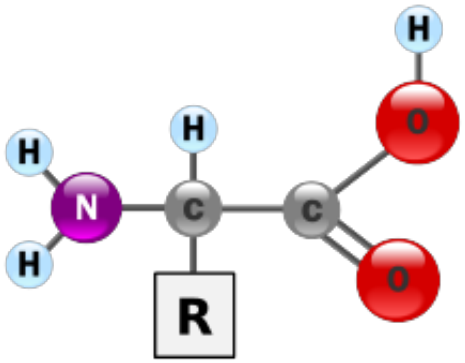
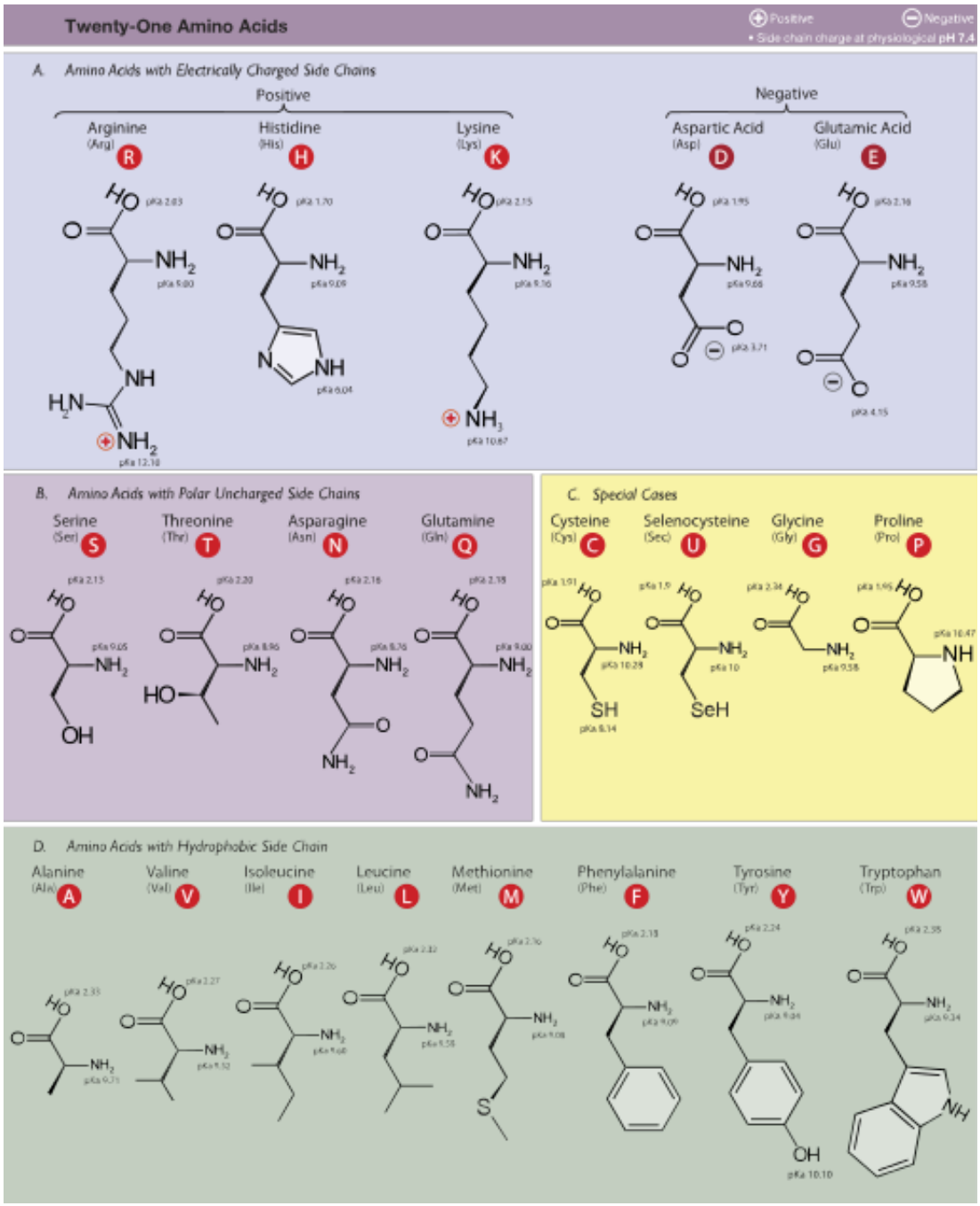
Proteins

Contents

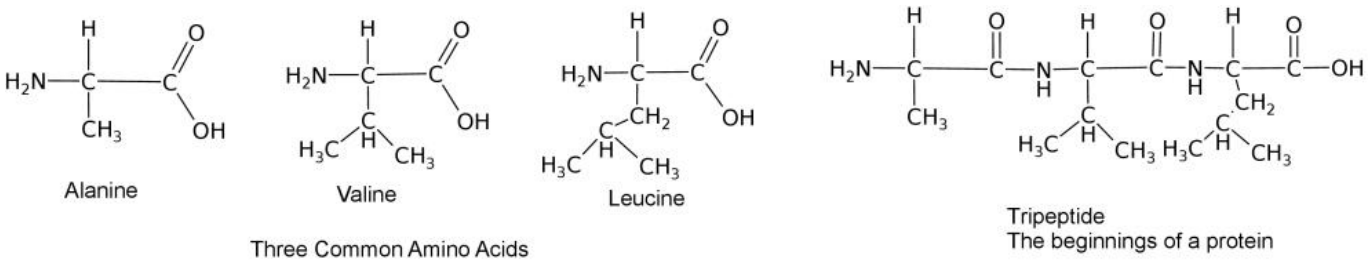
Proteins are polymers of Amino Acids



Proteins provide much of the structural and functional capacity of cells. Proteins are composed of monomers called amino acids. **Amino Acids** are hydrocarbons that have an **amino group** ($-NH_2$) and an acidic **carboxyl group** (-COOH).The R group represents a hydrocarbon chain with a modification that alters the properties of the amino acid. 20 universal amino acids are used to construct proteins. The variation in functional groups along the amino acid chain gives rise to the functional diversity of proteins.



20 amino acids and their properties. A 21st amino acid on this table represents the non-universally found selenocysteine.Monomers bond together through a dehydration synthesis reaction between adjacent amino and carboxyl groups to yield a **peptide bond**.



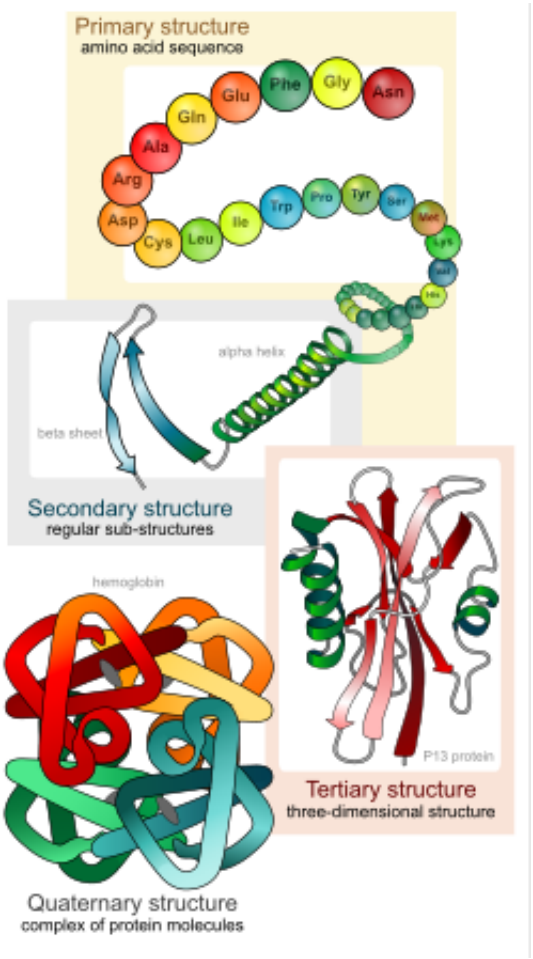
Three amino acids bound into a tripeptide.

How amino acids interact with each other and the environment

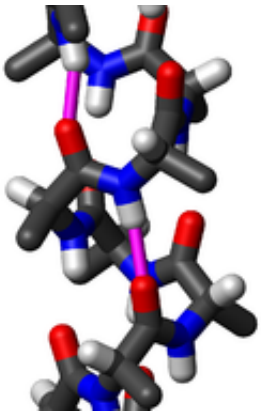
Use the following simulation to test how a polypeptide chain with fold based on the type of solution it is in and the composition of the amino acids.

- **Protein Folding Simulation** (CC BY 4.0 Concord Consortium)

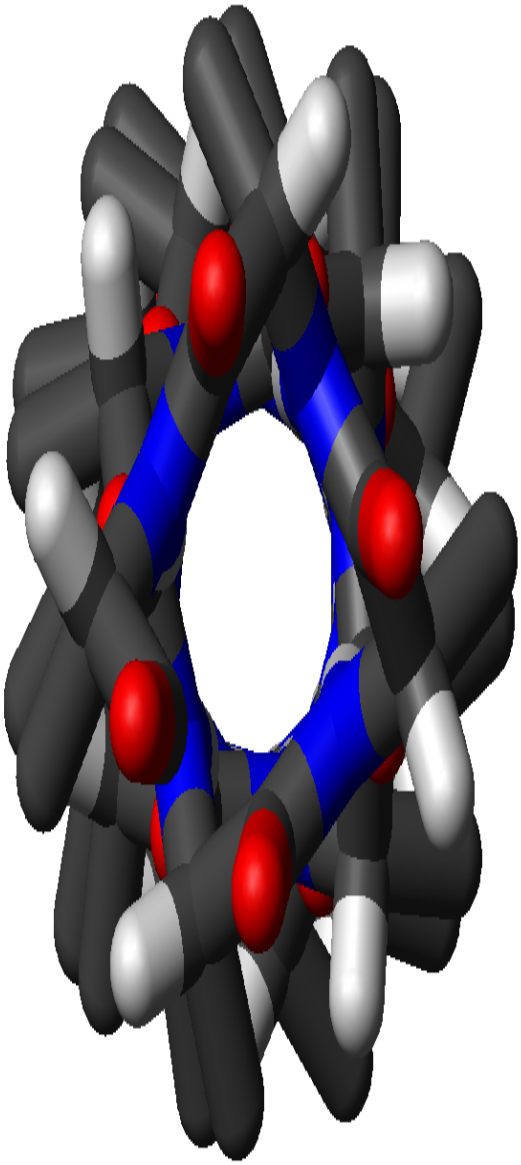
Levels of structure



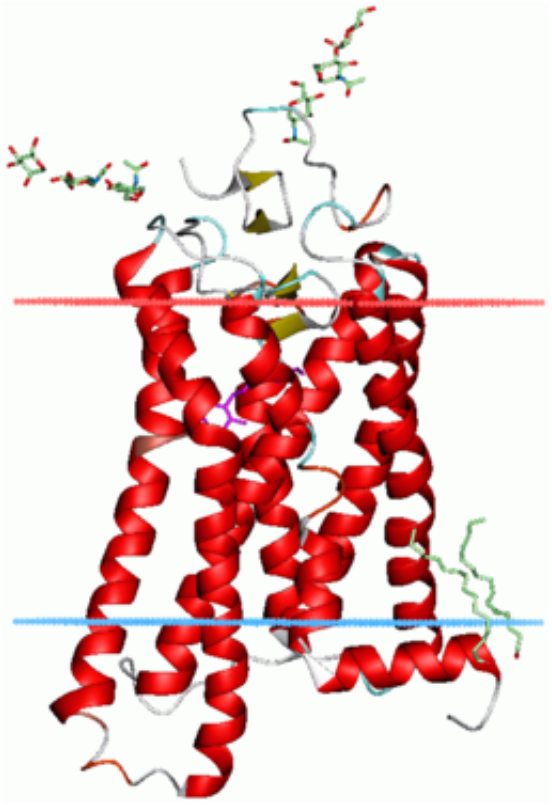
- **Primary Structure (1°)**: The sequence of amino acids read from the Amino or N-terminal end of the molecule to the Carboxyl or C-terminal end
    - Tyr-Cys-Arg-Phe-Leu-Val-….
- **Secondary Structure (2°)**: local three-dimensional structures that form from interactions of amino acids, like hydrogen bonding
    - **Alpha Helix** – coils occurring from the H-bonds between N-H and C=O groups along the backbone of the protein



- Side view of ?-helix illustrating H-bonds in magenta between carboxyl oxygen (red) and amine nitrogen (blue)

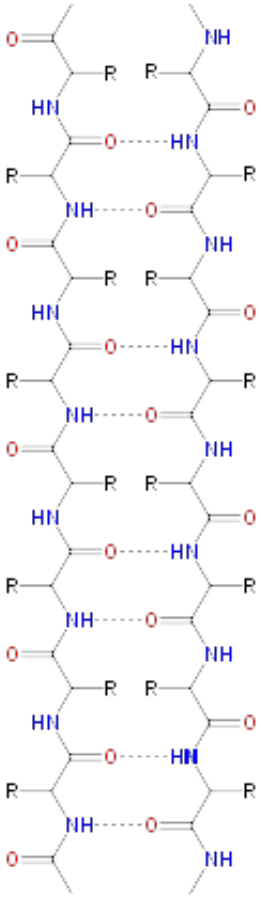


Top-down view of an ?-helix



- Side view of ribbon diagram of ?-helices traversing a membrane.

- **Beta Sheets** – laterally connected strands or sheets of amino acids occurring from the H-bonds between N-H and C=O groups along the backbone of the protein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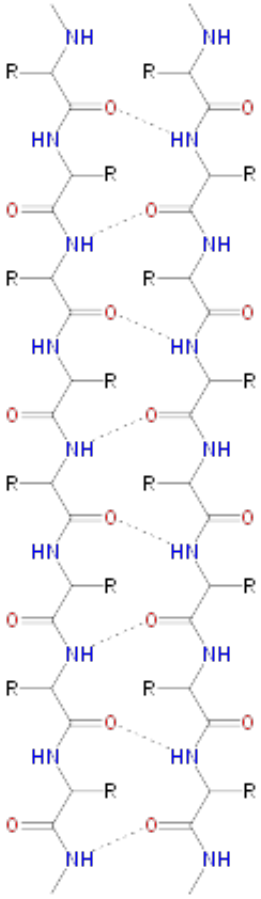
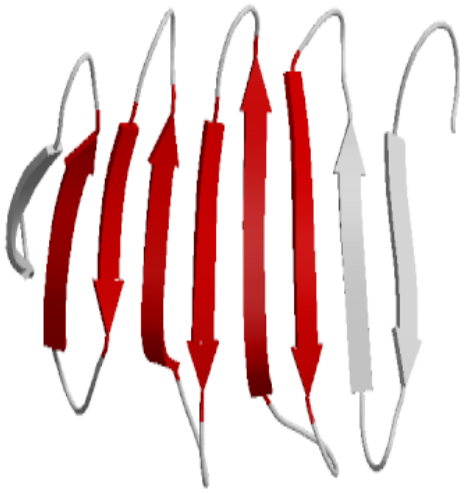
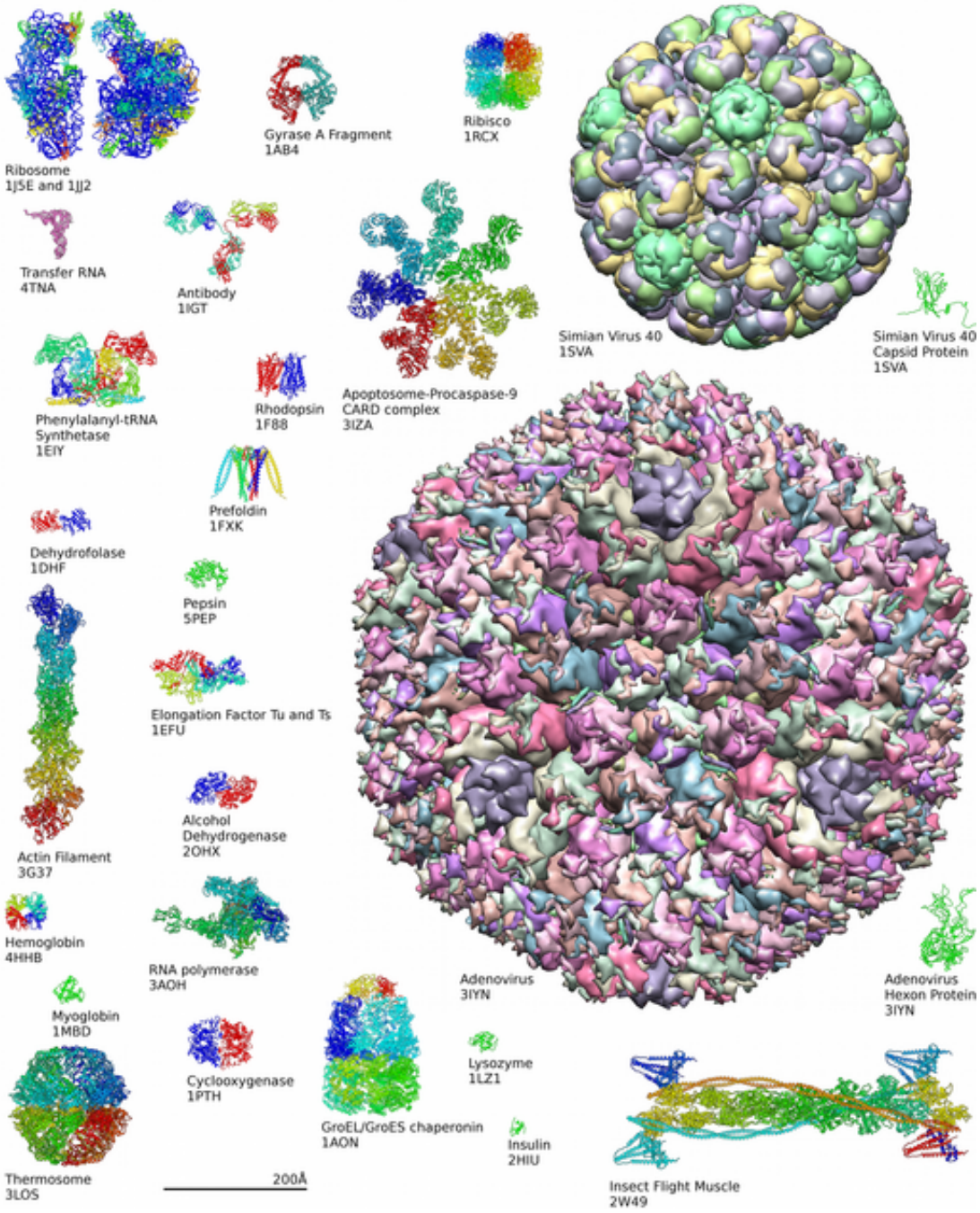




- Ribbon diagram of ?-sheets

- **Tertiary structure (3°)**: overall 3-D structure of the peptide chain
- **Quaternary structure(4°)**: multimeric protein structure from assembling multiple peptide subunits

Diversity of Proteins



Learn more about complexity of protein structures at the [Protein Data Bank]