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Proteins



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Introduction

- Macromolecular polymers composed of amino acids as the basic unit linked by peptide bonds
- Fundamental structural units of all proteins
- Contain carbon, hydrogen, oxygen, nitrogen, and sulfur, and some minerals
- May be present as simple or complexes with lipids or nucleic acids



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Importance of Proteins

- Found in all living cells and constituent of protoplasm, cell membrane, and nuclear material
- Constitute about 20% of the animal body
- Play an important role in many biochemical, biophysical, and physiological processes
- Enzymes are specialized proteins with catalytic activities present in all living cells
- Serve as regulators of metabolic reactions indirectly in the form of chemical messengers known as hormones
- Are transport agents
- Antibodies are proteins



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Amino Acids

- Building blocks of proteins are amino acids
- There are 20 amino acids that are protein constituents
- Contain a basic amino group and an acidic carboxyl group attached to the same carbon atom
- Possess a third group referred to as the side chain denoted by the letter R

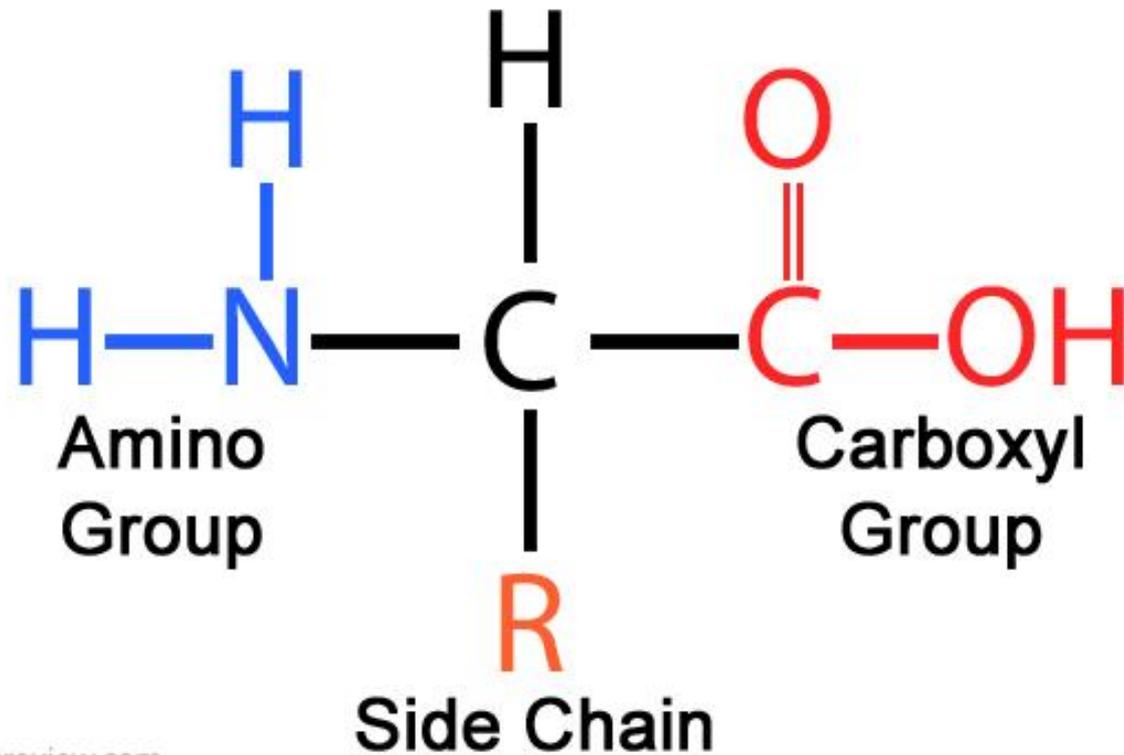


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Structural Formula

Amino Acid Structure





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Properties of Amino Acids

- White crystalline substances
- Aliphatic and aromatic compounds are readily soluble in polar organic solvents
- Have high melting points (200-300°C)
- Amino acids are amphoteric compounds
- Amino acids possessing both positive and negative charges are called Zwitterions
- The pH at which the amino acid has no tendency to move either towards positive or negative electrode is called isoelectric pH



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Properties of Amino Acids

- All amino acids possess asymmetric carbon atom except glycine
- The D and L forms refer to the steric configuration of amino group
- All proteins are formed from 20 different amino acids, and they have common names based on the source from which they were first isolated
- The 20 amino acids found in proteins are referred to as standard or protein amino acids



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Non-polar (or) Aliphatic R groups

- Includes glycine, alanine, valine, leucine, isoleucine, and proline
- Hydrocarbon R groups are non-polar
- These amino acids tend to fold inside away from the aqueous phase
- Promote hydrophobic reactions with protein structures
- Proline reduces the structural flexibility of the protein



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Non-polar Aromatic R groups

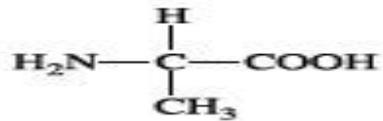
- Includes phenylalanine, tyrosine, tryptophan
- Participate in hydrophobic interactions that are stronger than aliphatic R groups
- Tyrosine (hydroxyl) and tryptophan (nitrogen in indole ring) are more polar
- Absorption of ultraviolet (UV) light at 280 nm is useful in the characterization and quantification of proteins



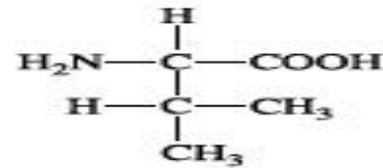
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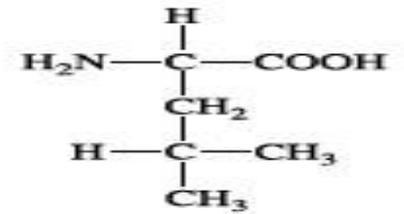
Amino Acids



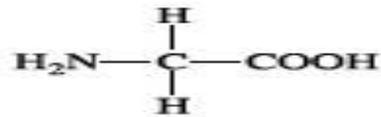
alanine
(Ala, A)



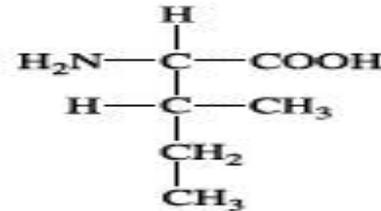
valine
(Val, V)



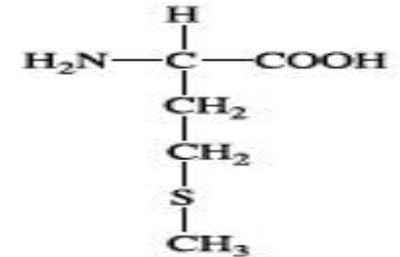
leucine
(Leu, L)



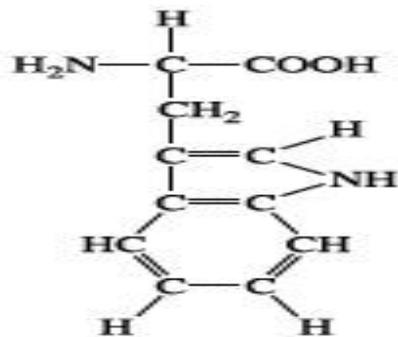
glycine
(Gly, G)



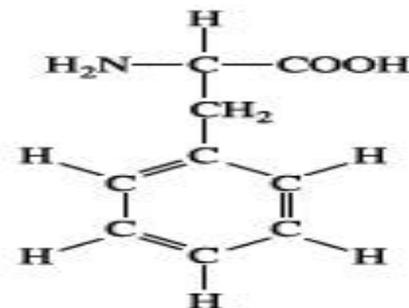
isoleucine
(Ile, I)



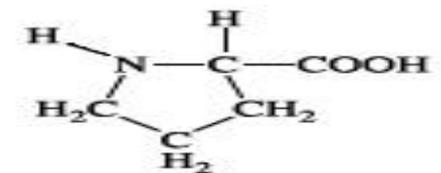
methionine
(Met, M)



tryptophan
(Try or Trp, W)



phenylalanine
(Phe, F)



proline
(Pro, P)
an imino acid



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Polar Uncharged R groups

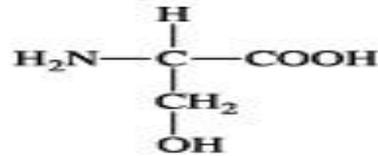
- Includes serine, threonine, cysteine, methionine, asparagine, and glutamine
- Serine (Ser), threonine (OH), cysteine (Cys), methionine (Met) (sulfur), asparagine, glutamine (amide) contribute to the polarity
- The R groups are more hydrophilic than the non-polar amino acids



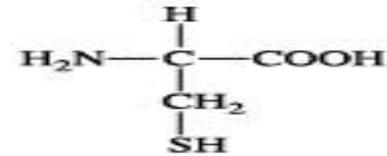
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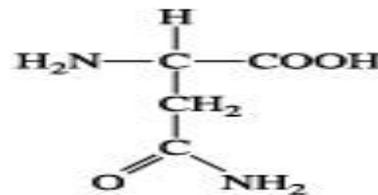
Polar Uncharged Amino Acids



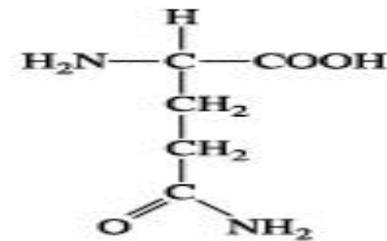
serine
(Ser, S)



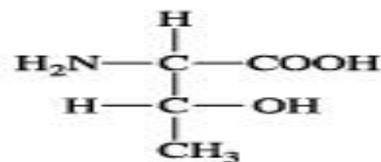
cysteine
(CysH, C)



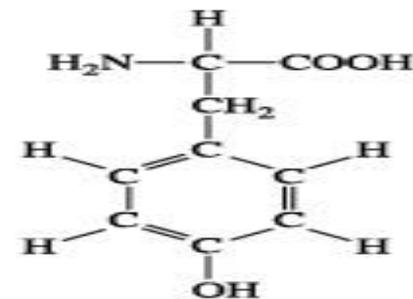
asparagine
(AspNH₂ or Asn, N; Asx or B)



glutamine
(GluNH₂, GluN,
or Gln, Q; Glx or Z)



threonine
(Thr, T)



tyrosine
(Tyr, Y)