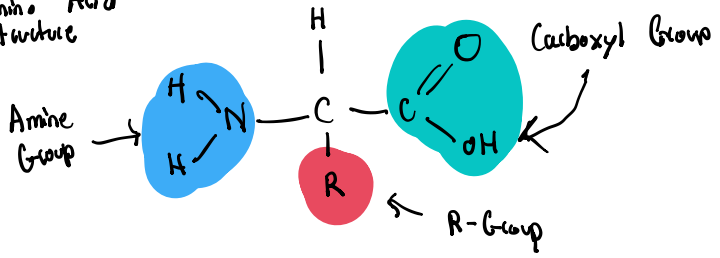
Biochemistry

Proteins are organized in 4 levels of structure, which differ in their size/scale

#1: Primary Structure (Smallest)

- Composed of amino acids, which are the building blocks of proteins, held together by **peptide bonds**
- Dictates the other 3 levels of structure

Amino Acid Structure

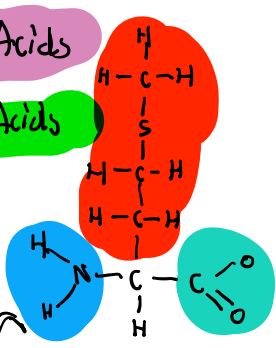


R-Groups, or Side Chains, determine an amino acids properties; they are what make amino acids distinctive from one another and vary

List of Amino Acids

Nonpolar/Hydrophobic Amino Acids

- Glycine (Gly)
- Alanine (Ala)
- Valine (Val)
- Leucine (Leu)
- Isoleucine (Ile)
- Methionine (Met)
- Phenylaline (Phe)
- Tryptophan (Trp)
- Proline (Pro)



Above: Structure of Methionine, which is the start codon in (AUG) protein synthesis

Beta-Branched Amino Acids

Includes:
- Leucine
- Isoleucine
- Valine

(all nonpolar)

Contain long Hydrocarbon branches, leading to the formation of Beta-Sheets

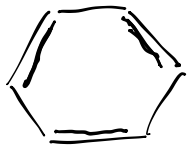
Basic Amino Acids

- Lysine (Lys)
- Arginine (Arg)
- Histidine (His)

Aromatic Amino Acids

Includes:
- Phenylalanine
- Tyrosine
- Tryptophan

Contains stable six-carbon benzene rings that stabilize the molecule

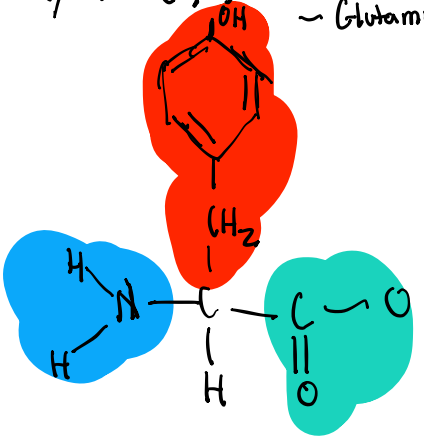


Acidic Amino Acids

- Aspartic Acid
- Glutamic Acid

Polar Side Chains/Hydrophilic

- Serine (Ser)
- Threonine (Thr)
- Cysteine (Cys)
- Tyrosine (Tyr)
- Asparagine (Asn)
- Glutamine (Gln)



Every amino acid chain ends at a **carboxyl** and **amino group**. They are referred to as a **C-Terminus** and **N-Terminus** respectively

#2: Secondary Structure (2nd Smallest)

- Arises from interactions between amine and Carboxyl groups

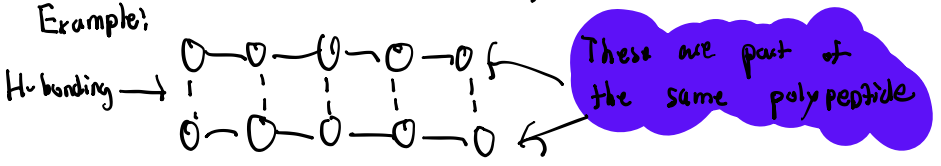
α - Helices → A secondary Structure that arises from Hydrogen Bonding

R-Groups don't play a major role in the formation of alpha-helices, but some can break down helix structures, including
- Proline
- Glycine

β - Sheets → Another major type of secondary structure

- β-pleated sheets form from Hydrogen bonds between parallel parts of a polypeptide chain
- Leads to stability in the molecule

Example:



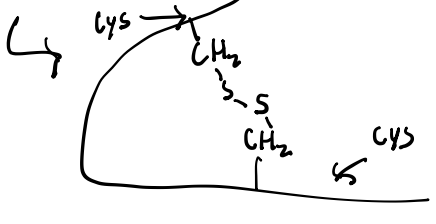
#3: Tertiary Structure

↳ stems from interactions between R-groups of amino acids
- Can coincide w/ 2nd Structure, they depend on different interactions

Hydrophobic Interactions → Caused by nonpolar/polar R-groups
- Polar amino acids → Hydrophilic
- Nonpolar amino acids → Hydrophobic

IMFs between R-Groups determine protein structure

R-Group interactions also include:
- Ionic Bonding: Depends on the environmental pH, which determines whether amino acids undergo an acid-base reaction
- Covalent Bonding: The Cysteine (polar) amino acid interacts with each other, forming a disulfide bridge between its R-Groups



Amino Acids can undergo chemical modification through phosphorylation, including these 3...
- Serine
- Threonine
- Tyrosine (tyrosine kinase)

#4: Quaternary Structure

↳ Arises from interactions between multiple polypeptides

→ Some proteins DON'T have a quaternary structure

One protein that makes up stronger tissue is collagen → together in a triple helix

Another one is hemoglobin → transports Oxygen in red blood cells

↳ two α and two β subunits