Protein: Amino Acids

Protein and Amino Acids

- Protein: a compound composed of C, H, O and N atoms, arranged into amino acids linked in a chain.
- Amino acid: a building block of protein, a compound containing amino group and an acid group attached to a central carbon atom.

Structure of Amino Acids

- Central C is connected to three compounds: amino group (NH2), acid group (COOH), and hydrogen (H).
- Central C is also another atom or group of atoms that varies one amino acid to another.

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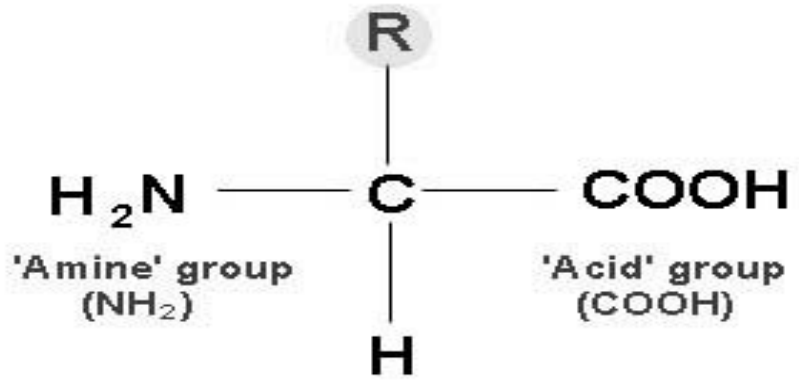
Structure of Amino Acids



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20 Amino Acids

G	Glycine	Gly	P	Proline	Pro
A	Alanine	Ala	V	Valine	Val
L	Leucine	Leu	I	Isoleucine	Ile
M	Methionine	Met	C	Cysteine	Cys
F	Phenylalanine	Phe	Y	Tyrosine	Tyr
W	Tryptophan	Trp	H	Histidine	His
K	Lysine	Lys	R	Arginine	Arg
Q	Glutamine	Gln	N	Asparagine	Asn
E	Glutamic Acid	Glu	D	Aspartic Acid	Asp
S	Serine	Ser	T	Threonine	Thr

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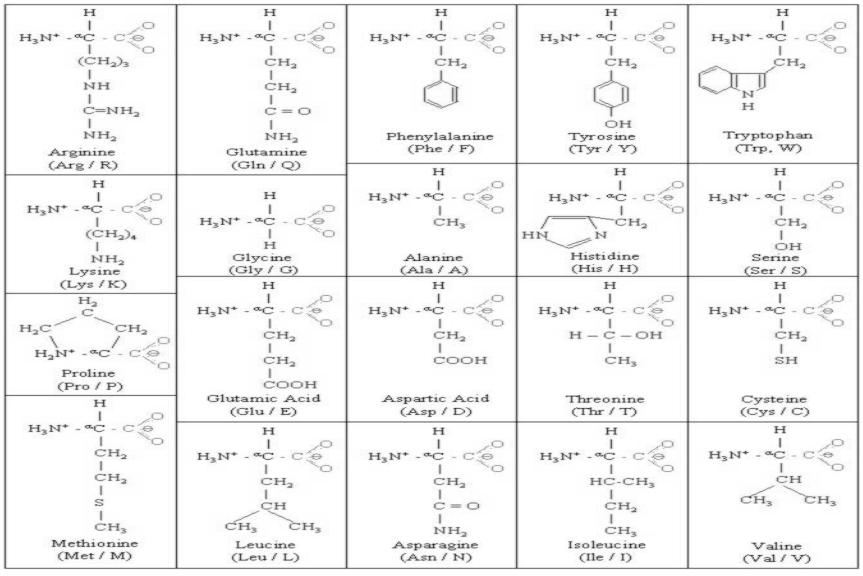

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Amino Acid		M_r*	Occurrence in Proteins (%)†
Alanine	Ala A	71.1	9.0
Arginine	Arg R	156.2	4.7
Asparagine	Asn N	114.1	4.4
Aspartic acid	Asp D	115.1	5.5
Cysteine	Cys C	103.1	2.8
Glutamine	Gln Q	128.1	3.9
Glutamic acid	Glu E	129.1	6.2
Glycine	Gly G	57.1	7.5
Histidine	His H	137.2	2.1
Isoleucine	Ile I	113.2	4.6
Leucine	Leu L	113.2	7.5
Lysine	Lys K	128.2	7.0
Methionine	Met M	131.2	1.7
Phenylalanine	Phe F	147.2	3.5
Proline	Pro P	97.1	4.6
Serine	Ser S	87.1	7.1
Threonine	Thr T	101.1	6.0
Tryptophan	Trp W	186.2	1.1
Tyrosine	Tyr Y	163.2	3.5
Valine	Val V	99.1	6.9

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Amino Acid Classification

- Polar and non polar
- Hydrophobic and hydrophilic
- Acid and Base
- Aromatic
- Amino acid contains sulfur

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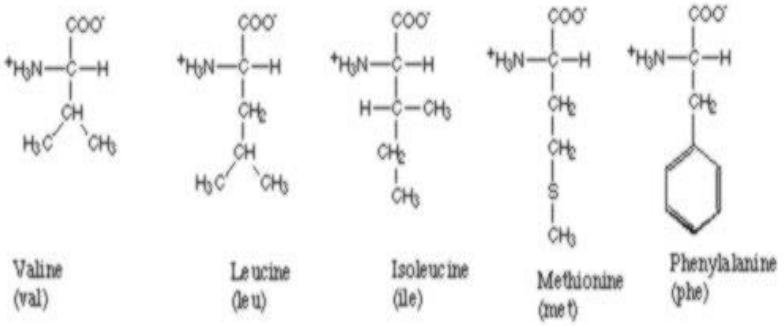
Hydrophobic Amino Acids

Amino acids with hydrophobic side groups



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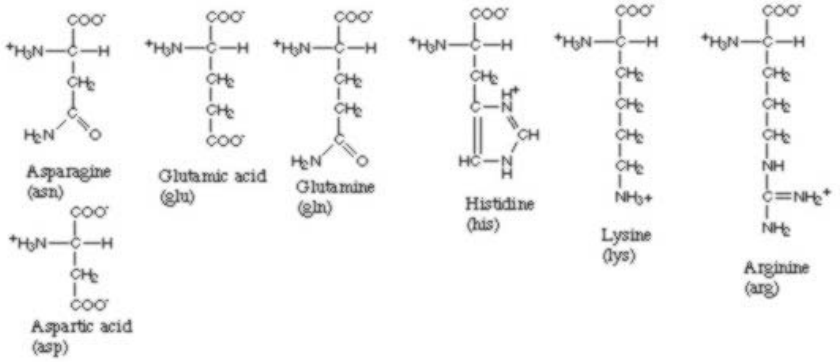
Hydrophilic Amino Acids

Amino acids with hydrophilic side groups



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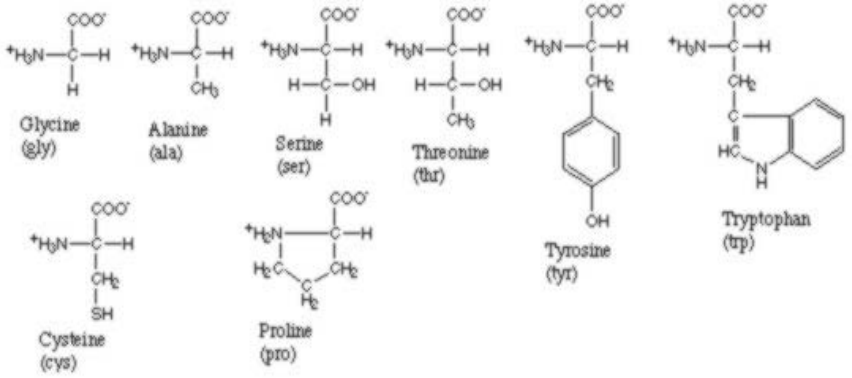
Hydrophobic and hydrophilic Amino Acids

Amino acids that are in between



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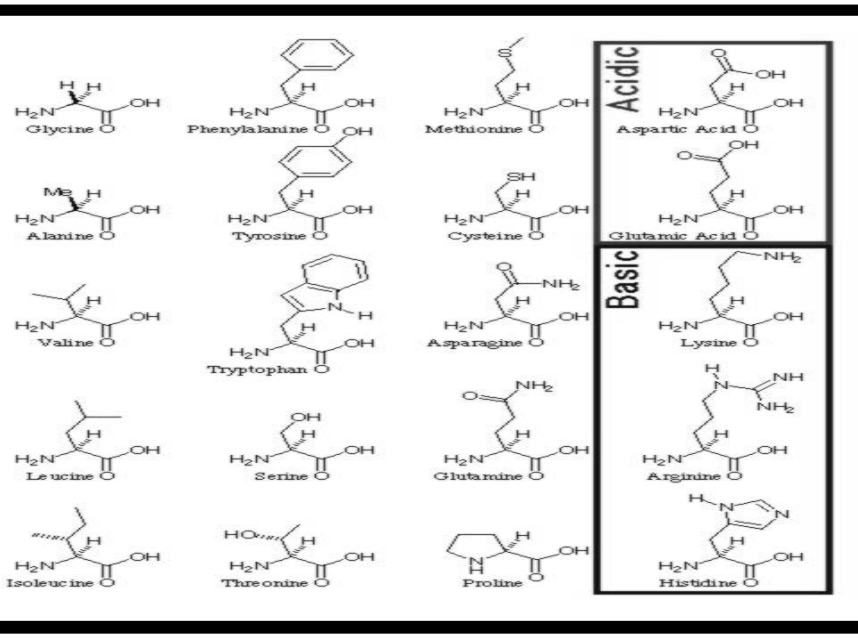

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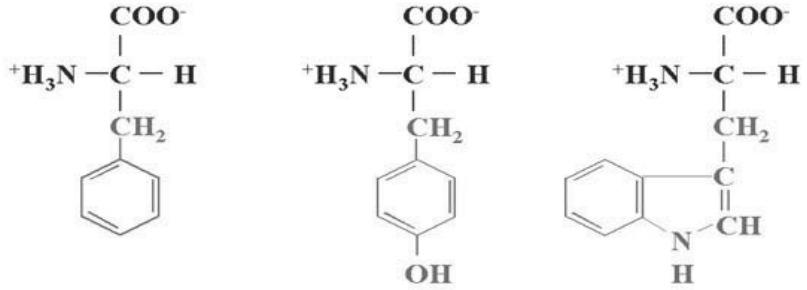
Aromatic Amino Acids



Phenylalanine Tyrosine Tryptophan

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Amino Acid Sequence

- Dipeptide: two amino acids bonded together by peptide bond.
- Tripeptide: three amino acids bonded together by peptide bond.
- Polypeptide: many (ten or more) amino acids bonded together by peptide bond.

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Amino Acid Sequence

- Oligopeptide: an intermediate string of between four to ten amino acids bonded by peptide bond.
- Peptide bond: a bond between amine group of one and carboxyl group of another amino acid.

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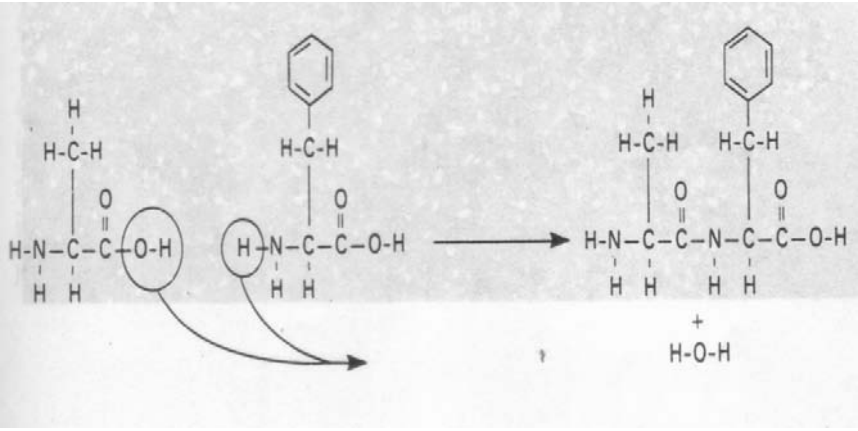
Formation of a dipeptide



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Amino Acid Sequence

Myosin Light Chain (pork)

1	msfsadqiae fkeafllfdr tgeckitlsq	30
31	vgdvlralgt nptnaevkkv lgnpsneemn	60
61	akkiefeqfl pmlqaisnnk dqgsyedfve	90
91	glrvfdkegn gtvmvtelrh vlatlgekmk	120
121	eeevealmag qedsngciny eafvkhimsi	150

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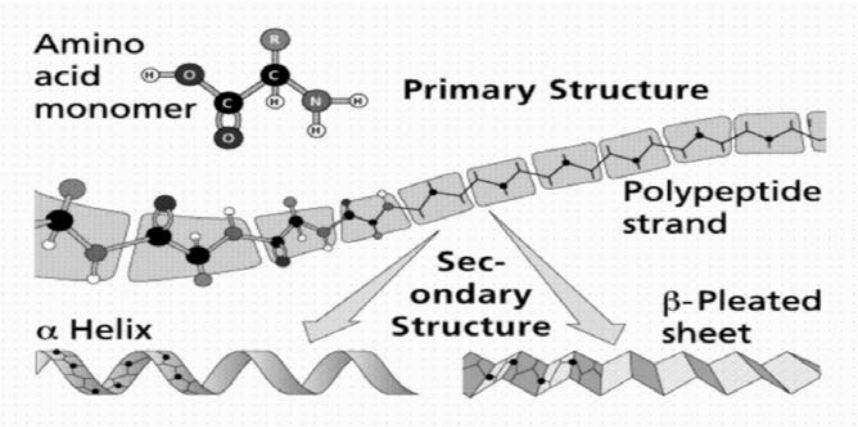
Structure of Protein



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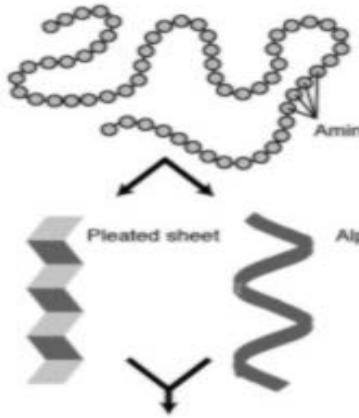
Structure of Protein



Primary protein structure
is sequence of a chain of amino acids

Secondary protein structure
occurs when the sequence of amino acids are linked by hydrogen bonds

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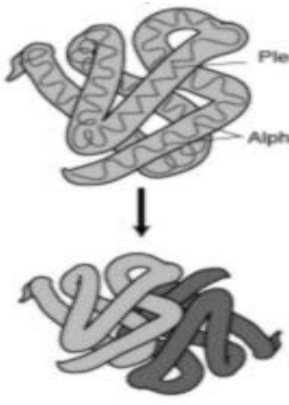
Structure of Protein



Tertiary protein structure
occurs when certain attractions are present between alpha helices and pleated sheets.

Quaternary protein structure
is a protein consisting of more than one amino acid chain.

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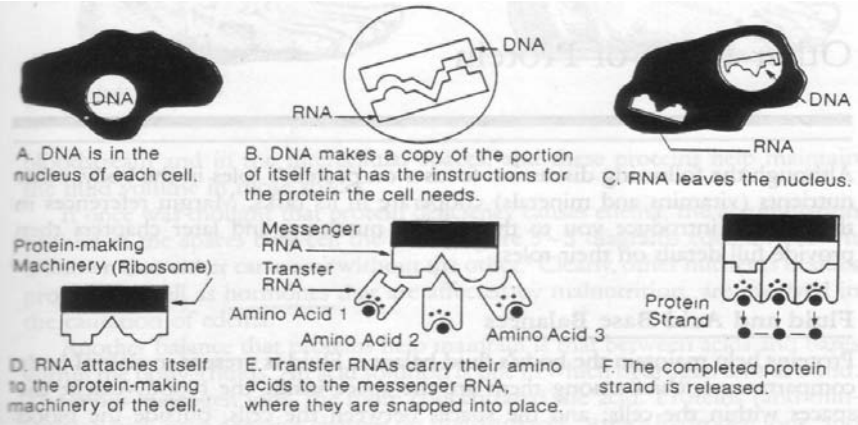
Protein Synthesis



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Complete and Incomplete Proteins

- Complete proteins, meaning that all indispensable AAs are present.
- Incomplete proteins, meaning that one or more of the indispensable AAs was absent.

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Dispensable and Indispensable Amino Acids

Dispensable	Indispensable
alanine	Lysine
glutamic acid	isoleucine (c)
aspartic acid	leucine (c)
Glycine	valine
serine	Histidine
proline	Threonine
glutamine(a)	Methionine
asparagine	Phenylalanine
cysteine (b)	tryptophan
tyrosine (b)	

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Dispensable and Indispensable Amino Acids

a. Conditionally indispensable under times of severe bodily stress

b. Conditionally indispensable if methionine and phenylalanine are not available

c. Leucine, isoleucine, and valine are called branch chain amino acids (BCAAs) because of their structure.

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Complex proteins

- Lipoproteins contain lipid subunits in addition to the amino acid.
- Glycoproteins contain carbohydrate subunits.
- Phosphoproteins contain phosphoric acid, and nucleoproteins contain nucleic acids.
- Some proteins have important smaller molecules, known as prosthetic groups, attached to their surfaces.

Enzymes: A Function of Protein

- Protein catalysts
- Enzymes are protein molecules that regulate the metabolism of proteins, carbohydrates and fats.

Roles of Protein

- Fluid and acid-base balance,
- Antibodies and hormones,
- Nutrient transportation,
- Blood clotting,
- Muscle contraction,
- Blood vessel expansion,
- Contraction to maintain normal blood pressure,
- Connective tissues,
- Visual pigments

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Biologically Active Peptides

- Peptides that are inactive in the sequence of the parent protein, but can be released during enzymatic digestion or food processing, and have health benefits to the body.

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Biologically Active Peptides

- Antihypertensive activity,
- Antibacterial activity,
- Mineral-binding activity,
- Enhancement of intestinal activity

Peptide Sequences Showing Antihypertensive Effect

- Milk protein (casein, sour milk, whey protein)
- Poultry (chicken muscle, ovalbumin)
- Several kinds of fish (sardine, bonito, salmon)
- Porcine skeletal muscle protein (actin, myosin, troponin)