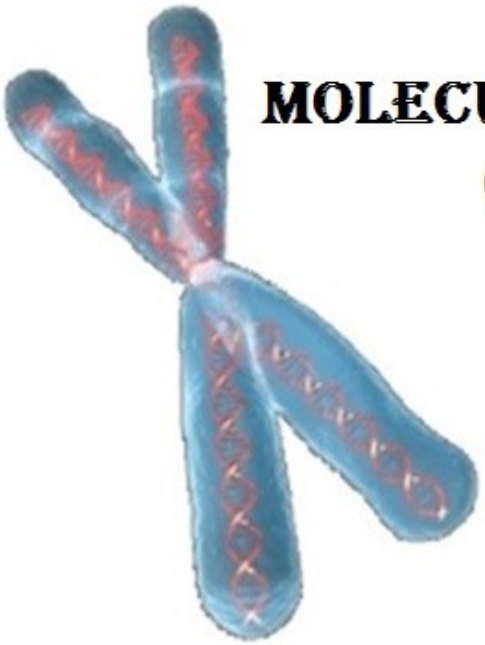
Lecture : 6

زانکۆی سەلاحەدین - هەولێر
Salahaddin University-Erbil



MOLECULAR GENETICS

Subject : **PROTEIN & AMINO ACIDS**

Animal Resources Department

2nd stage

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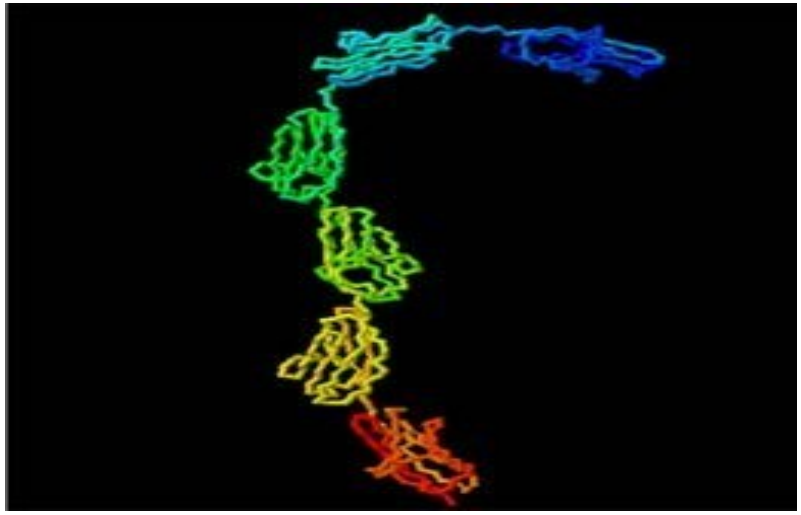
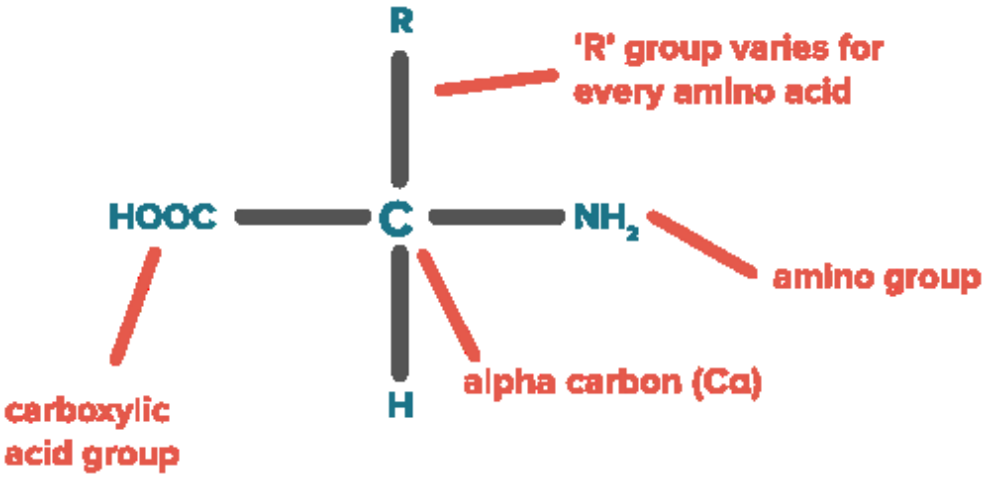
Introduction

- Twenty percent of the human body is made up of proteins. Proteins are the large, complex molecules that are critical for normal functioning of cells.
- They are essential for the structure, function, and regulation of the body's tissues and organs.
- Proteins are made up of smaller units called amino acids, which are building blocks of proteins. They are attached to one another by peptide bonds forming a long chain of proteins.



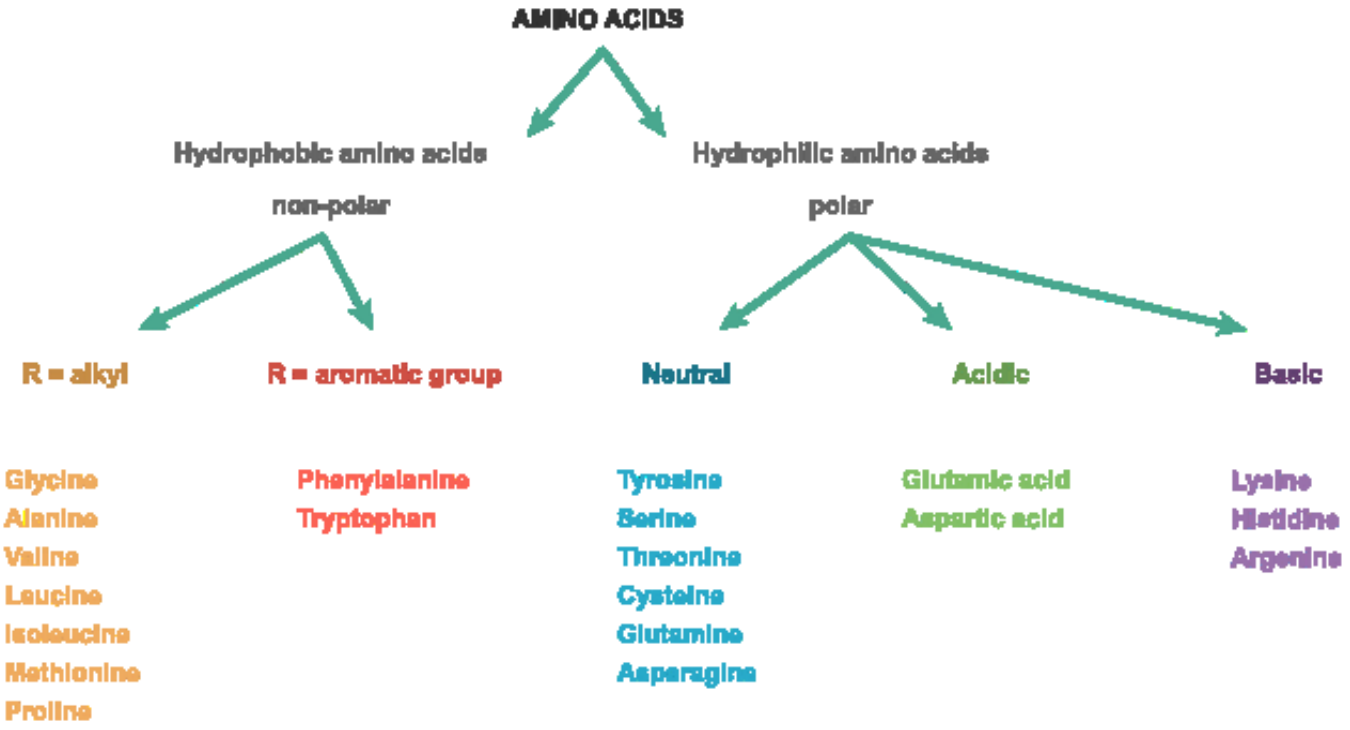
Amino acid structure and its classification

- An amino acid contains both a carboxylic group and an amino group. Amino acids that have an amino group bonded directly to the alpha-carbon are referred to as **alpha amino acids.**
- Every alpha amino acid has a carbon atom, called an **alpha carbon**, C*a* ; bonded to a **carboxylic acid**, –COOH group; an **amino**, –NH2 group; a hydrogen atom; and an R group that is unique for every amino acid.



Classification of amino acids

- There are 20 amino acids. Based on the nature of their 'R' group, they are classified based on their polarity as:



Classification based on essentiality:

Essential amino acids are the amino acids which you need through your diet because your body cannot make them. Whereas, **non-essential amino acids** are the amino acids which are not an essential part of your diet because they can be synthesized by your body.

Essential

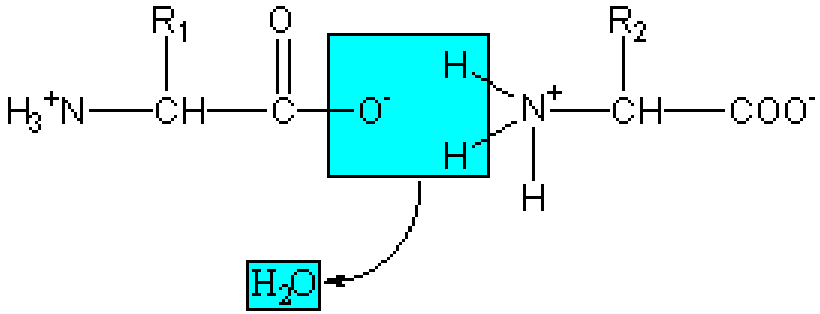
Histidine
Isoleucine
Leucine
Methionine
Phenyl alanine
Threonine
Tryptophan
Valine

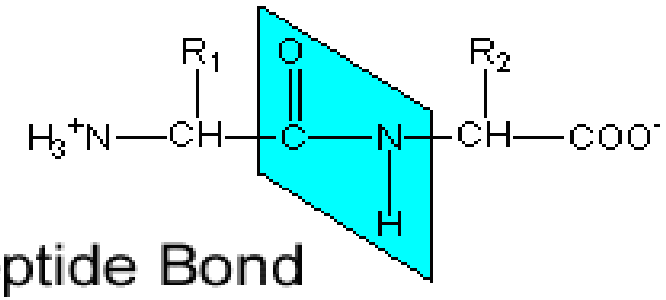
Non essential

Alanine
Arginine
Aspargine
Aspartate
Cystine
Glutamic acid
Glycine
Ornithine
Proline
Serine
Tyrosine

Peptide bonds

- Amino acids are linked together by 'amide groups' called peptide bonds.
- During protein synthesis, the carboxyl group of amino acid at the end of the growing polypeptide chain reacts with the amino group of an incoming amino acid, releasing a molecule of water. The resulting bond between the amino acids is a peptide bond.



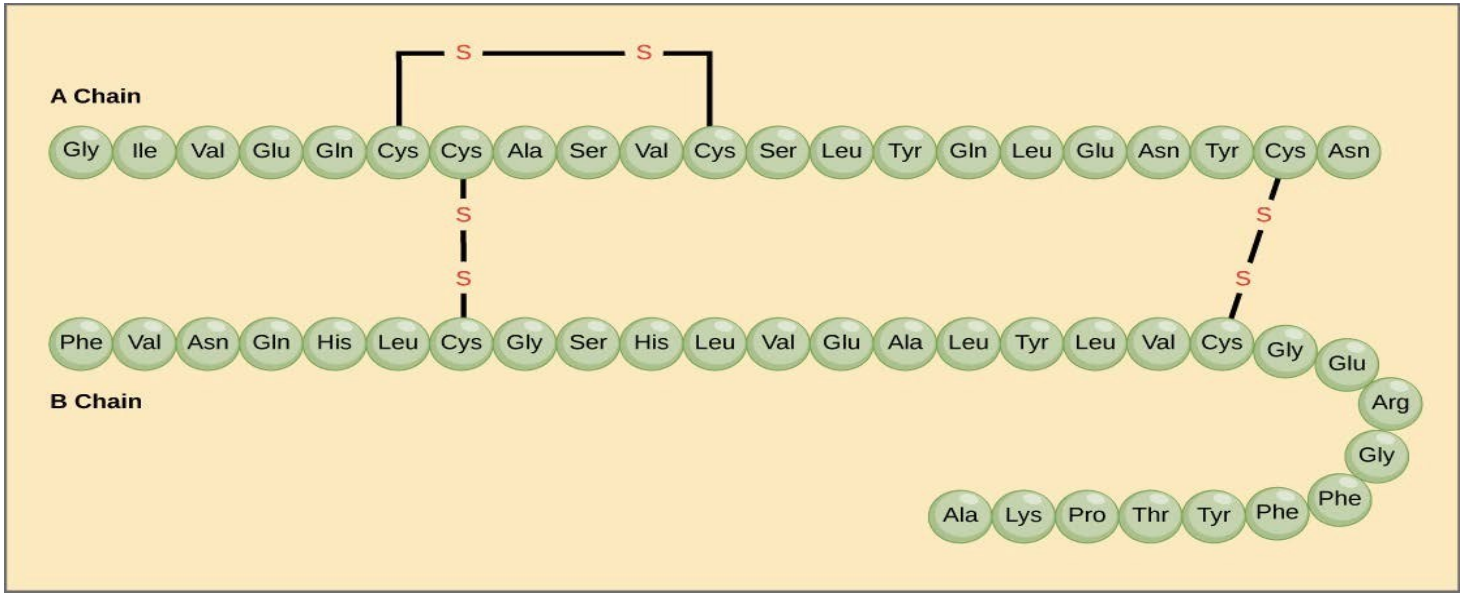


Structure of proteins

- The sequence of a protein is determined by the DNA of the gene that encodes the protein (or that encodes a portion of the protein, for multi-subunit proteins).
- A change in the gene's DNA sequence may lead to a change in the amino acid sequence of the protein. Even changing just one amino acid in a protein’s sequence can affect the protein’s overall structure and function.
- To understand how a protein gets its final shape or conformation, we need to understand the four levels of protein structure: primary, secondary, tertiary, and quaternary

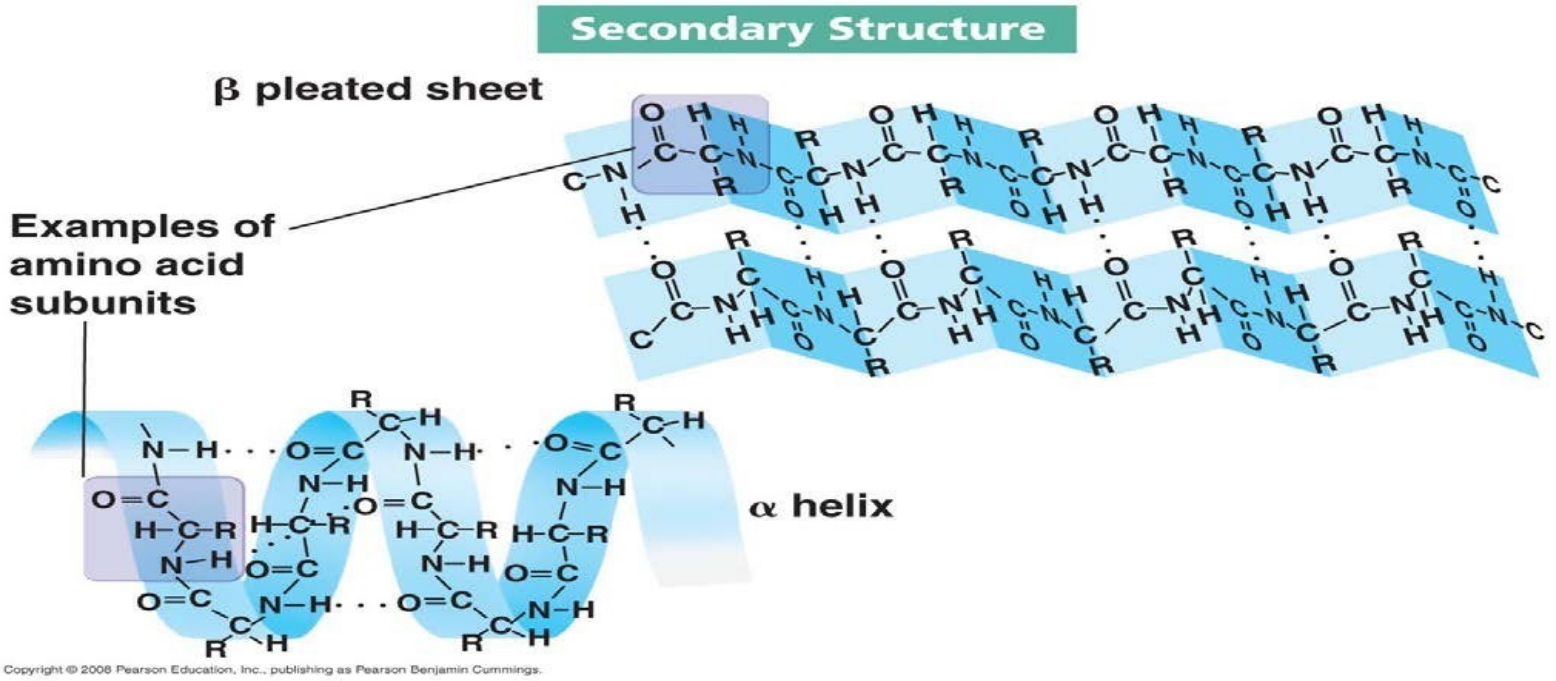
Primary Structure

- The simplest level of protein structure, primary structure is simply the sequence of amino acids in a polypeptide chain.
- The hormone insulin has two polypeptide chains A, and B. The sequence of the A chain, and the sequence of the B chain can be considered as an example for primary structure.



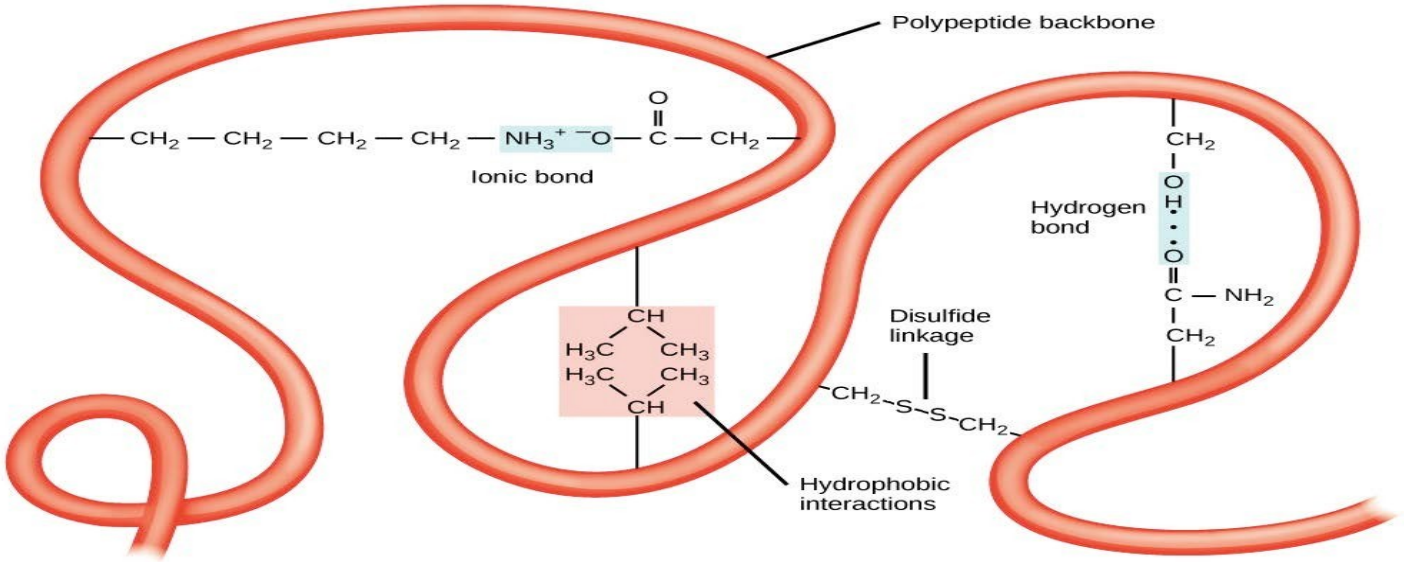
Secondary structure

- **secondary structure**, refers to local folded structures that form within a polypeptide due to interactions between atoms.
- The most common types of secondary structures are the α helix and the β pleated sheet. Both structures are held in shape by hydrogen bonds, which form between the carbonyl O of one amino acid and the amino H of another.



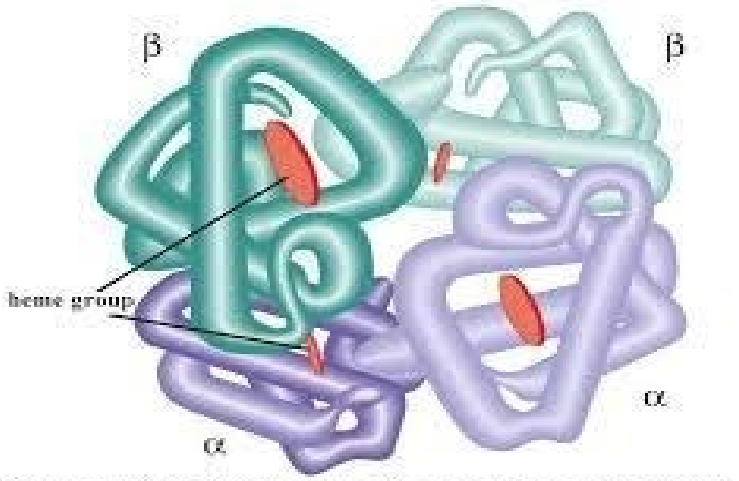
Tertiary structure

- The overall three-dimensional structure of a polypeptide is called its **tertiary structure**. The tertiary structure is primarily due to interactions between the R groups of the amino acids that make up the protein.
- Important to tertiary structure are **hydrophobic interactions**, in which amino acids with nonpolar, hydrophobic R groups cluster together on the inside of the protein, leaving hydrophilic amino acids on the outside to interact with surrounding water molecules.



Quaternary structure

- When multiple polypeptide chain subunits come together, then the protein attains its quaternary structure.
- An example for quaternary structure is hemoglobin. The hemoglobin carries oxygen in the blood and is made up of four subunits, two each of the α and β types.



Quaternary Protein Structue: Three-dimensional assembly of subunits

Denaturation and protein folding

- Each protein has its own unique shape. If the temperature or pH of a protein's environment is changed, or if it is exposed to chemicals, these interactions may be disrupted, causing the protein to lose its three-dimensional structure and turn back into an unstructured thread of amino acids.
- When a protein loses its higher-order structure, but not its primary sequence, it is said to be **denatured**. Denatured proteins are usually non-functional.