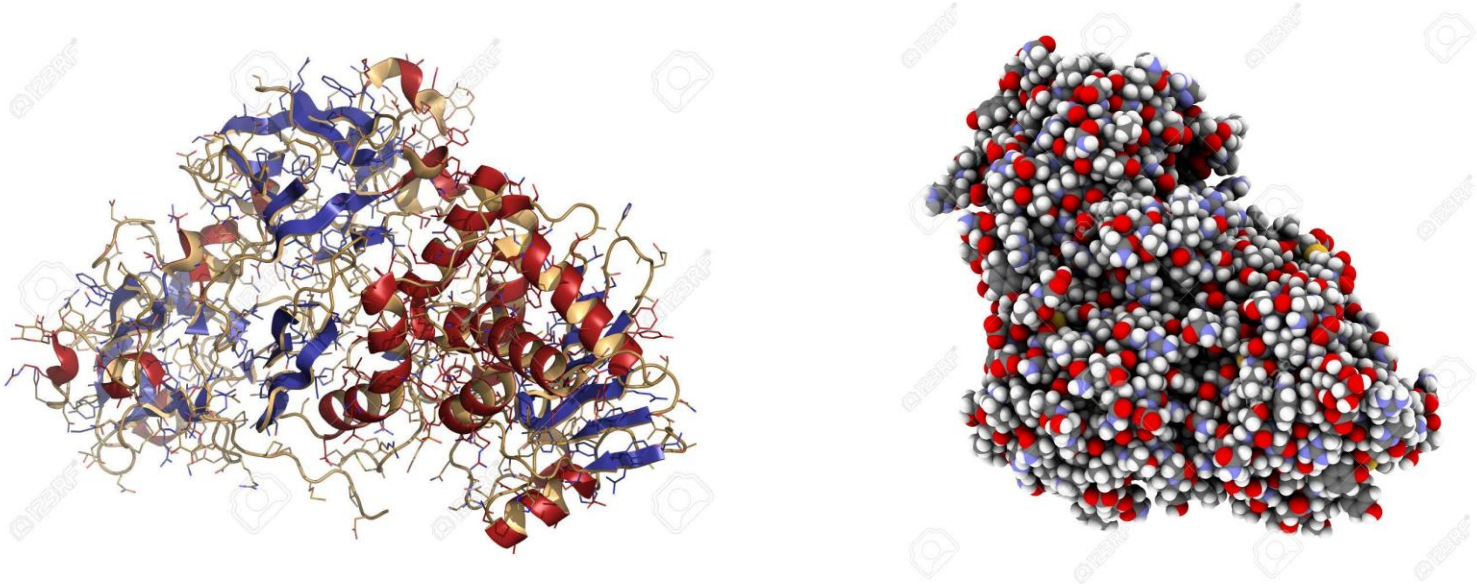
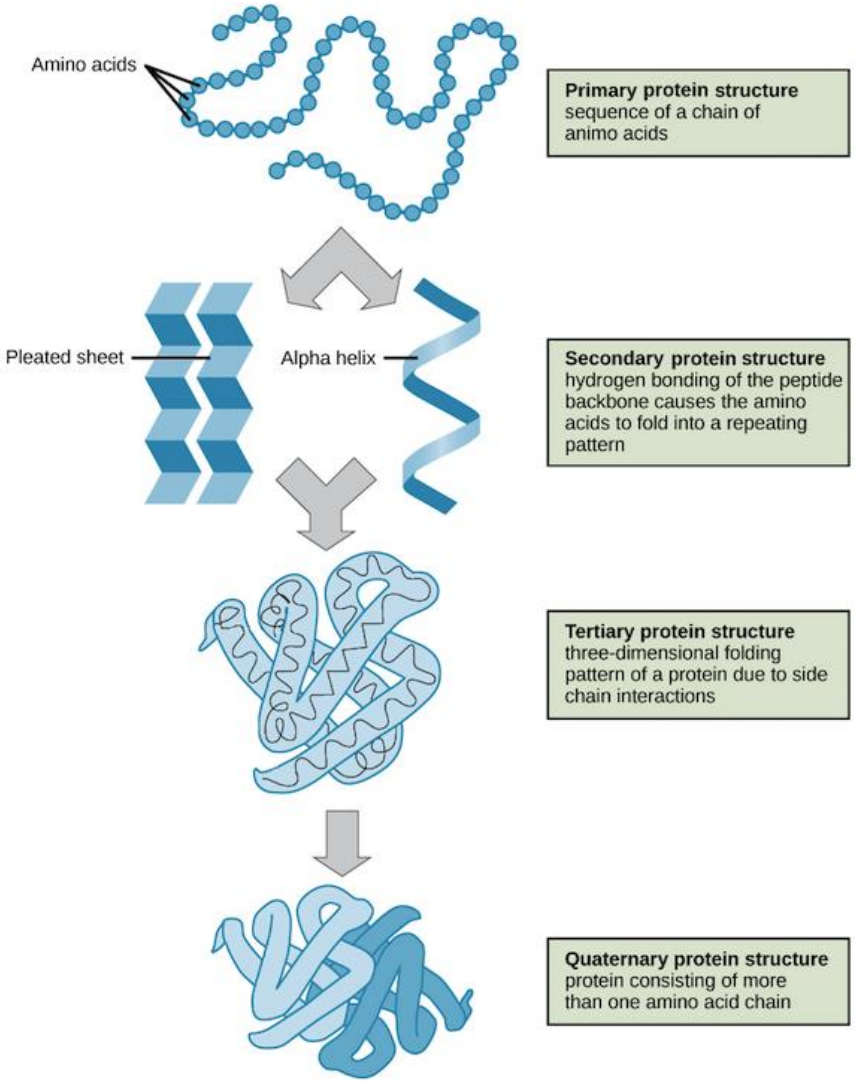
LEVELS OF PROTEIN STRUCTURE

Proteins are very large molecules with complex 3-D organization



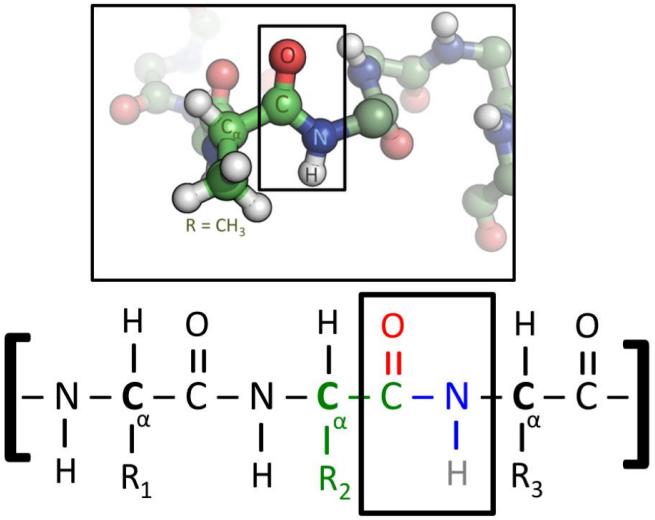
3-D structure of ricin – poisonous protein of castor beans

Levels of protein structure



Protein primary structure

- Protein primary structure is the linear sequence of amino acids in a peptide or protein.
- The sequence of amino acids determines each protein's unique 3-dimensional structure and its specific function.

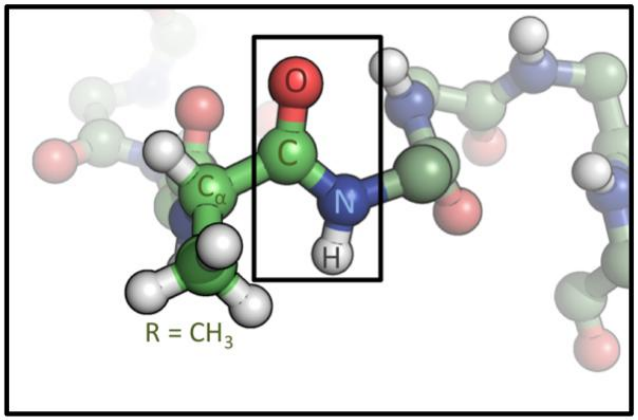


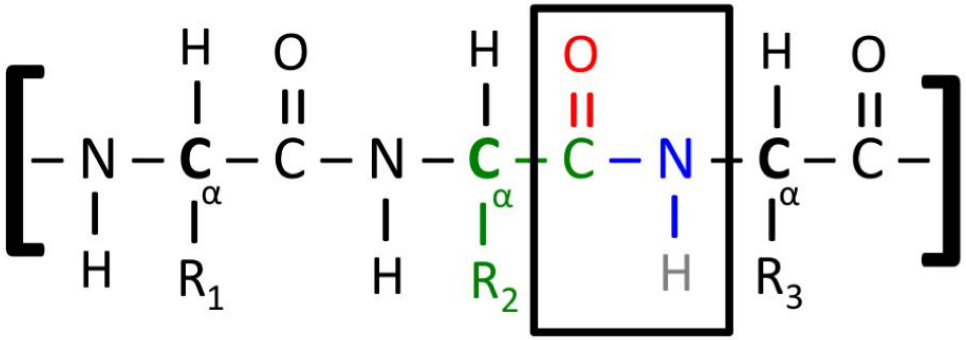
- Peptide bond is a single covalent bond
- Single bonds tend to be very flexible allowing atoms to rotate around the bond. They can also bend and stretch within certain limits without breaking.
- Flexibility of the peptide backbone allows atoms of proteins to find partners in forming non-covalent interactions within the same molecule. These interactions are called ***intramolecular interactions***.

Protein secondary structure

- Protein secondary structure is the three dimensional form of **local segments** of proteins.
- Secondary structure forms as the result of hydrogen bonding of the **peptide backbone**. It causes the amino acids to fold into a repeating pattern

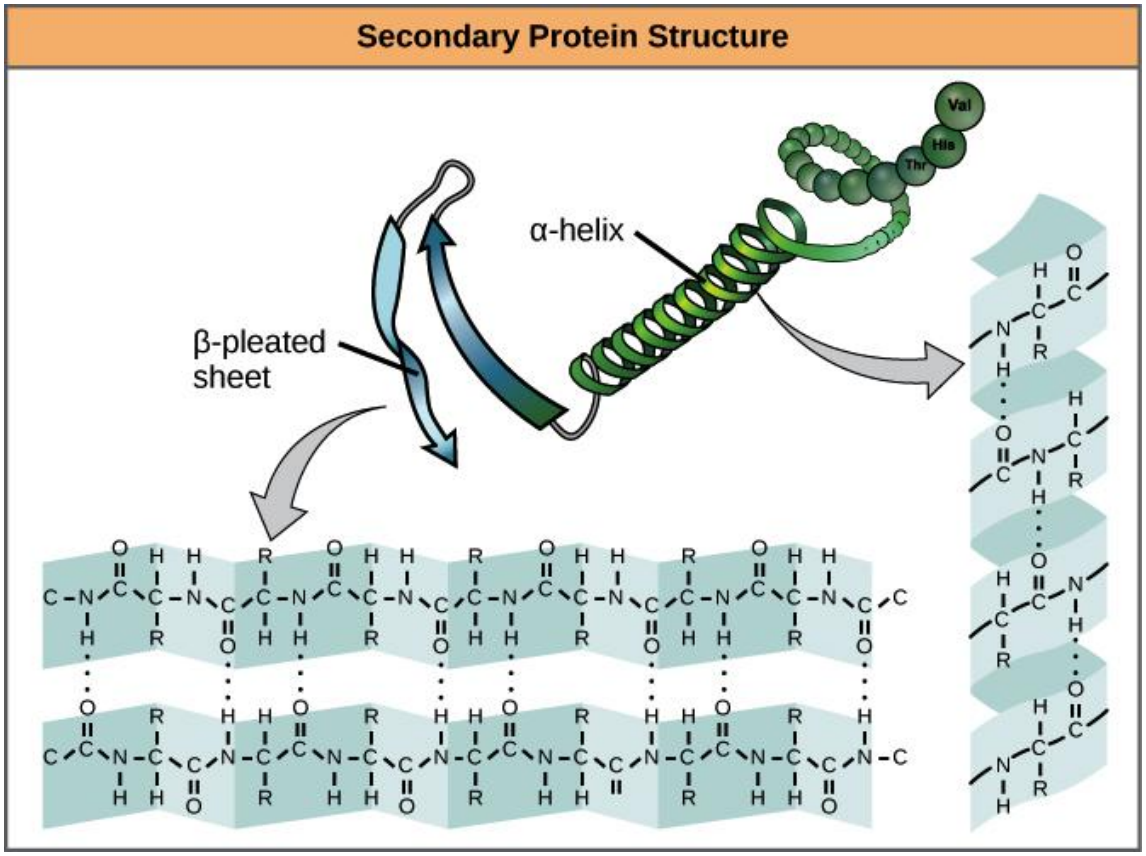
- **Protein secondary structure forms due to <u>hydrogen bonds</u> between the amino hydrogen and carboxyl oxygen atoms in the <u>peptide backbone</u>.**



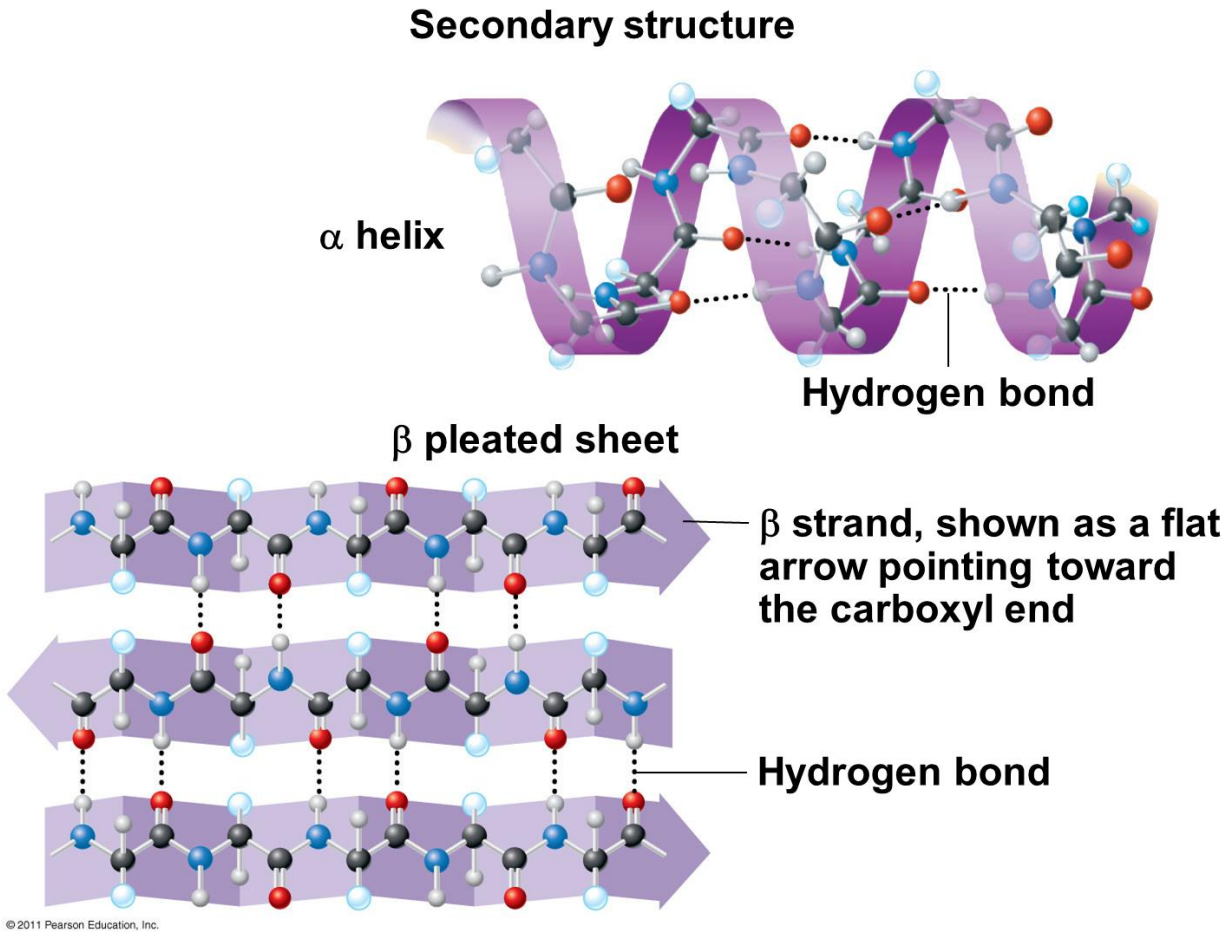


- The two most common secondary structural elements are alpha helices and beta sheets.
- Secondary structure elements typically spontaneously form as an intermediate before the protein folds into its three dimensional tertiary structure.

- **In alpha helices hydrogen bonds are formed within the peptide strand, in beta sheets – between peptide strands.**



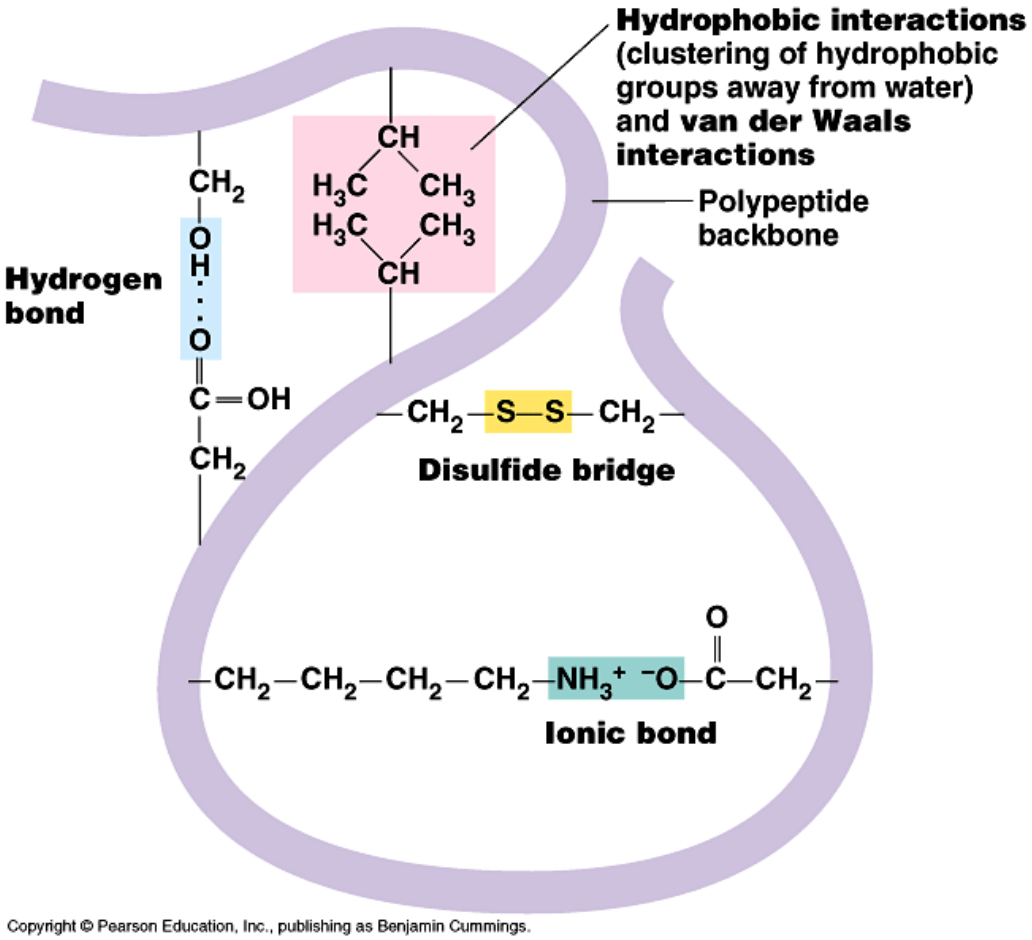
Protein secondary structure



Protein tertiary structure

- The overall three-dimensional shape of an entire protein molecule is the tertiary structure. The protein molecule will bend and twist in such a way as to achieve maximum stability. Although the three-dimensional shape of a protein may seem irregular and random, it is fashioned by many stabilizing forces due to bonding **interactions between the side-chain groups** of the amino acids.

Protein tertiary structure



Protein quaternary structure

- Many proteins are made up of **multiple polypeptide chains**, often referred to as **protein subunits**. These subunits may be the same (as in a homodimer) or different (as in a heterodimer). The quaternary structure refers to how these protein subunits interact with each other and arrange themselves to form a larger aggregate protein complex.
- The final shape of the protein complex is once again stabilized by various interactions, including hydrogen-bonding, disulfide-bridges and ionic bonds.

Functions of proteins

- Proteins are large, complex molecules that play many critical roles in the cell:

1. Enzymes carry out almost all of the thousands of chemical reactions that take place in cells. They also assist with the formation of new molecules by reading the genetic information stored in DNA.
2. Structural component proteins provide structure and support for cells.
3. Transport/storage proteins bind and carry atoms and small molecules within cells and throughout the body