

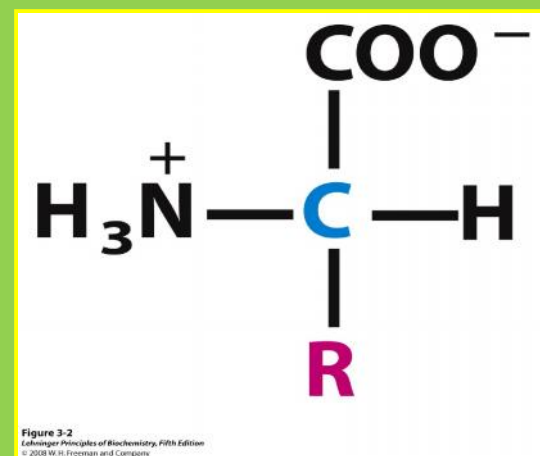
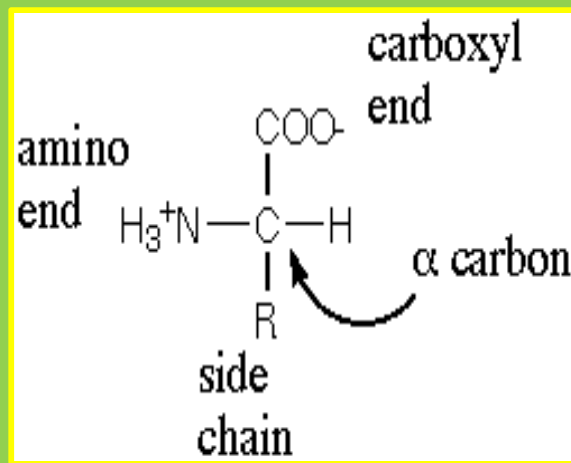
AMINO ACIDS (AA)

- Proteins - dehydration polymers of AA, with each AA **residue** joined to next AA by covalent bond (peptide bond)
- > 300 AA present in nature
- AA - present in proteins are called **standard AA (20)**

Standard AA

- Asparagine **First AA** discovered (1806).
- Threonine **Last AA** identified in 1938
- AA have trivial/common names, in some cases derived from the source from which they were first isolated
 - Asparagine was first found in asparagus
 - Glutamate was first found in wheat gluten

- Tyrosine first isolated from cheese (name is derived from Greek tyros, "cheese")
- Glycine (Greek glykys, "sweet") was so named as it has sweet taste
- Have a carboxylic group & an amino group bonded to the same carbon atom (alpha carbon)
- Differ from each other in side chains, or **R** groups, which vary in **Structure, Size, Electric charge** (which influence the solubility of AA in H_2O)



Standard AA

- 20 AA of proteins called **standard amino acids**
- Distinguish from less common AA that are residues modified after a protein has been synthesized & from the many other kinds of AA present in living organisms but not in proteins
- Standard AA given 3-letter abbreviations & 1-letter symbols to indicate composition & sequence of AA polymerized in proteins

Non - Standard AA

1. Modification of standard residues already incorporated into a polypeptide. (example: 4-Hydroxyproline, 5-Hydroxylysine)
2. Non protein AA. (example: Ornithine, Citrulline)

Steric relationship of the stereoisomers of alanine to the absolute configuration of L- and D-glyceraldehyde

The carbons in these molecules are numbered beginning with the terminal aldehyde or carboxyl carbon (red), 1 to 3 from top to bottom as shown.

When presented in this way, the R group of the amino acid (in this case the methyl group of alanine) is always below the α carbon.

L-Amino acids are those with the α -amino group on the left, and **D-amino acids** have the α -amino group on the right

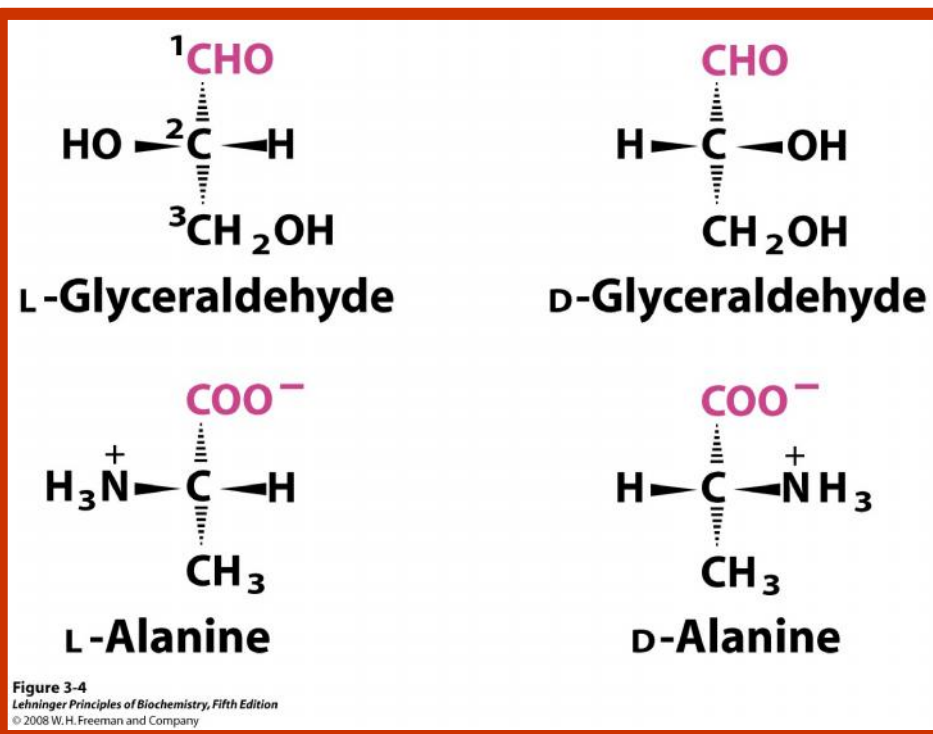


TABLE 3–1

Properties and Conventions Associated with the Common Amino Acids Found in Proteins

Amino acid	Abbreviation/ symbol	M_r^*	pK_a values			pI	Hydropathy index [†]	Occurrence in proteins (%) [‡]
			pK_1 (—COOH)	pK_2 (—NH ₃ ⁺)	pK_R (R group)			
Nonpolar, aliphatic								
R groups								
Glycine	Gly G	75	2.34	9.60		5.97	−0.4	7.2
Alanine	Ala A	89	2.34	9.69		6.01	1.8	7.8
Proline	Pro P	115	1.99	10.96		6.48	1.6	5.2
Valine	Val V	117	2.32	9.62		5.97	4.2	6.6
Leucine	Leu L	131	2.36	9.60		5.98	3.8	9.1
Isoleucine	Ile I	131	2.36	9.68		6.02	4.5	5.3
Methionine	Met M	149	2.28	9.21		5.74	1.9	2.3
Aromatic								
R groups								
Phenylalanine	Phe F	165	1.83	9.13		5.48	2.8	3.9
Tyrosine	Tyr Y	181	2.20	9.11	10.07	5.66	−1.3	3.2
Tryptophan	Trp W	204	2.38	9.39		5.89	−0.9	1.4
Polar, uncharged								
R groups								
Serine	Ser S	105	2.21	9.15		5.68	−0.8	6.8
Threonine	Thr T	119	2.11	9.62		5.87	−0.7	5.9
Cysteine [§]	Cys C	121	1.96	10.28	8.18	5.07	2.5	1.9
Asparagine	Asn N	132	2.02	8.80		5.41	−3.5	4.3
Glutamine	Gln Q	146	2.17	9.13		5.65	−3.5	4.2
Positively charged								
R groups								
Lysine	Lys K	146	2.18	8.95	10.53	9.74	−3.9	5.9
Histidine	His H	155	1.82	9.17	6.00	7.59	−3.2	2.3
Arginine	Arg R	174	2.17	9.04	12.48	10.76	−4.5	5.1
Negatively charged								
R groups								
Aspartate	Asp D	133	1.88	9.60	3.65	2.77	−3.5	5.3
Glutamate	Glu E	147	2.19	9.67	4.25	3.22	−3.5	6.3

Aromatic R groups

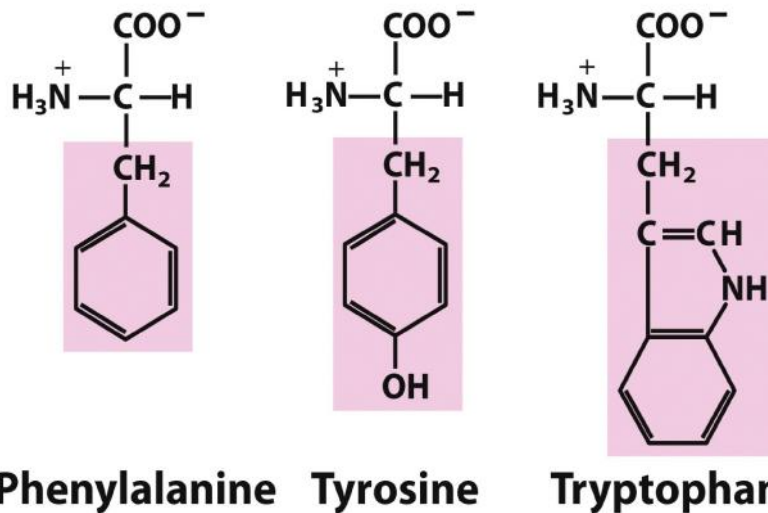


Figure 3-5 part 2
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Nonpolar, aliphatic R groups

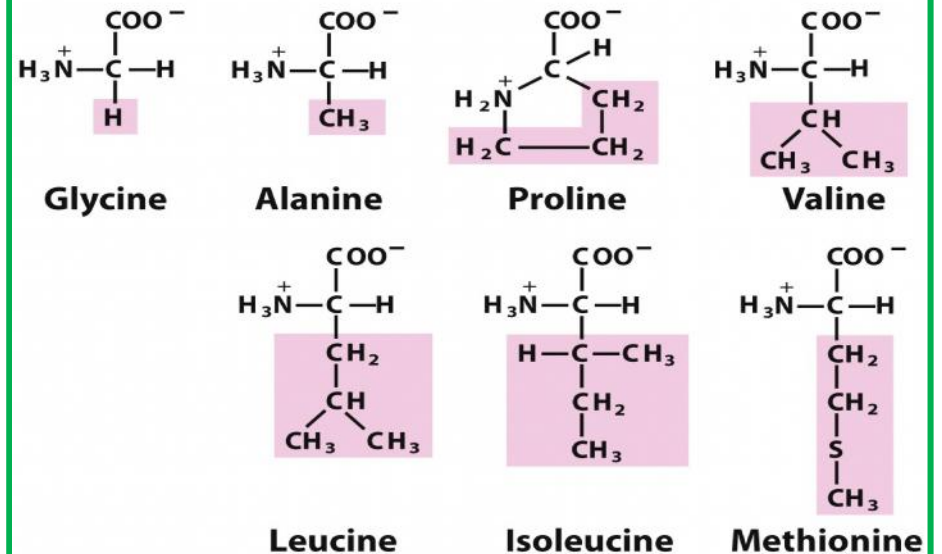


Figure 3-5 part 1
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Negatively charged R groups

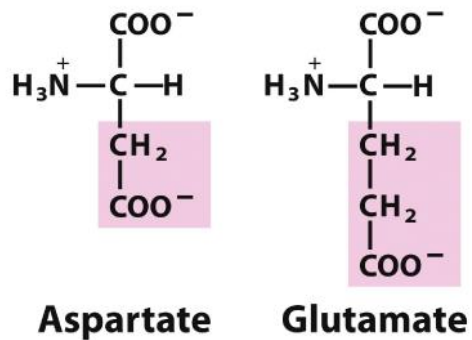


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Positively charged R groups

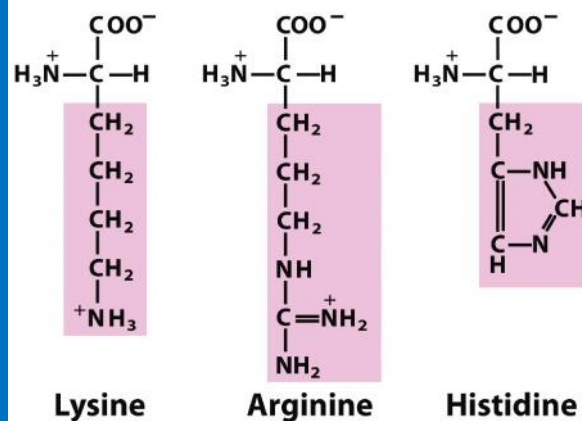


Figure 3-5 part 4
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Polar, uncharged R groups

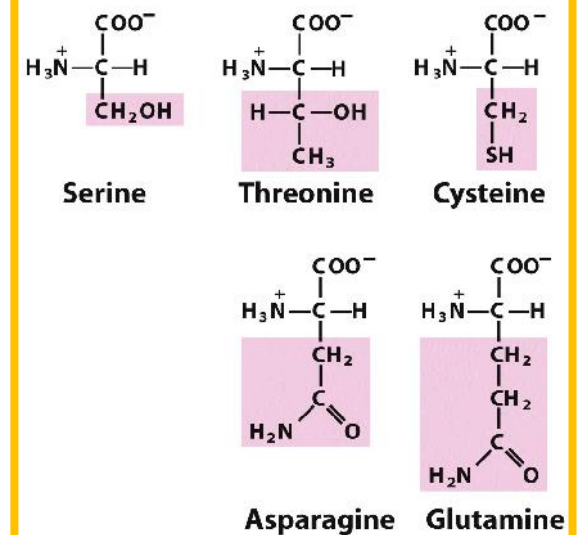


Figure 3-5 part 3
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BIOCHEMICAL CLASSIFICATION OF STANDARD AA

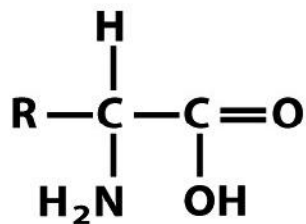
1. Essential Amino acids (indispensable)

Val, Leu, Ile, Thr, Met, Lys, Phe, Trp, His (9 in adults)
Val, Leu, Ile, Thr, Met, Lys, Phe, Trp, His Arg * (10 in Children)

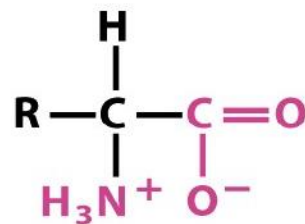
In growing children, arginine may not be synthesized in amounts adequate to fill the requirement for both protein biosynthesis and urea formation; under these circumstances, it would be considered an essential amino acid

2. Non - Essential Amino acids

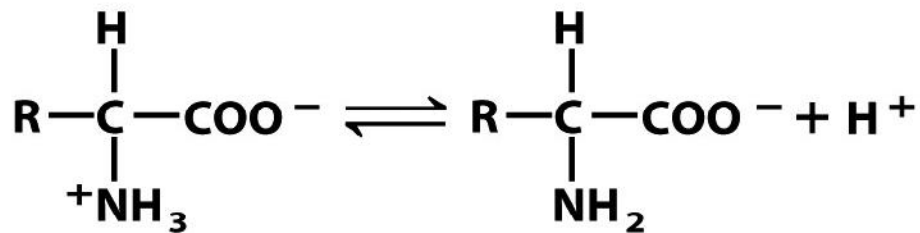
Gly, Ala, Ser, Cys, Asp, Glu, Asn, Gln, Tyr, Pro



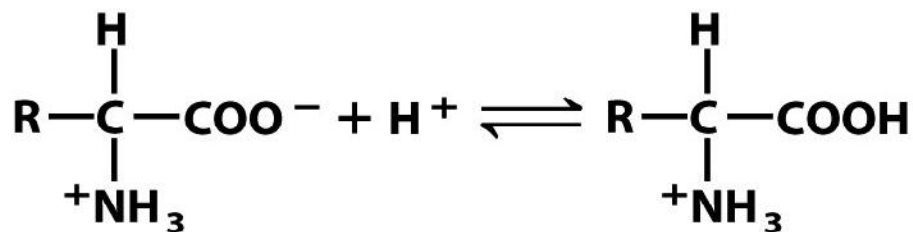
Nonionic form



Zwitterionic form



**Zwitterion
as acid**



**Zwitterion
as base**

Nonionic & zwitterion forms of AA

Nonionic form does
not occur in
significant amounts in
aqueous solutions

Zwitterion
predominates at
neutral pH

Zwitterion can act as
either an acid (proton
donor) or a base
(proton acceptor)

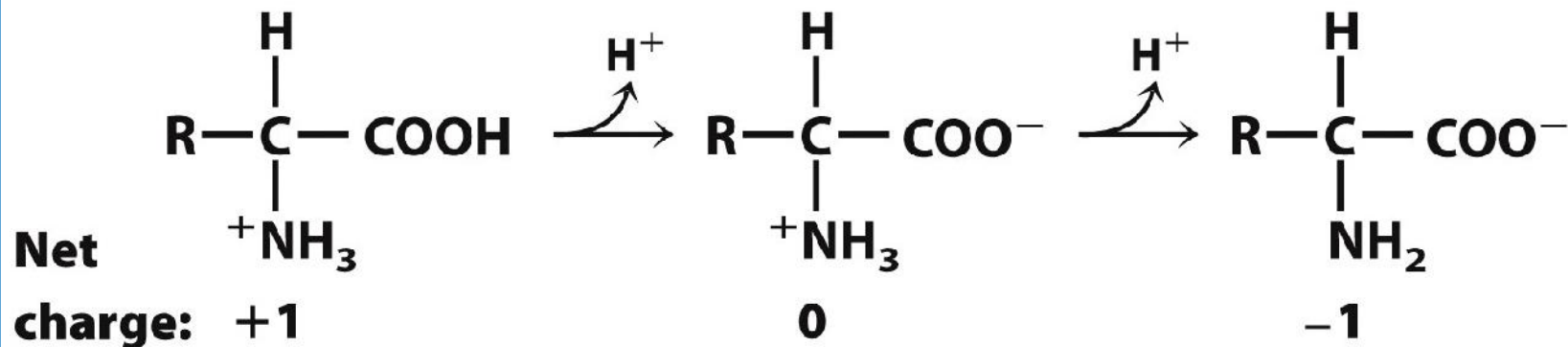
Figure 3-9

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Ampholytes OR Amphoteric Electrolytes

- The characteristic pH at which the net electric charge is zero is called the **isoelectric point** or **isoelectric pH**, designated **pI**

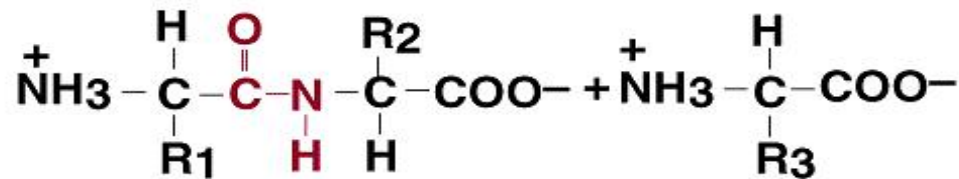
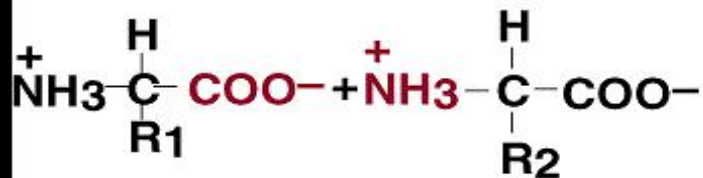


Unnumbered 3 p79

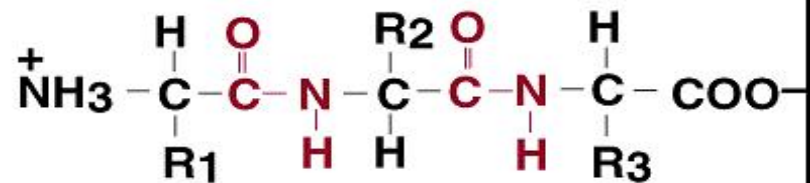
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PEPTIDE BOND



Dipeptide



Tripeptide

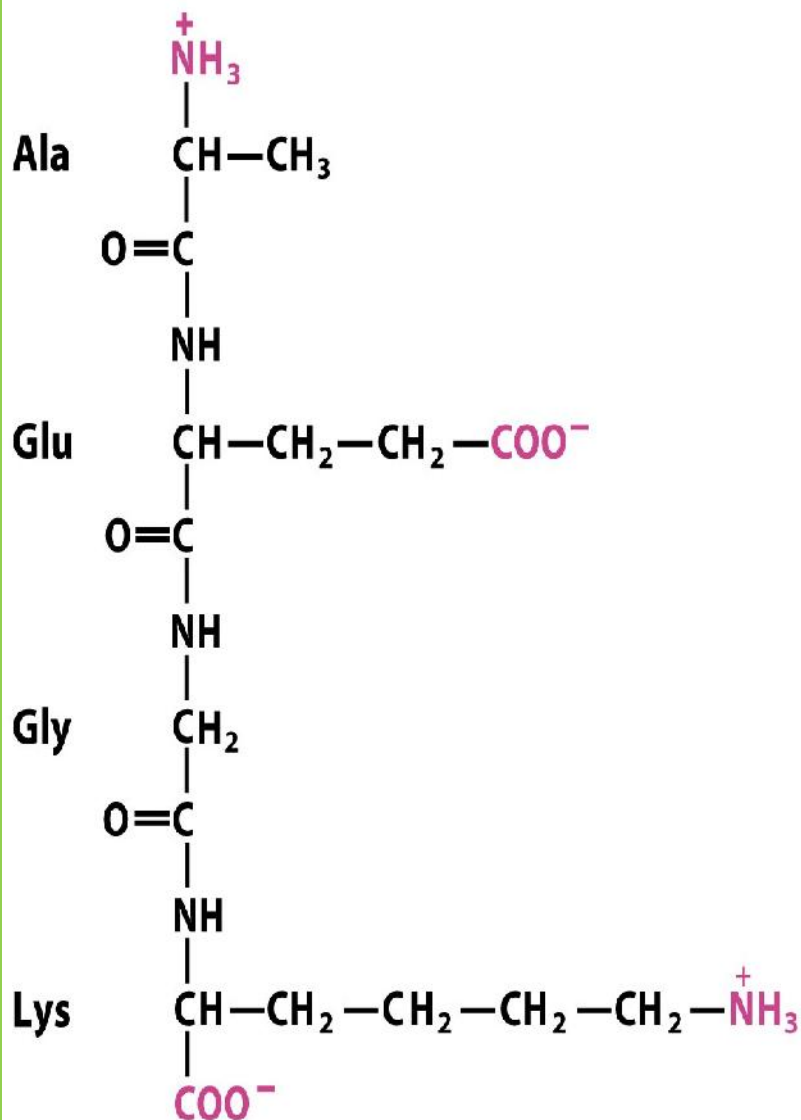


Figure 3-15
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Naming of a Peptide

- Amino acids whose names end with -ine, -ane, -ate, are changed to -yl with the exception of amino acid with free COOH terminal
- Free N- terminal is written to the left side and C- terminal to the right
- All amino acid sequence is read from N - terminal to C- terminal i.e. from left to right

Alanylglutamylglycyllysine

This tetrapeptide has one free α -amino group, one free α -carboxyl group, and two ionizable R groups. The groups ionized at pH 7.0 are in red

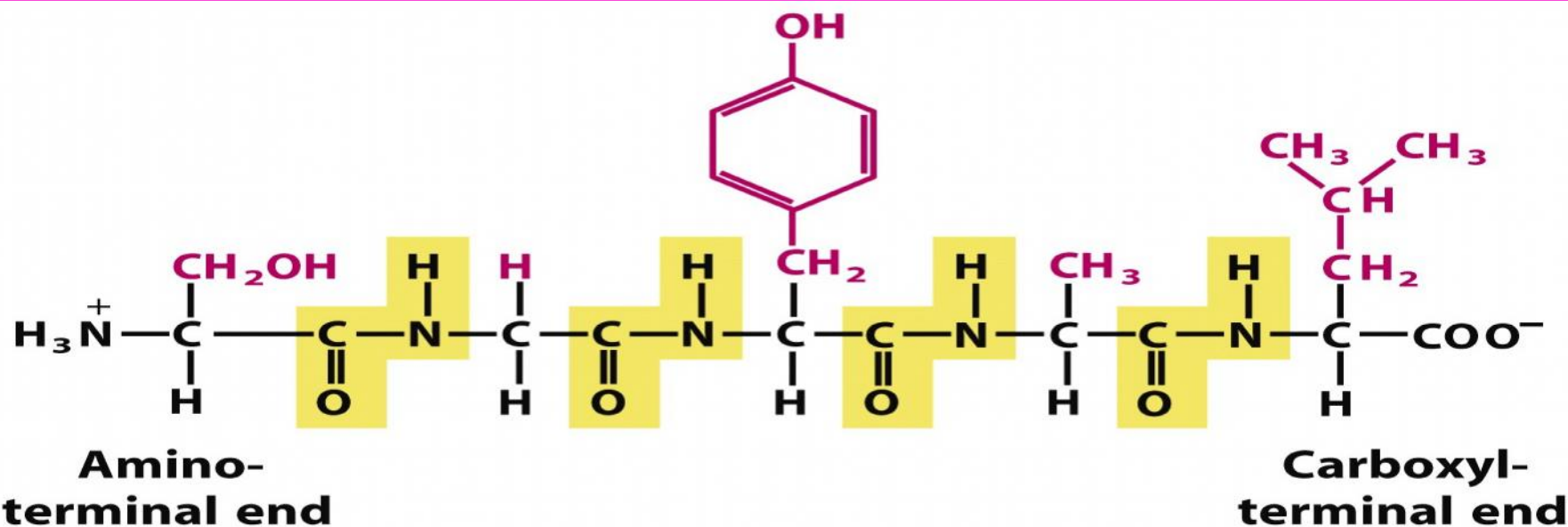


Figure 3-14
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Pentapeptide
 Serylglycyltyrosylalanylleucine
 OR
 Ser-Gly-Tyr-Ala-Leu
 OR
 SGYAL

Peptides are named beginning with the amino-terminal residue, which by convention is placed at the left. The peptide bonds are shaded in yellow; the R groups are in red.

Properties of Peptide Bond:

1. Lack of rotation around the bond
2. Trans Configuration
3. Uncharged but polar: -COO and -NH groups neither accept nor give off protons. These are polar and form H-bond in α -Helices and β - sheets

PEPTIDE:

A) Naturally occurring Polypeptides

Insulin Glucagon

B) Commercially synthesized Polypeptides:

NutraSweet - Aspartame (dipeptide)

