

Proteins



Objectives :

- *Describe the functions of proteins*
- *Draw the general structure of amino acids*
- *Describe how Amino acids are linked together through peptide bonds formed by condensation to form polypeptides*
- *State that there are 20 different amino acids in polypeptides synthesized on ribosomes.*
- *State that amino acids can be linked together in any sequence giving a huge range of possible polypeptides .*
- *State that the amino acid sequence of polypeptides is coded for by genes*
- *State that protein may consist of a single polypeptide or more than one polypeptide linked together.*
- *Explain how the amino acid sequence determines the three-dimensional conformation of a protein including the primary, secondary, tertiary and quaternary structure*
- *Explain the term denaturation*
- *Explain the term proteome*
- *Practical skill : Describe the test proteins using Biuret Reagent and be able to compare the content of proteins in different foods*

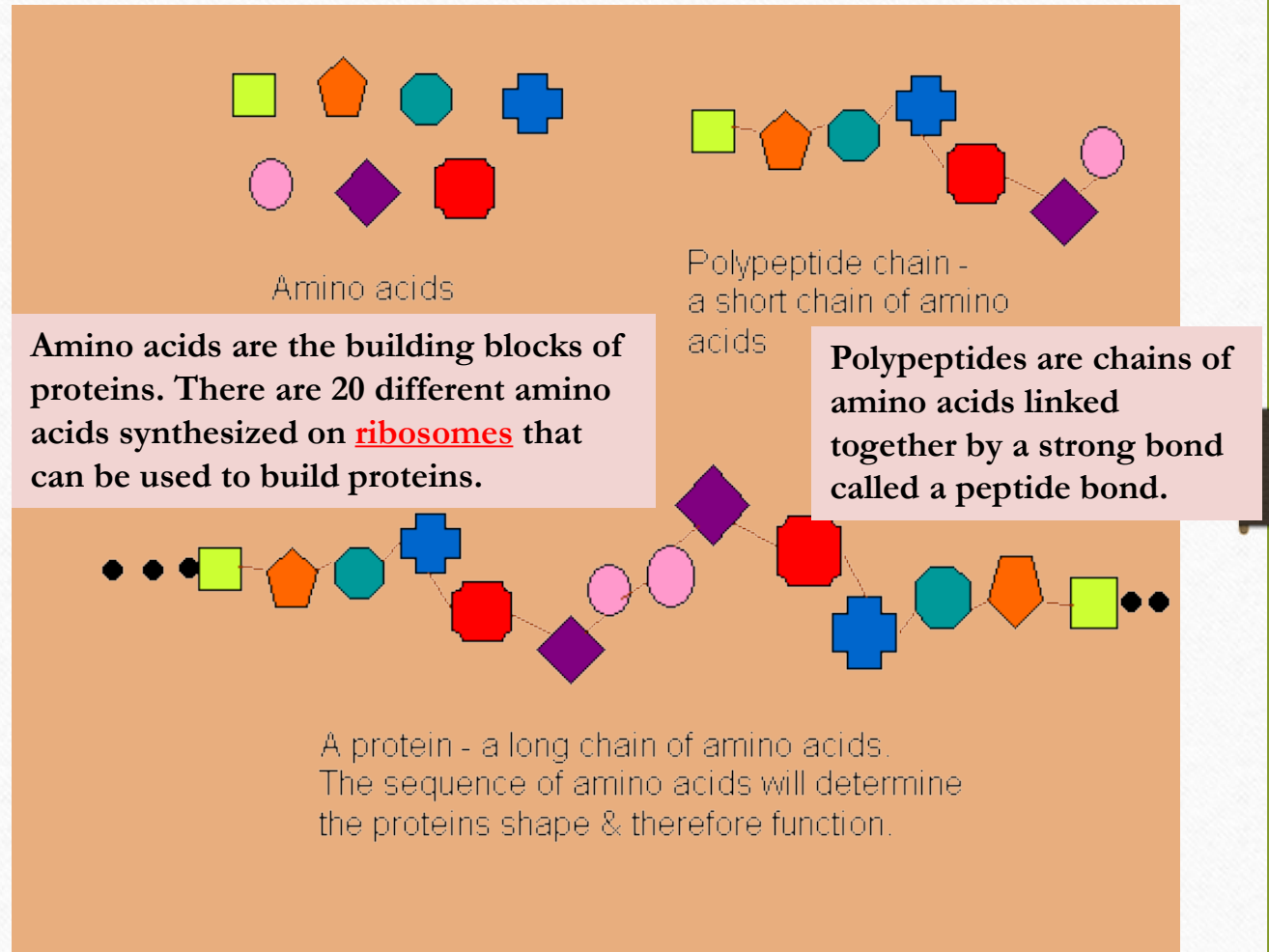
Resources :

Book pages 34,35,36,37,38

What are proteins ?

Proteins are large carbon compounds composed of long chains of amino acids called polypeptides.

Proteins perform important functions in living things and they are essential for life. That is why we need to regularly consume food that contains proteins. Such food includes beans, meat, milk and fish. There are different types of proteins in an organism or even in a cell. They are more diverse in their structures and function than any other macromolecule in living organisms.

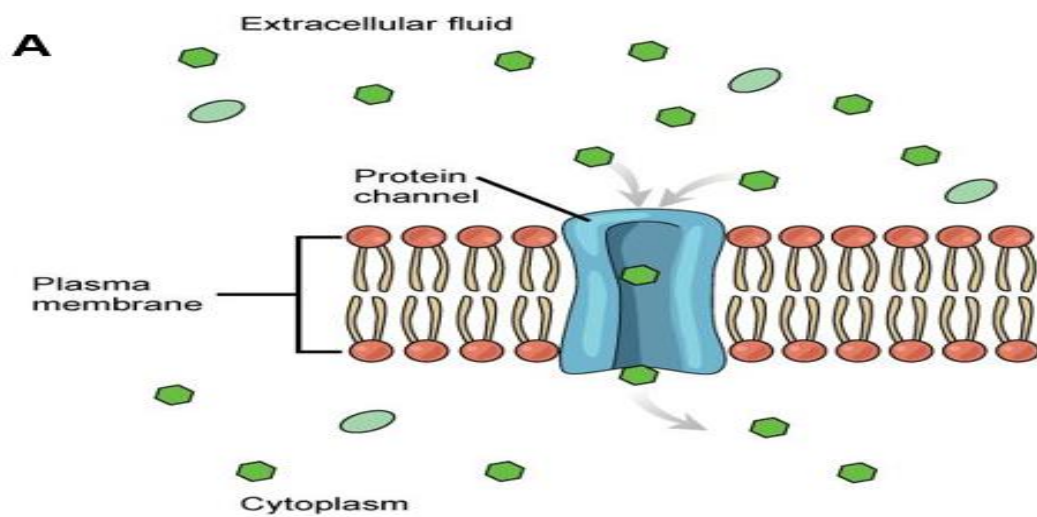
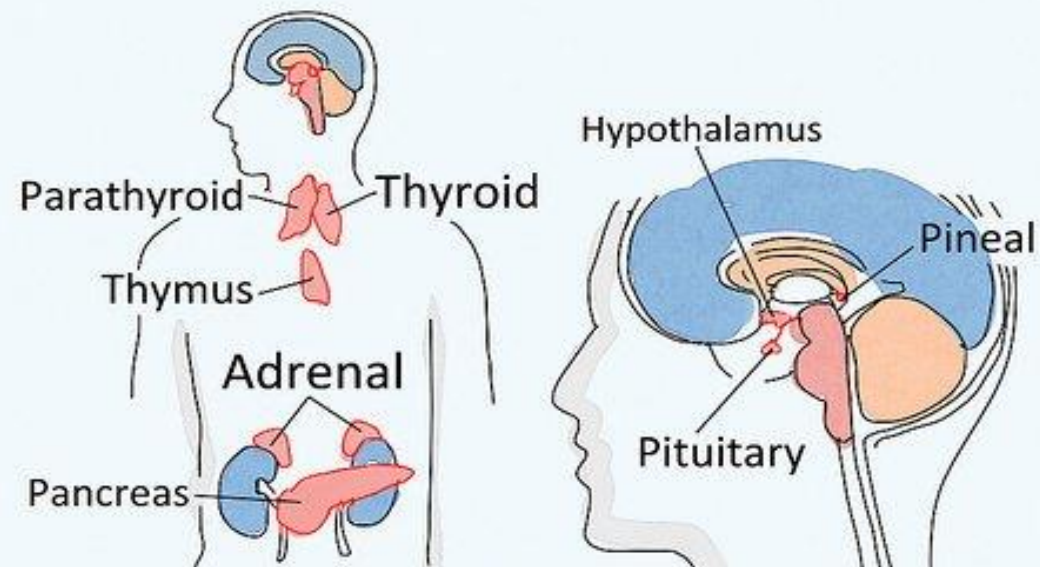
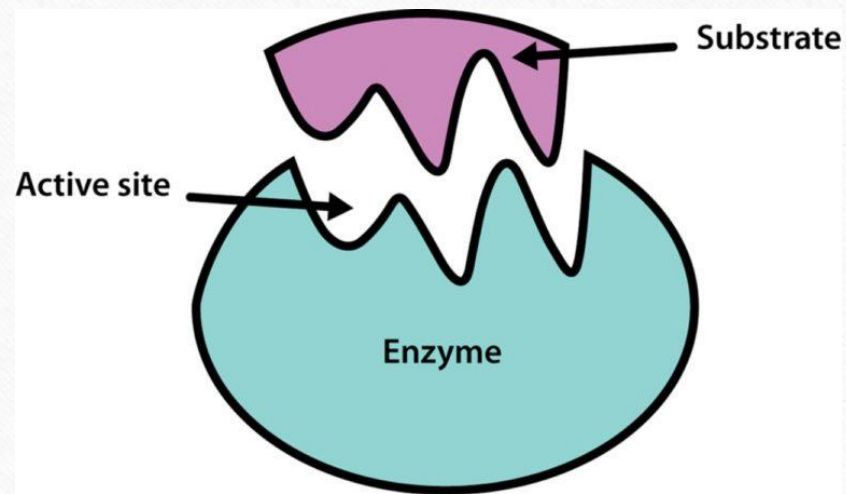


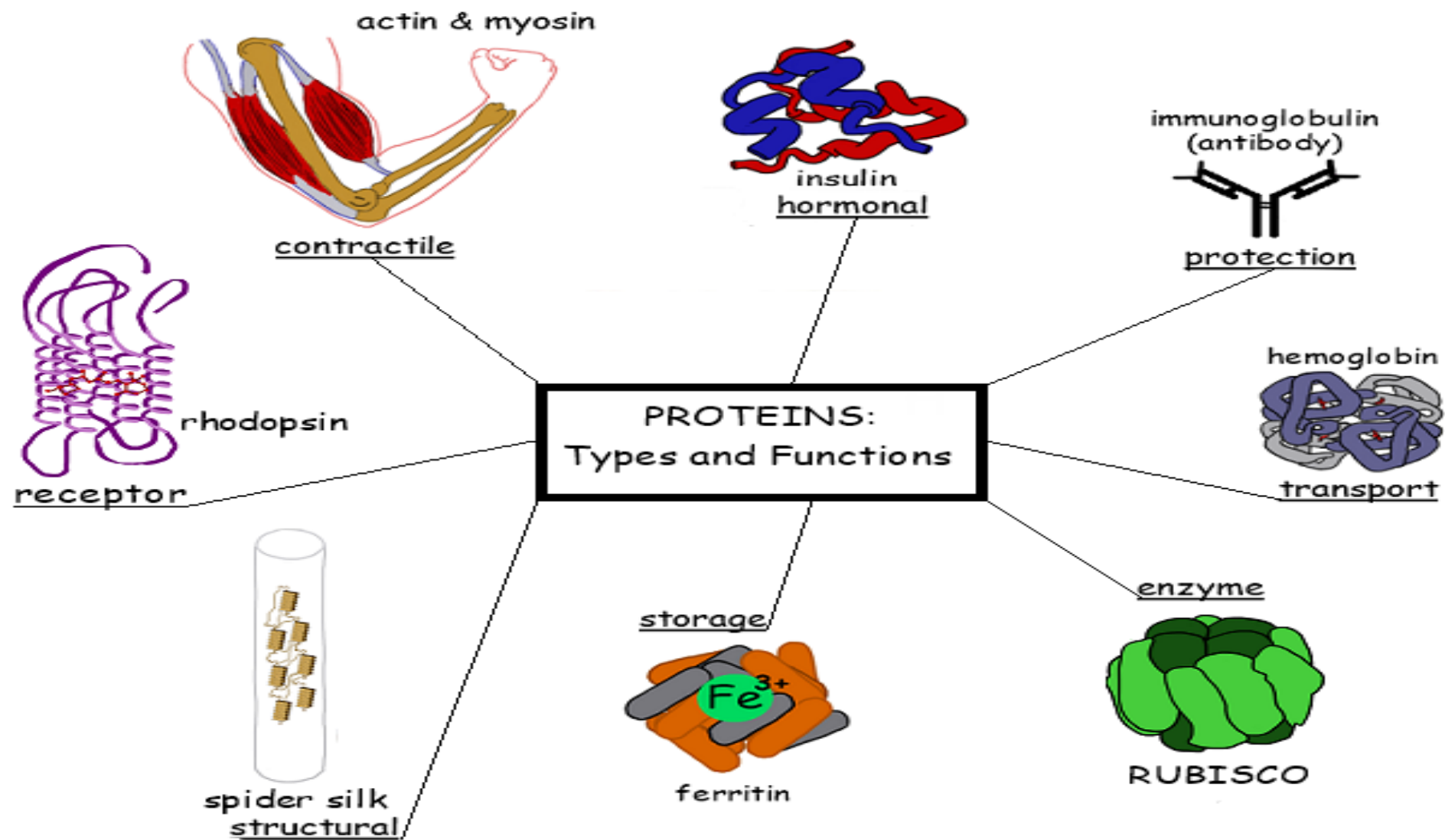
Functions of proteins :

<https://www.youtube.com/watch?v=E7mq8bv4g>

Proteins perform different functions in living organisms. Some examples of the functions of proteins include:

- ✓ Proteins maintain the structure of the body- for example, collagen strengthens bones and skin.
- ✓ Some proteins act as enzymes and speed up metabolic reactions for example, amylase is an enzyme that breaks down starch to simple molecules.
- ✓ Some proteins act as hormones to trigger a specific response in the body to control body functions-for example, insulin is a hormone that regulates blood sugar in the body.
- ✓ Proteins have a major role in immune response--for example, antibodies assist in destroying foreign particles in the body such as bacteria and viruses.
- ✓ Proteins facilitate the transportation of certain molecules in the body--for example, hemoglobin transports oxygen throughout the body.





Structure of protein : <https://www.youtube.com/watch?v=JGZj6DsUZhE>

↑
Revision

The building blocks of all proteins are **amino acids**. Proteins vary in their structure from a very simple amino acid chain to a very complex subunit.

Each amino acid is made of **three main parts**: **an amino group (-NH₂)**, **a carboxyl group (-COOH)** and **an "R-group"**. The identity of this R-group varies between different amino acids--this is what distinguishes one amino acid from another.

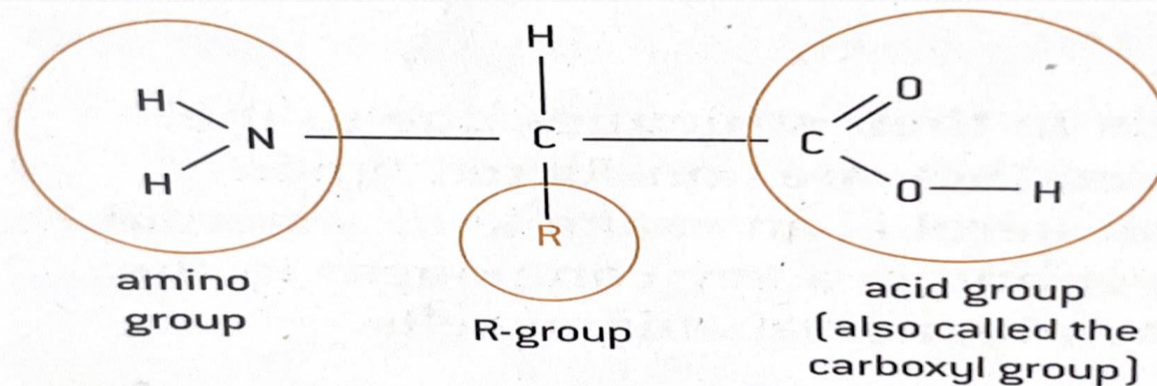
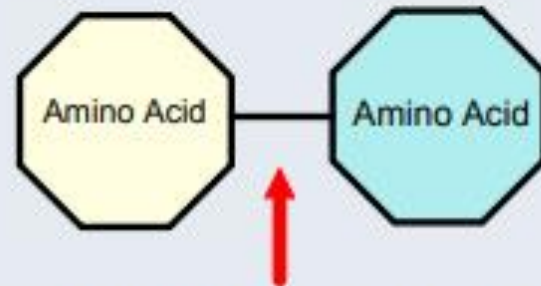


Figure 14. The basic structure of an amino acid

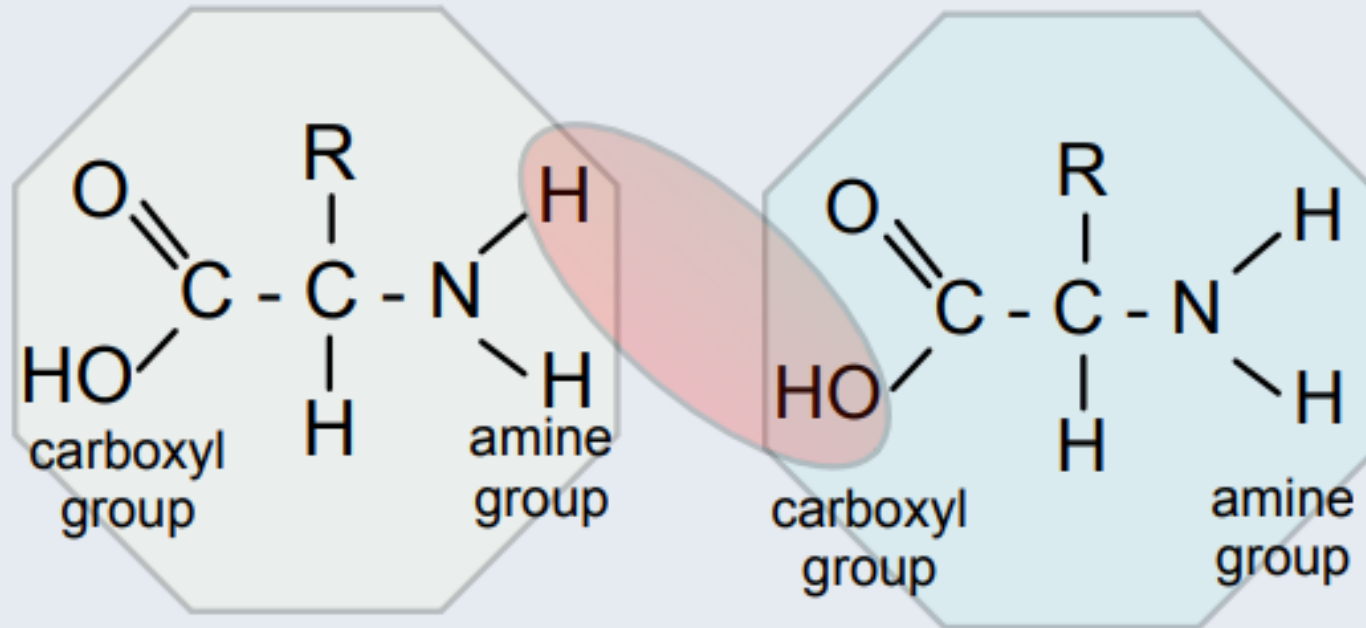
Two Amino Acids make a Di-peptide



They are joined together by a type covalent bond called a 'Peptide Bond'

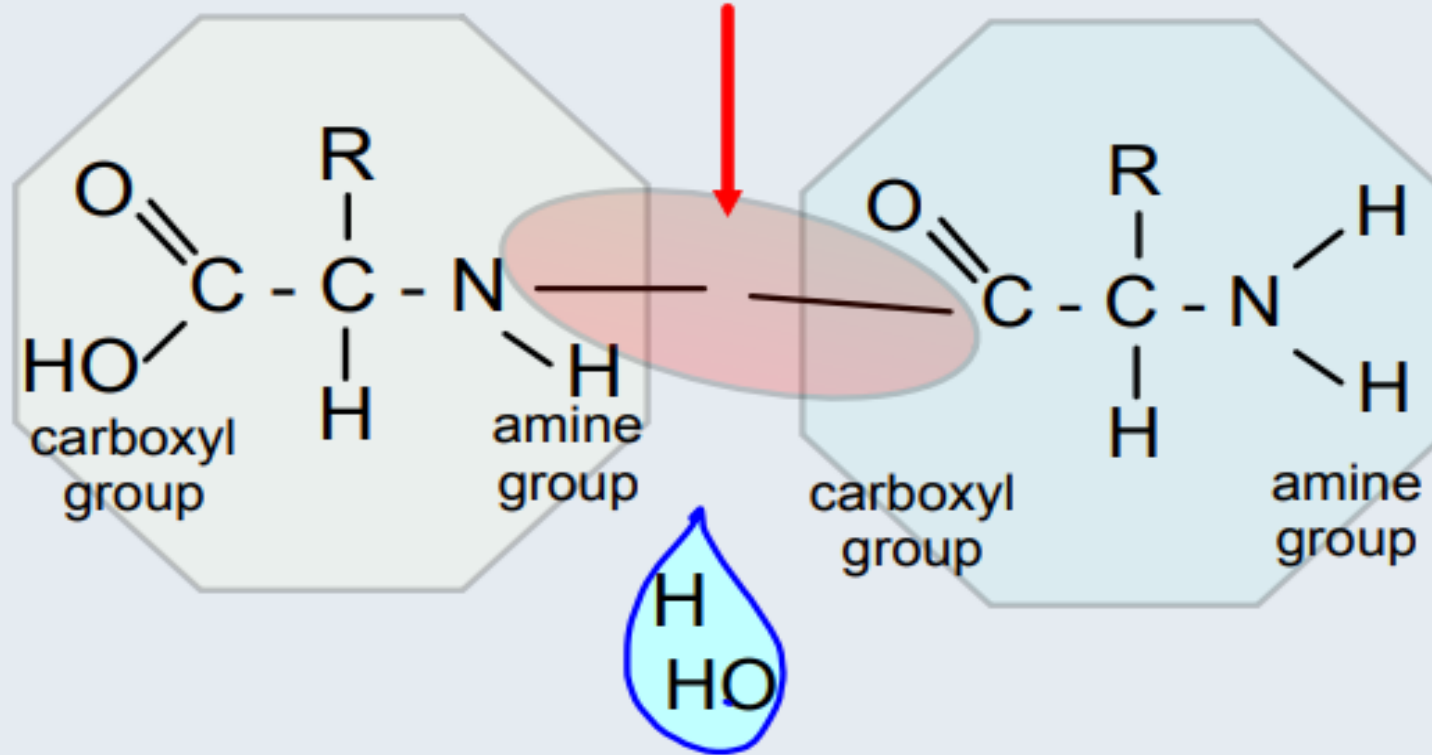
The formation of a peptide bond is a condensation reaction.
A water molecule is formed during the reaction
from an -OH and a -H group.

Amino acids have a carboxyl group at one end and an amine group at the other end.



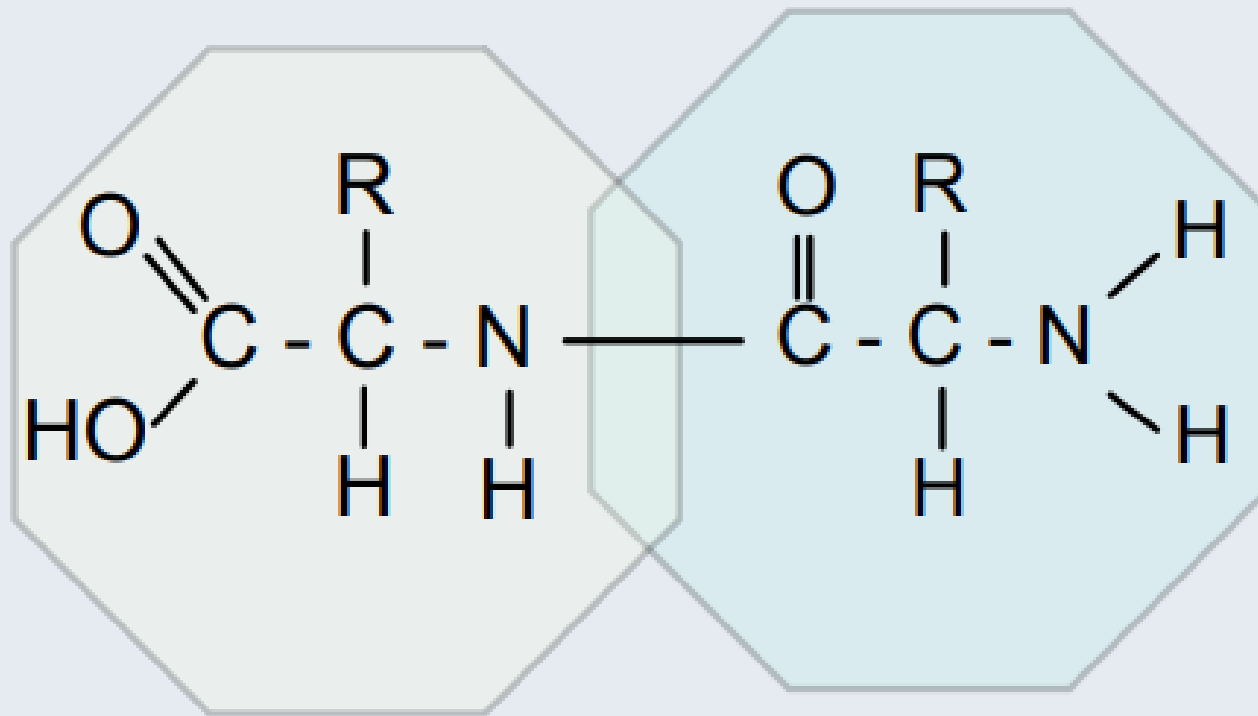
To form a peptide bond the carboxyl group of one amino acid reacts with the amine group of another.

The carboxyl group reacts with the amine group forming a peptide bond.



The H and OH form water, which is removed in a condensation reaction.

A dipeptide molecule



+ H₂O

The covalent bond between N - C is a peptide bond

Five Facts to Remember

Two amino acids form a dipeptide.

The carboxyl group of one amino acid reacts with the amine group of another amino acid.

A water molecule is eliminated in a condensation reaction.

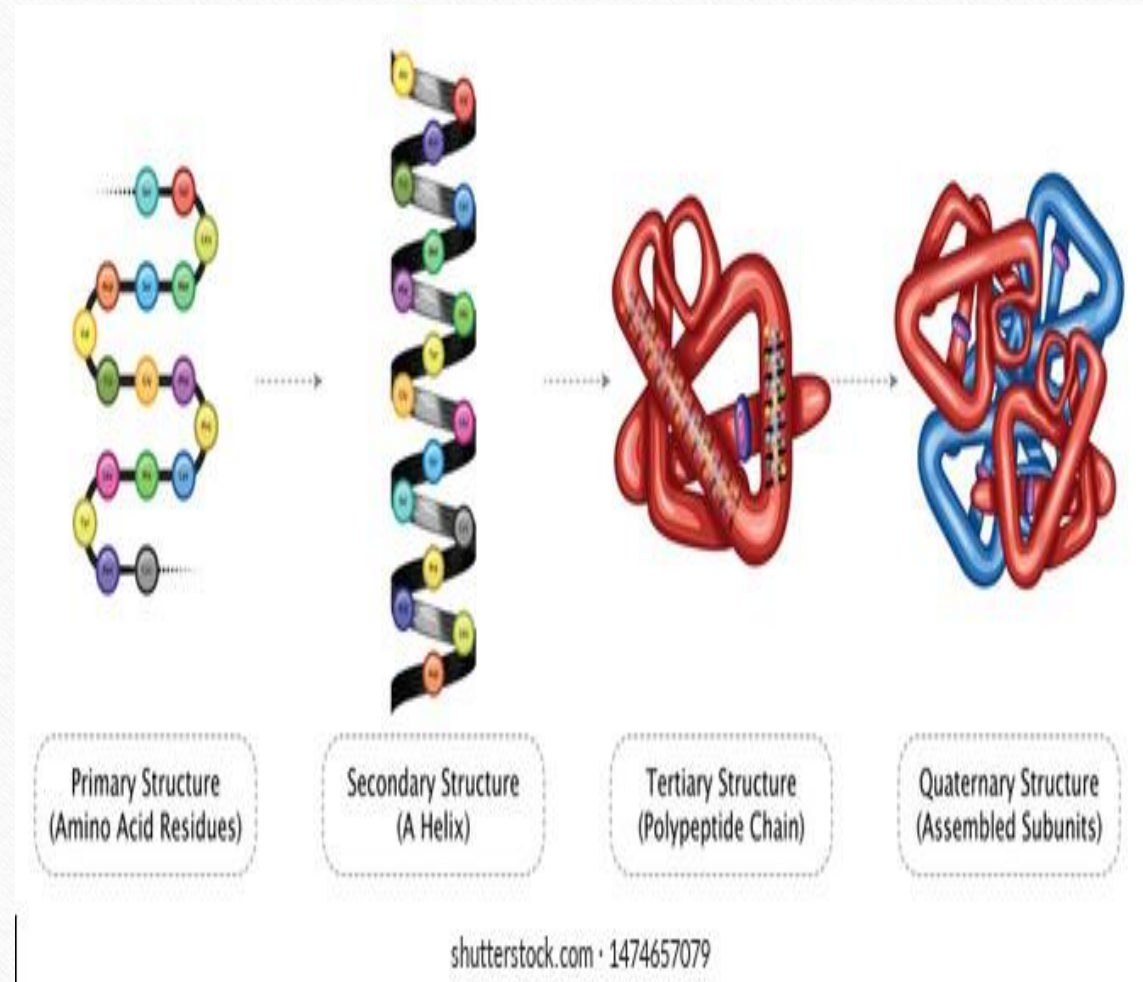
A peptide bond is formed between N and C.

This is a covalent bond.

Amino acids are linked together by a peptide bond to form polypeptide chains. A protein may consist of a single polypeptide or more than one polypeptide linked together. The long polypeptide chains that form proteins fold to create three-dimensional shapes.

There are four main types (or structures) used to describe the folding and overall structure of polypeptides:

- ❖ Primary
- ❖ Secondary
- ❖ Tertiary
- ❖ Quaternary.



Primary



α Helix



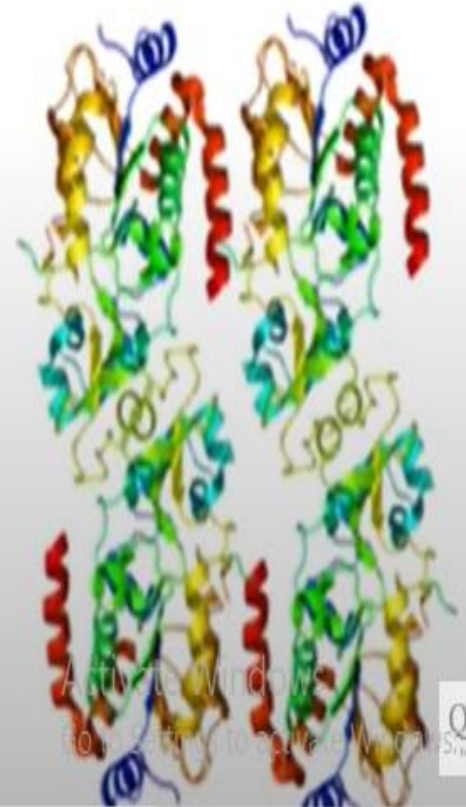
β sheet



Tertiary



Quaternary



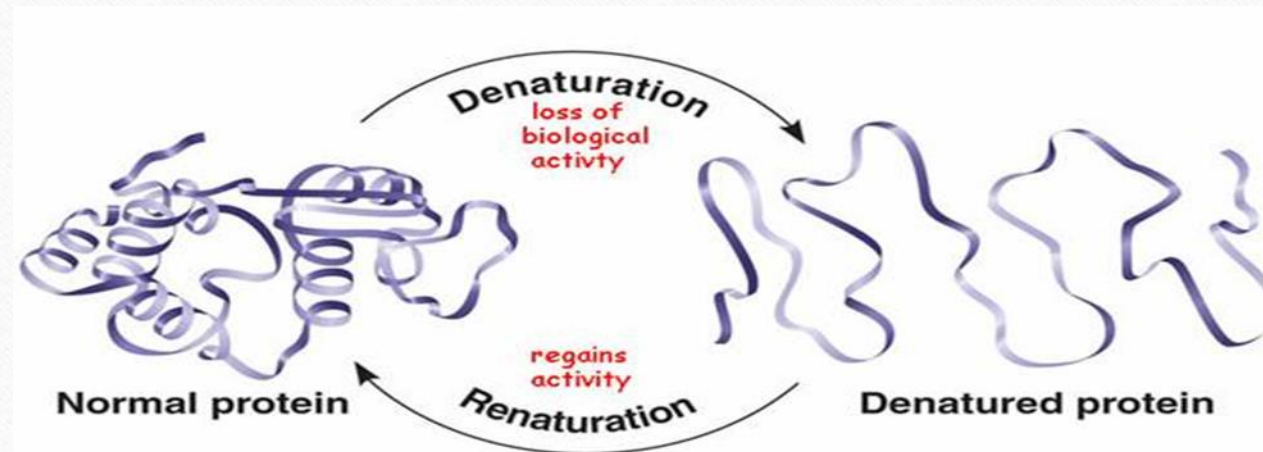
Proteome :

A proteome is a set of **proteins produced in an organism, system, or biological context.**

The importance of the proteome cannot be overstated as it is **the proteins within the cell that provide structure, produce energy, as well as allow communication, movement, and reproduction.** Basically, proteins provide structural and functional framework for cellular life.

Denaturation :

When proteins are exposed to extreme conditions such as heat, or strong acids or bases, they become denatured. This means that proteins will lose their secondary and tertiary structures; when these extreme conditions are implemented, the bonds within the protein structure break and this results in the altering of the shape of the protein. When the protein denatures, it returns to its primary structure.



1. Heat causes vibrations within protein molecules that break intramolecular bonds and cause the conformation to change. Heat denaturation is almost always irreversible.

This can be demonstrated by heating egg white, which contains dissolved albumin proteins. The albumins are denatured by the heat and in their new conformation are insoluble.

This causes the liquid egg white to turn into a white solid.



2. Every protein has an ideal or optimum pH at which its conformation is normal. If the pH is increased by adding alkali or decreased by adding acid, the conformation of the protein may initially stay the same but denaturation will eventually occur when the pH has deviated too far from the optimum. **This is because the pH change causes intramolecular bonds to break within the protein molecule.** The photograph shows egg white mixed with hydrochloric acid.



Lab visit / Test for protein

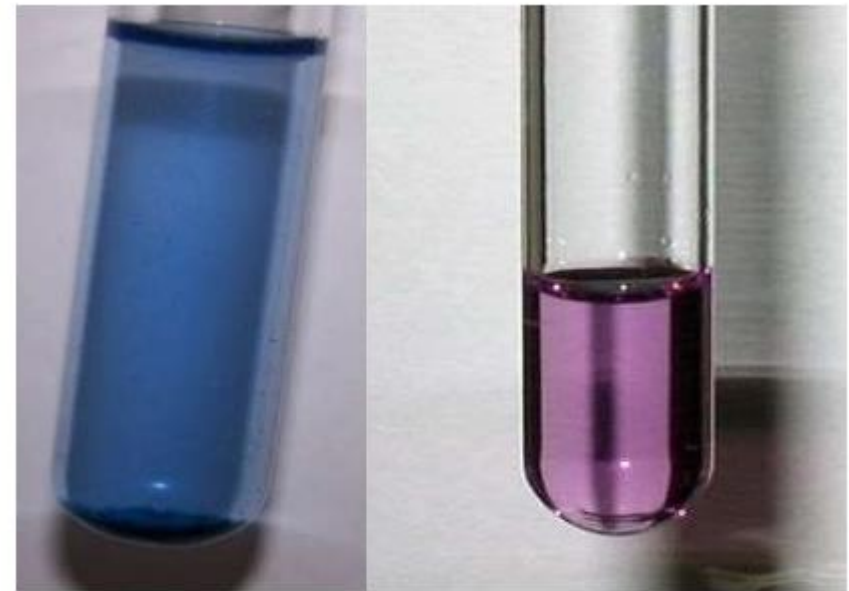
<https://www.youtube.com/watch?v=ufec89A47uM>

Preparation Biuret reagent

Biuret reagent is prepared by adding NaOH in CuSO_4 solution, making it alkaline.

Procedure :

1. Take 1 ml of test solutions in dry test tubes and in another tube take 1 ml distilled water as control.
2. Add 1 ml of biuret reagent to all test tubes, mix well.
3. Look for the development of blue colors



negative biuret
test results

positive biuret
test results