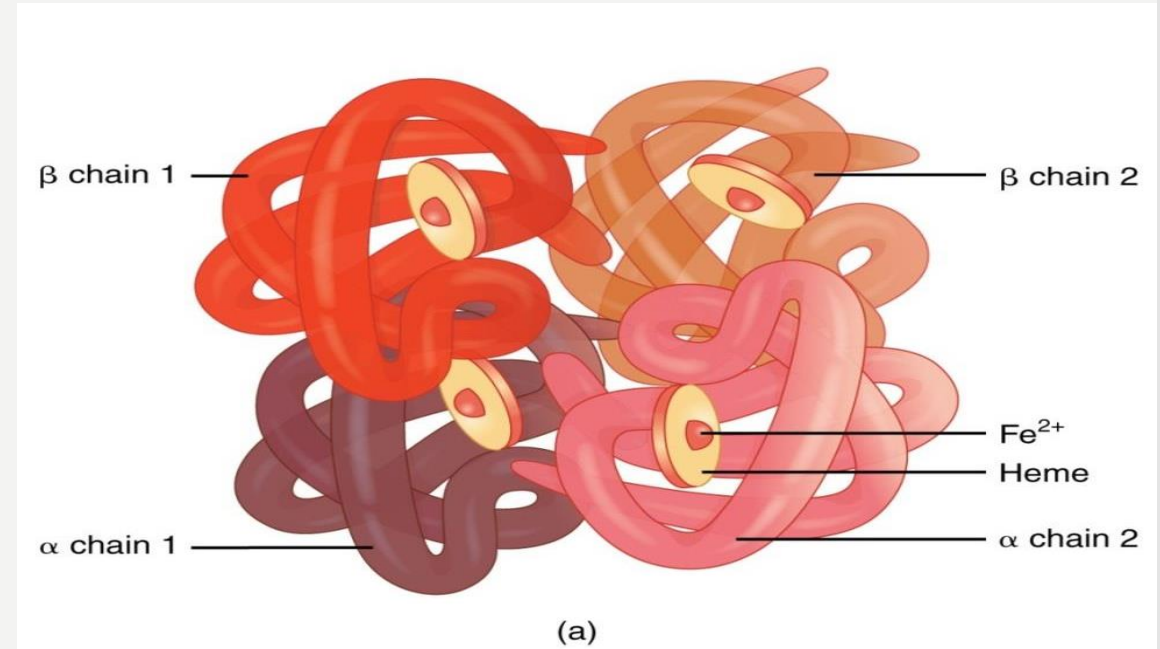
Hemoglobin as an example

- Hemoglobin is a globular protein.

- It composed of four subunits :

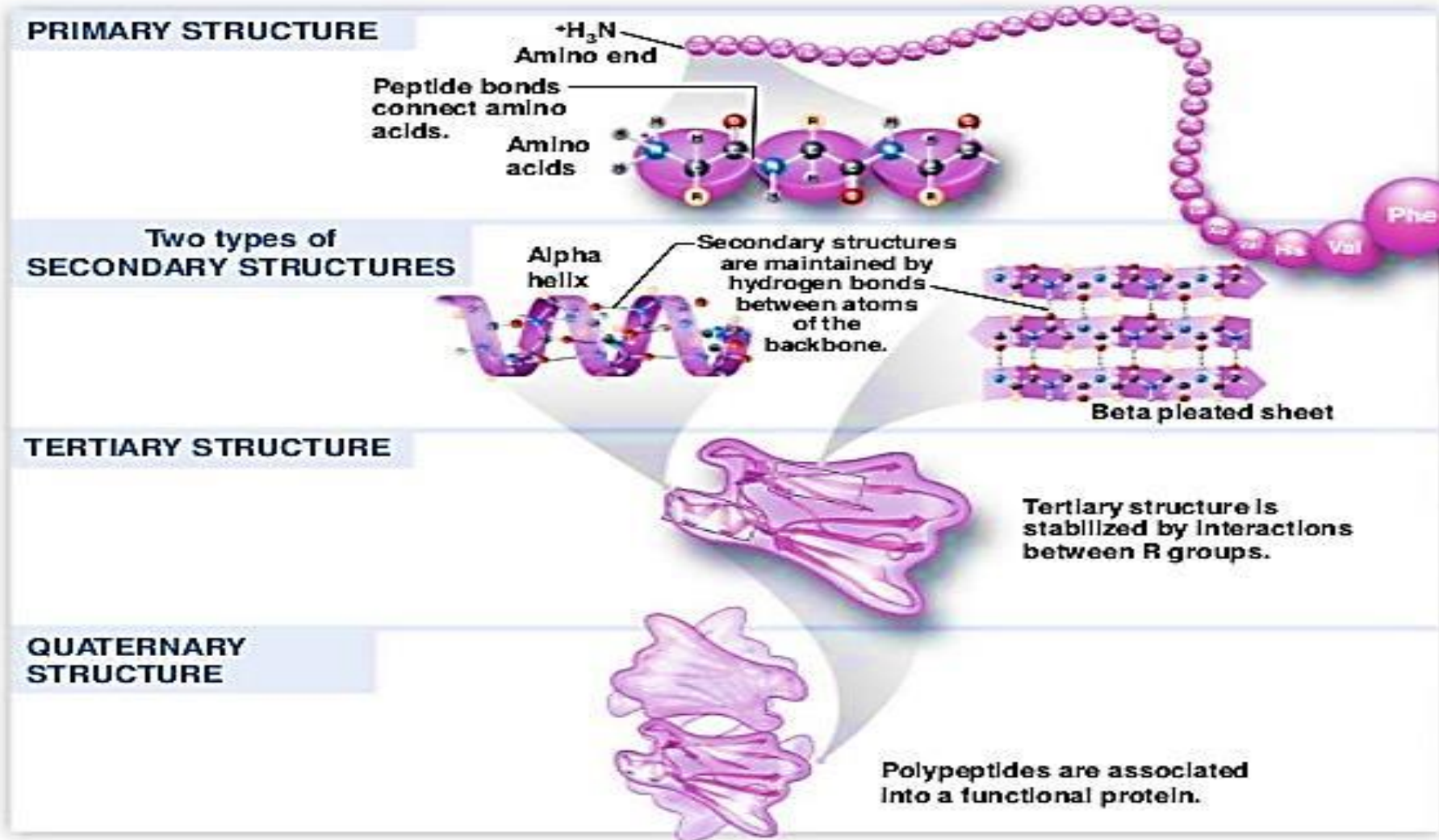
Two α and two β ($\alpha_2 \beta_2$ subunits) .

- Two same subunits are called protomers.
- A multisubunits is called oligomer.

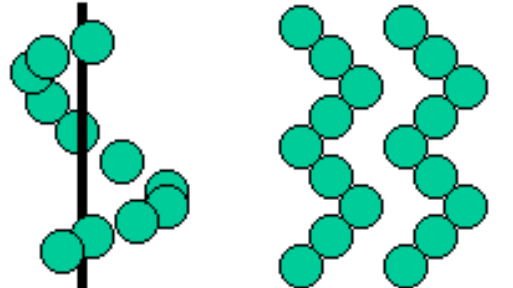
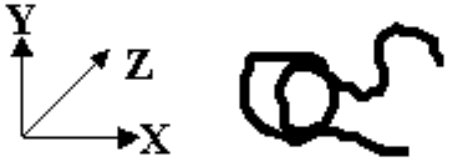



SUMMARY OF LEVELS OF PROTEIN STRUCTURE:

Figure 3.14-9-4

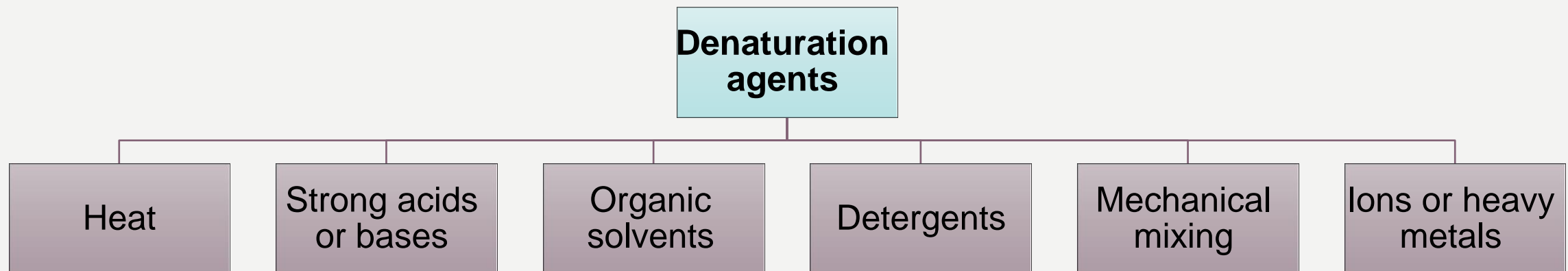
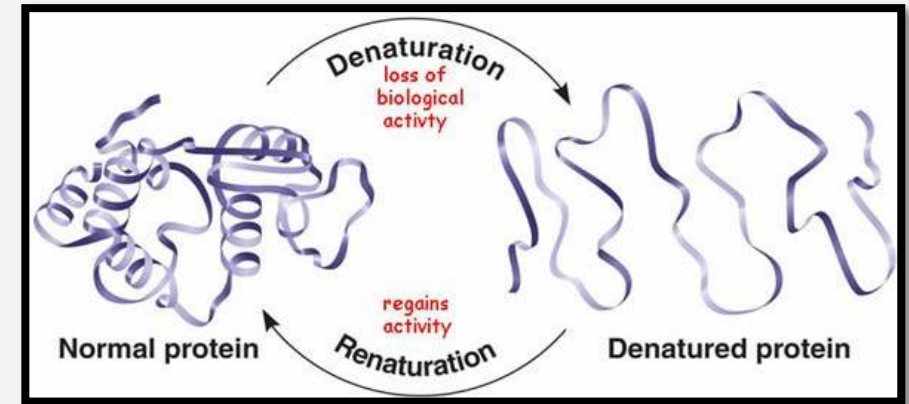


Protein Structure(Summary)

<ul style="list-style-type: none"> • Primary 	The amino acid sequence	Glu-Arg-Phe-Gly
<ul style="list-style-type: none"> • Secondary 	Characteristic structures that occur in many proteins (E.g. alpha helix , beta sheets)	 <p>alpha helix beta sheets</p>
<ul style="list-style-type: none"> • Tertiary 	Three dimensional structure of proteins	
<ul style="list-style-type: none"> • Quaternary 	Three dimensional structure of proteins composed of multiple subunits	

DENATURATION OF PROTEINS:

- It results in the unfolding and disorganization of the protein's secondary and tertiary structures.
- Once the protein denatured → remain permanently disordered.
- Denatured proteins are often insoluble and there for precipitate from soluble.



PROTEINS MISFOLDING :

- Every protein must fold to achieve its normal conformation and function
- Abnormal folding leads to number of diseases in human.

Alzheimer's disease

- β amyloid protein is a misfolding protein.
- It forms deposits or plaque in the brain of Alzheimer's patients.

Creutzfeldt-Jakob or prion disease

- Prion protein is misfolded of diseased brains tissues.
- It , therefore forms insoluble fibrous aggregates that damage cells of brain.

helpful videos :

- [Basic protein Structure.](#)
- [-Proteins Secondary structure.](#)'
- [Protein Quaternary structure.](#)
- [Protein Denaturation](#)

Boys Team:

- عبدالعزيز المالكي.

Girls Team:

- شهد العنزي.
- نوره الرميح .
- بدور جليدان.
- علا النهير.
- أفنان المالكي.
- أمجاد الدهيش.
- دلال الحزيمي.
- فاطمه الدين.
- جواهر الحربي.
- جوهره المالكي.
- خوله العريني.
- لجين السواط.
- منيال باوزير.
- نوره القحطاني.
- رزان السبتي .
- ريف العباد .
- وضحي العتيبي.
- ساره العنزي .

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