Amino acids

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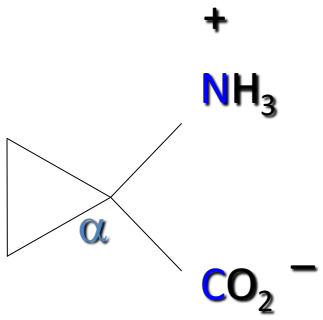
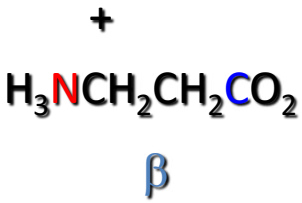
Fundamentals

- While their name implies that amino acids are compounds that contain an —NH_2 group and a —CO_2H group, these groups are actually present as —NH_3^+ and —CO_2^- respectively.
- They are classified as α, β, γ, *etc*. amino acids according the carbon that bears the nitrogen.

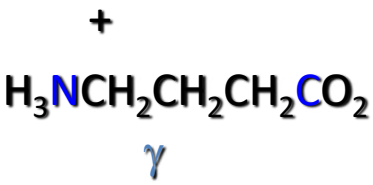
Amino Acids



an α-amino acid that is an intermediate in the biosynthesis of ethylene



a β-amino acid that is one of the structural units present in coenzyme A

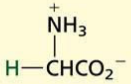
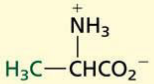
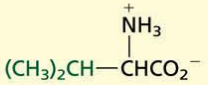
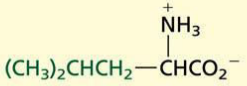
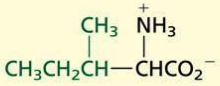
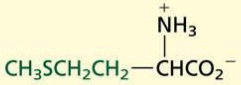
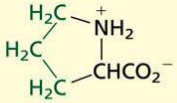
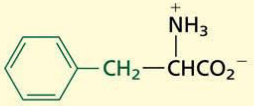
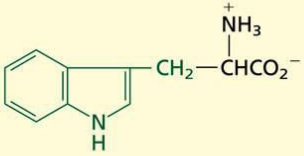
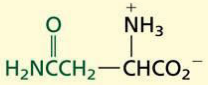


a γ-amino acid involved in the transmission of nerve impulses

The 20 Key Amino Acids

- More than 700 amino acids occur naturally, but 20 of them are especially important.
- These 20 amino acids are the building blocks of proteins. All are α-amino acids.
- They differ in respect to the group attached to the α carbon.
- These 20 are listed in Table

TABLE 27.1 α-Amino Acids Found in Proteins

Name	Abbreviation	Structural formula*
Amino acids with nonpolar side chains		
Glycine	Gly (G)	
Alanine	Ala (A)	
Valine†	Val (V)	
Leucine†	Leu (L)	
Isoleucine†	Ile (I)	
Methionine†	Met (M)	
Proline	Pro (P)	
Phenylalanine†	Phe (F)	
Tryptophan†	Trp (W)	
Amino acids with polar but nonionized side chains		
Asparagine	Asn (N)	

*All amino acids are shown in the form present in greatest concentration at pH 7.
†An essential amino acid, which must be present in the diet of animals to ensure normal growth.

(Continued)

TABLE 27.1 α-Amino Acids Found in Proteins *(Continued)*

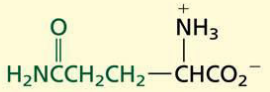
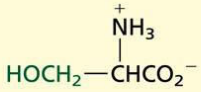
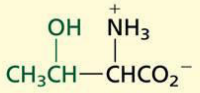
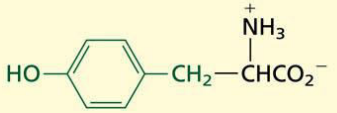
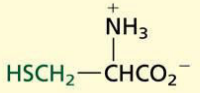
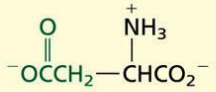
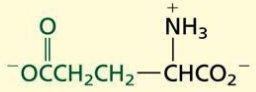
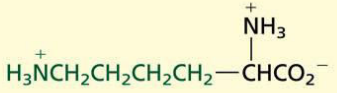
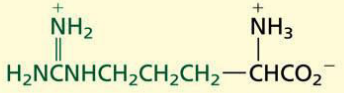
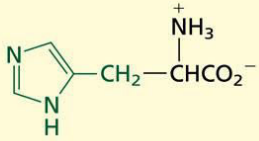
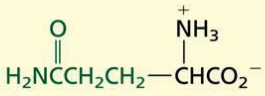
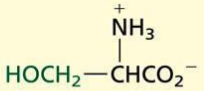
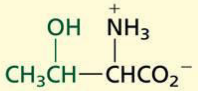
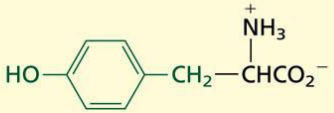
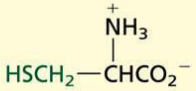
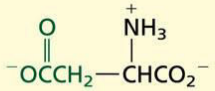
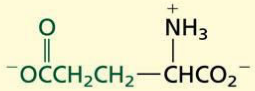
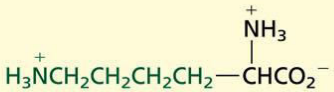
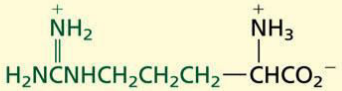
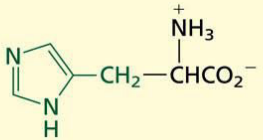
Name	Abbreviation	Structural formula*
Amino acids with polar but nonionized side chains		
Glutamine	Gln (Q)	
Serine	Ser (S)	
Threonine†	Thr (T)	
Tyrosine	Tyr (Y)	
Cysteine	Cys (C)	
Amino acids with acidic side chains		
Aspartic acid	Asp (D)	
Glutamic acid	Glu (E)	
Amino acids with basic side chains		
Lysine†	Lys (K)	
Arginine†	Arg (R)	
Histidine†	His (H)	

TABLE 27.1 α-Amino Acids Found in Proteins *(Continued)*

Name	Abbreviation	Structural formula*
Amino acids with polar but nonionized side chains		
Glutamine	Gln (Q)	
Serine	Ser (S)	
Threonine†	Thr (T)	
Tyrosine	Tyr (Y)	
Cysteine	Cys (C)	
Amino acids with acidic side chains		
Aspartic acid	Asp (D)	
Glutamic acid	Glu (E)	
Amino acids with basic side chains		
Lysine†	Lys (K)	
Arginine†	Arg (R)	
Histidine†	His (H)	

Amino Acids

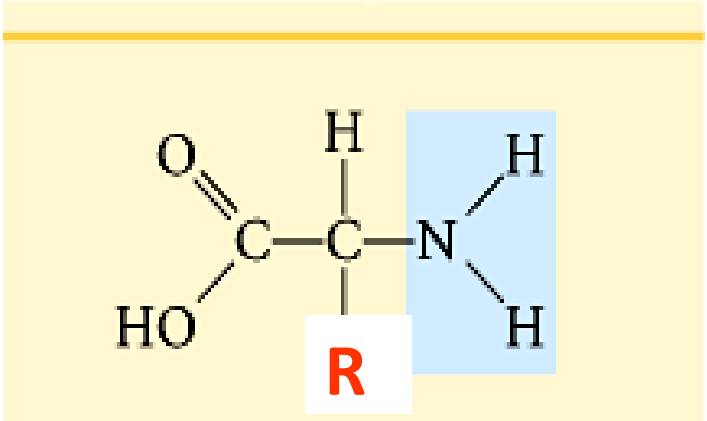
Amino Acids are the building units of proteins. Proteins are polymers of amino acids linked together by what is called " Peptide bond".

Structure of amino acids:

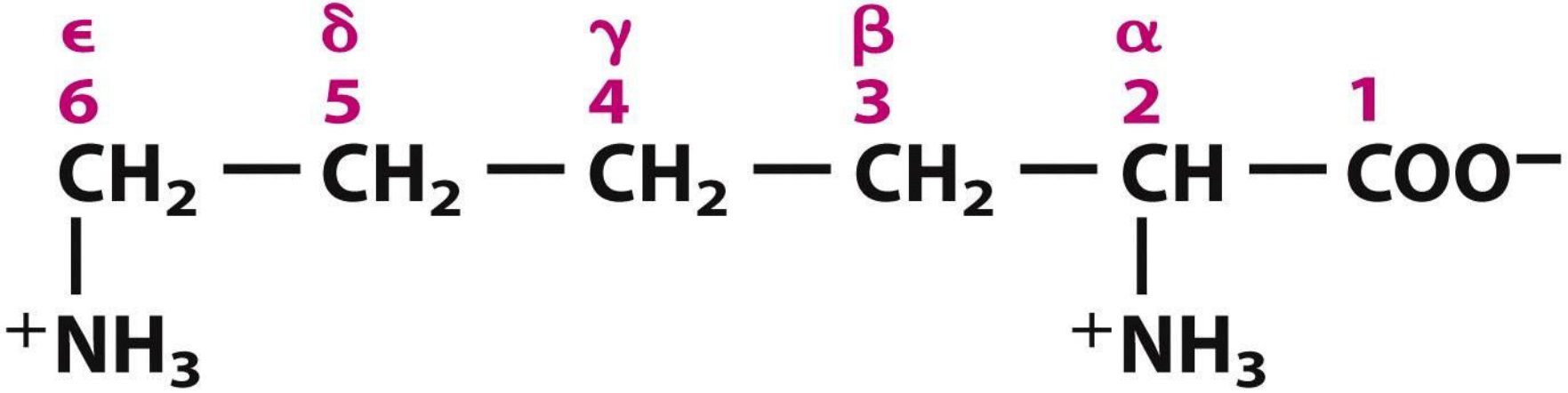
Each amino acid has 4 different groups attached to α- carbon (which is C-atom next to COOH). These 4 groups are : amino group, COOH gp,

Hydrogen atom and side

Chain ®



Carbon Numbering System



Lysine

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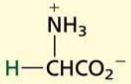
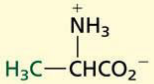
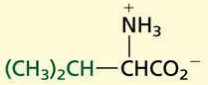
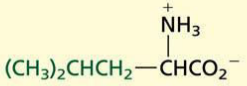
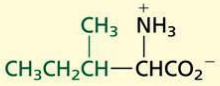
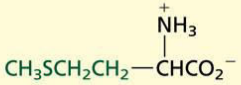
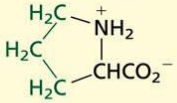
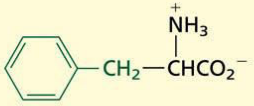
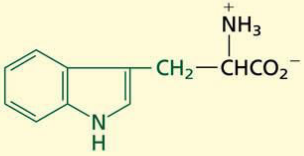
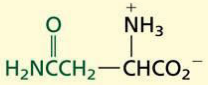
Glycine	Gly (G)	
Alanine	Ala (A)	
Valine†	Val (V)	
Leucine†	Leu (L)	
Isoleucine†	Ile (I)	
Methionine†	Met (M)	
Proline	Pro (P)	
Phenylalanine†	Phe (F)	
Tryptophan†	Trp (W)	
Amino acids with polar but nonionized side chains		
Asparagine	Asn (N)	

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†An essential amino acid, which must be present in the diet of animals to ensure normal growth.

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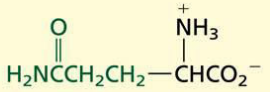
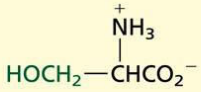
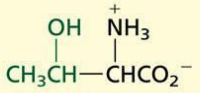
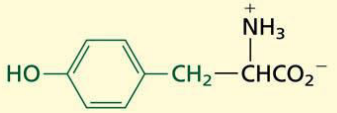
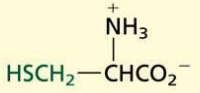
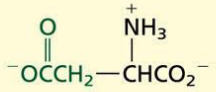
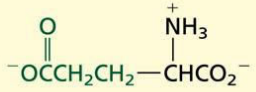
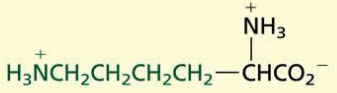
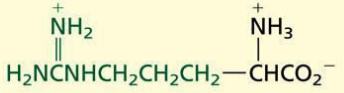
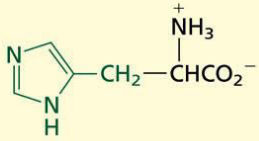
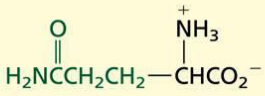
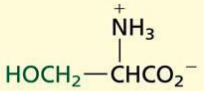
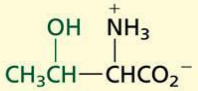
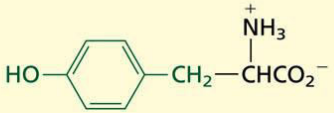
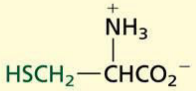
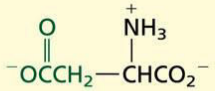
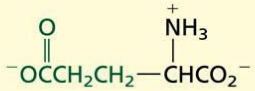
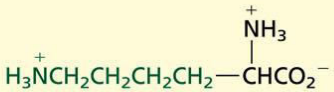
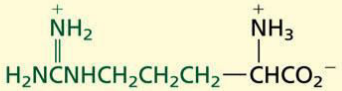
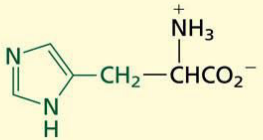
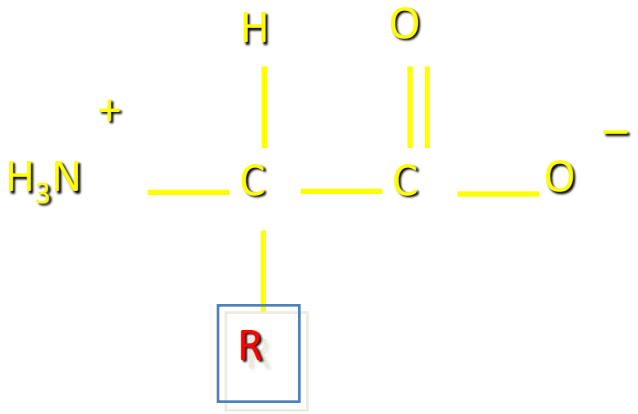
Glutamine	Gln (Q)	
Serine	Ser (S)	
Threonine†	Thr (T)	
Tyrosine	Tyr (Y)	
Cysteine	Cys (C)	
Amino acids with acidic side chains		
Aspartic acid	Asp (D)	
Glutamic acid	Glu (E)	
Amino acids with basic side chains		
Lysine†	Lys (K)	
Arginine†	Arg (R)	
Histidine†	His (H)	

TABLE 27.1 α-Amino Acids Found in Proteins *(Continued)*

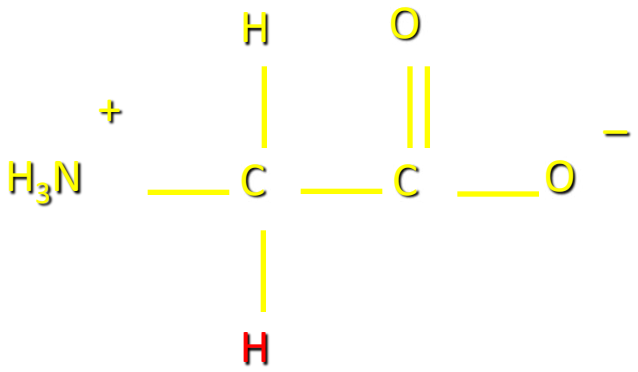
Name	Abbreviation	Structural formula*
Amino acids with polar but nonionized side chains		
Glutamine	Gln (Q)	
Serine	Ser (S)	
Threonine†	Thr (T)	
Tyrosine	Tyr (Y)	
Cysteine	Cys (C)	
Amino acids with acidic side chains		
Aspartic acid	Asp (D)	
Glutamic acid	Glu (E)	
Amino acids with basic side chains		
Lysine†	Lys (K)	
Arginine†	Arg (R)	
Histidine†	His (H)	



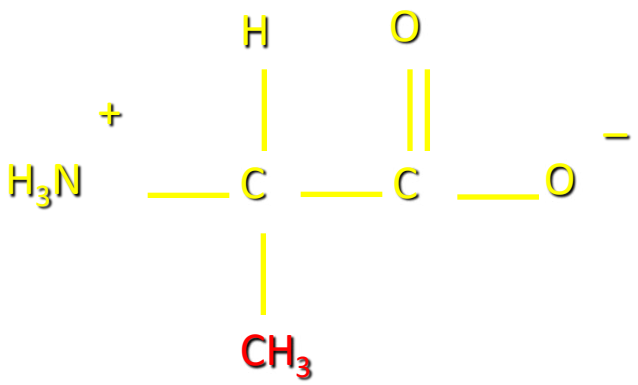
- The amino acids obtained by hydrolysis of proteins differ in respect to R (the side chain).
- The properties of the amino acid vary as the structure of R varies.

Glycine

(Gly or G)

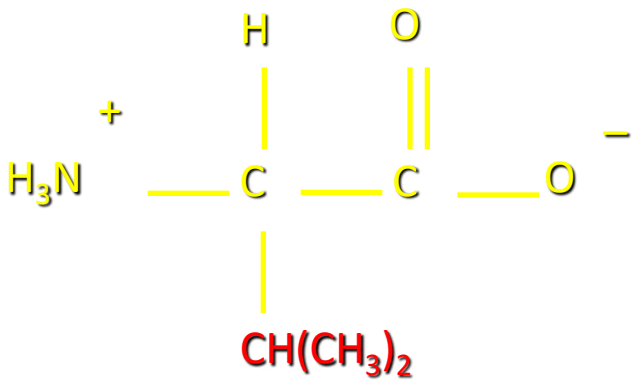


- Glycine is the simplest amino acid. It is the only one in the table that is achiral.
- In all of the other amino acids in the table the α carbon is a stereogenic center.



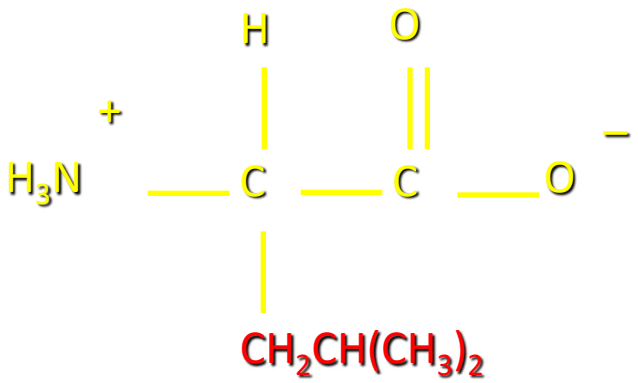
Alanine

(Ala or A)



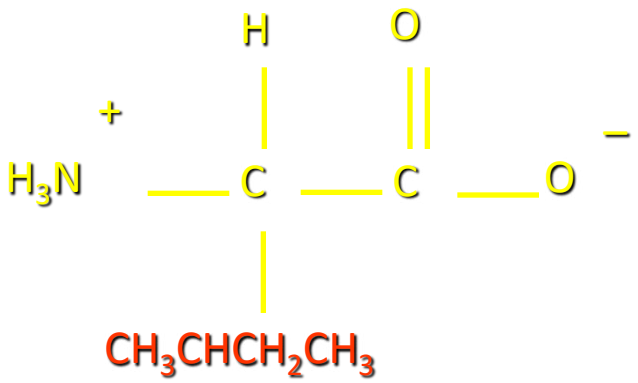
Valine

(Val or V)



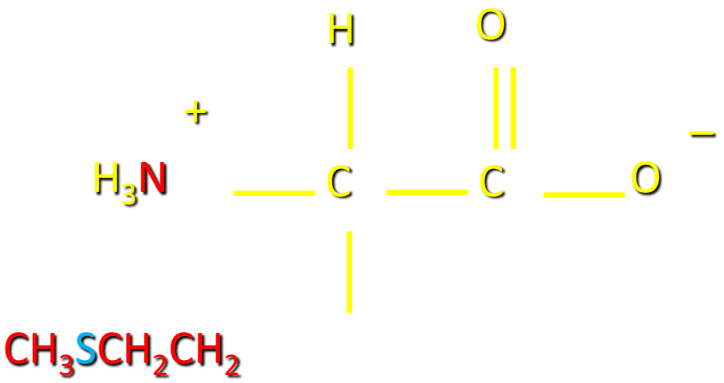
Leucine

(Leu or L)



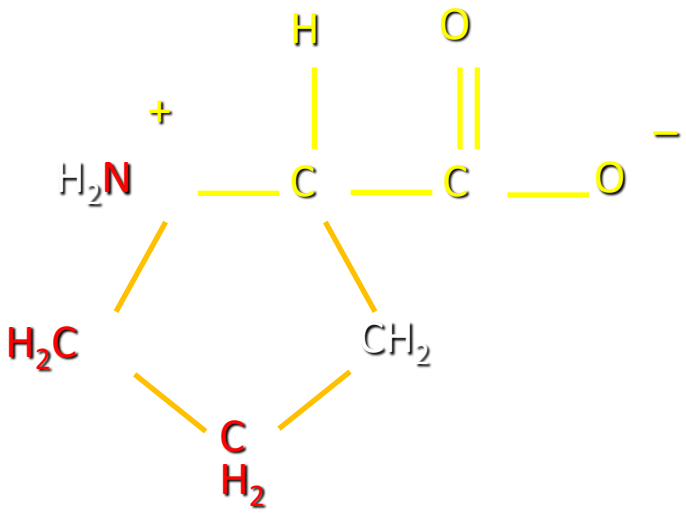
Isoleucine

(Ile or I)



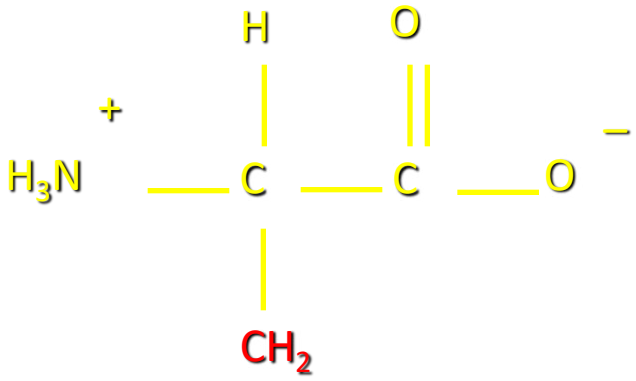
Methionine

(Met or M)



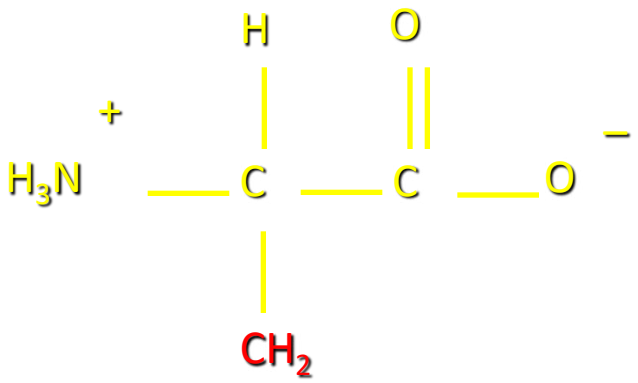
Proline

(Pro or P)



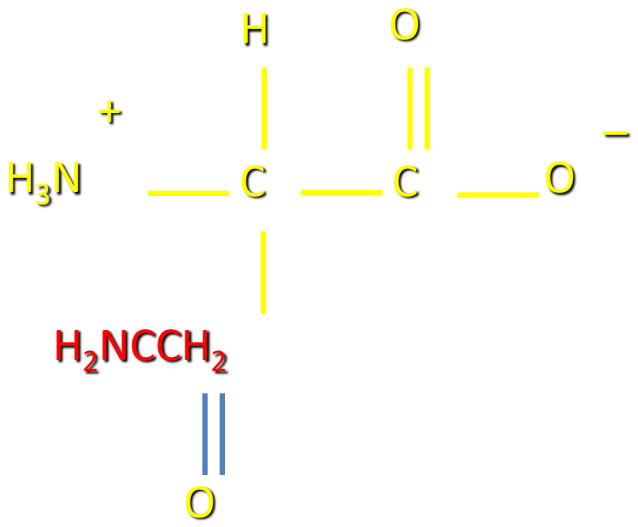
Phenylalanine

(Phe or F)



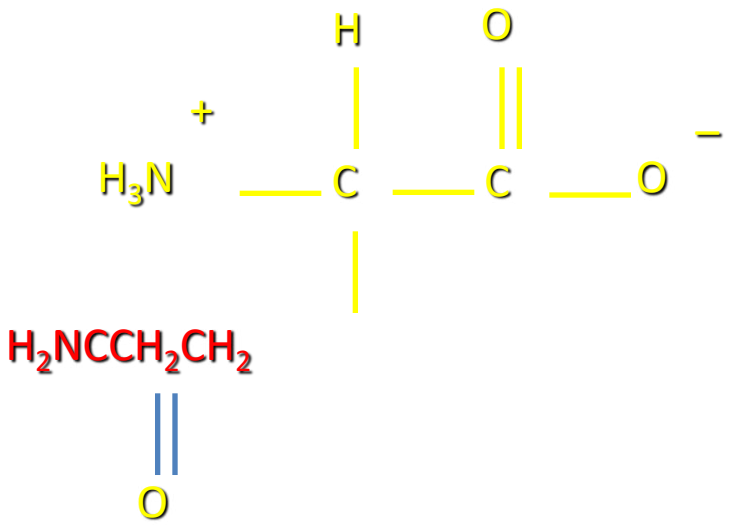
Tryptophan

(Trp or W)



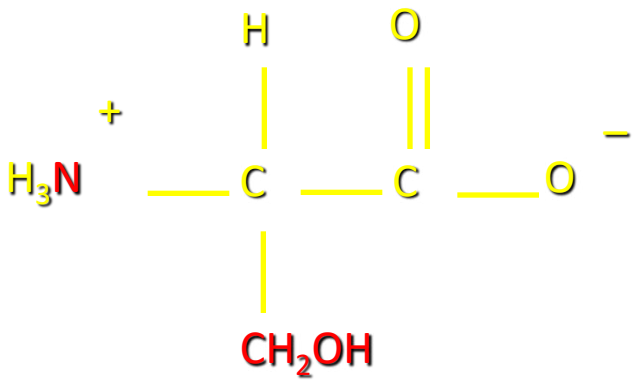
Asparagine

(Asn or N)



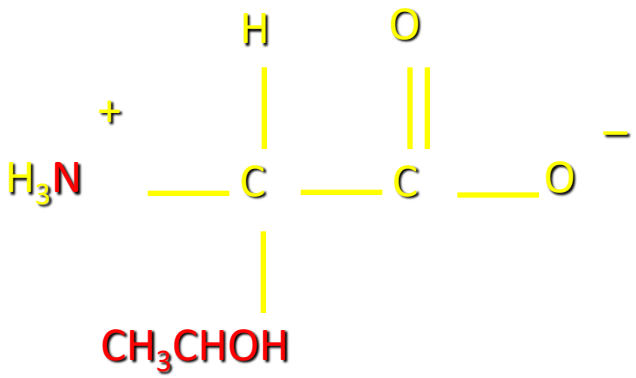
Glutamine

(Gln or Q)



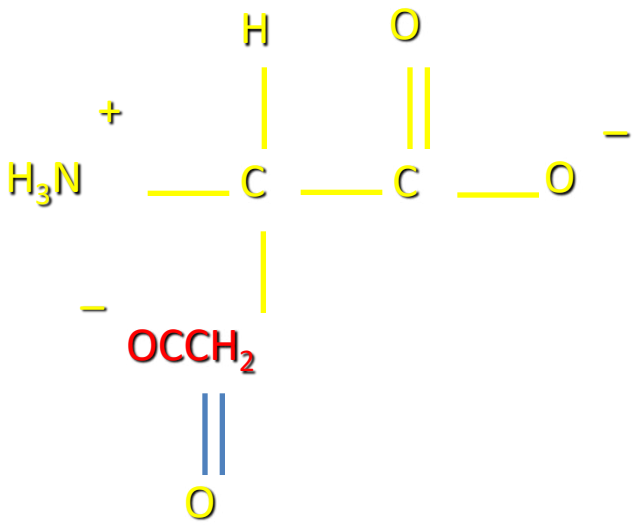
Serine

(Ser or S)



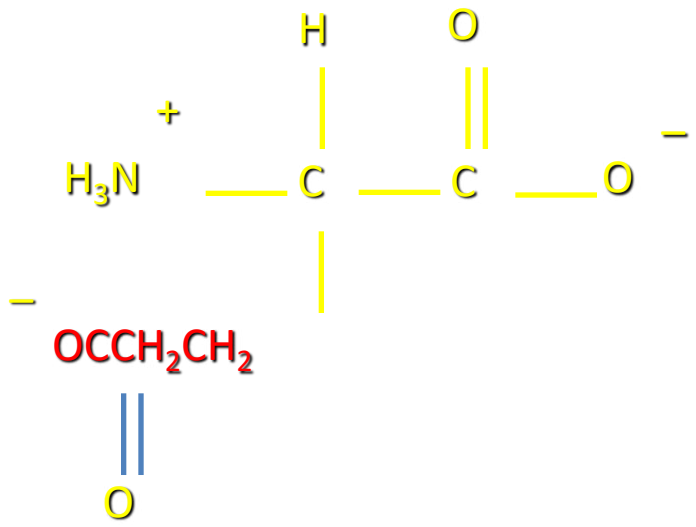
Threonine

(Thr or T)



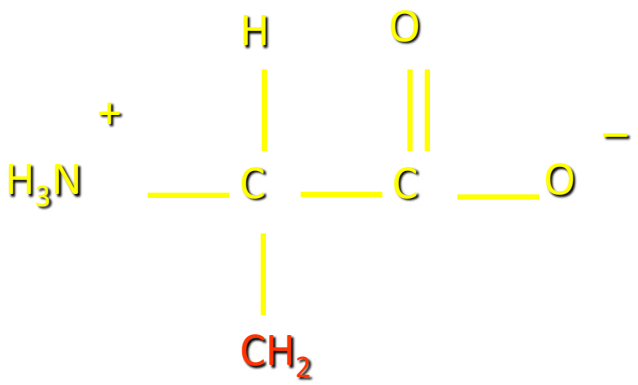
Aspartic Acid

(Asp or D)



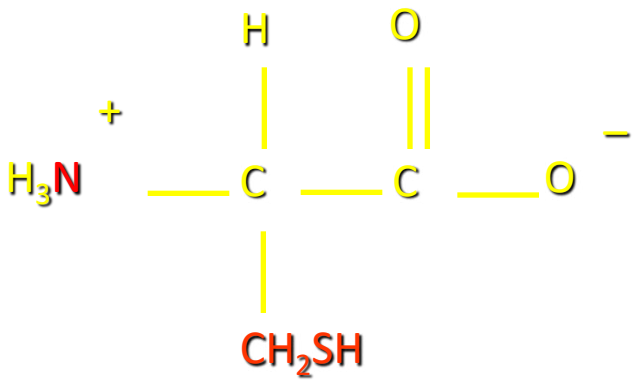
Glutamic Acid

(Glu or E)



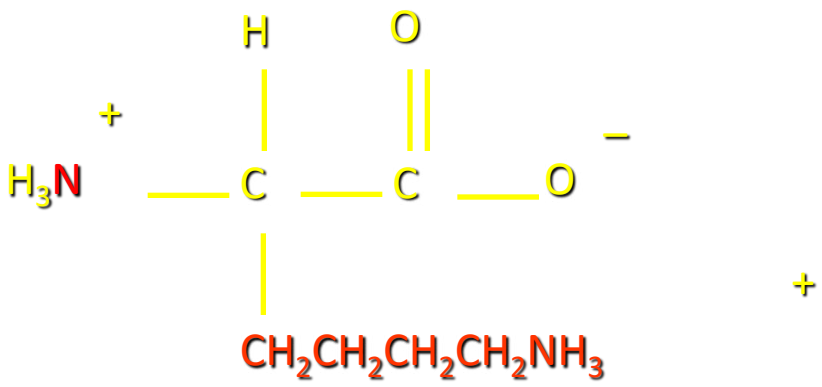
Tyrosine

(Tyr or Y)



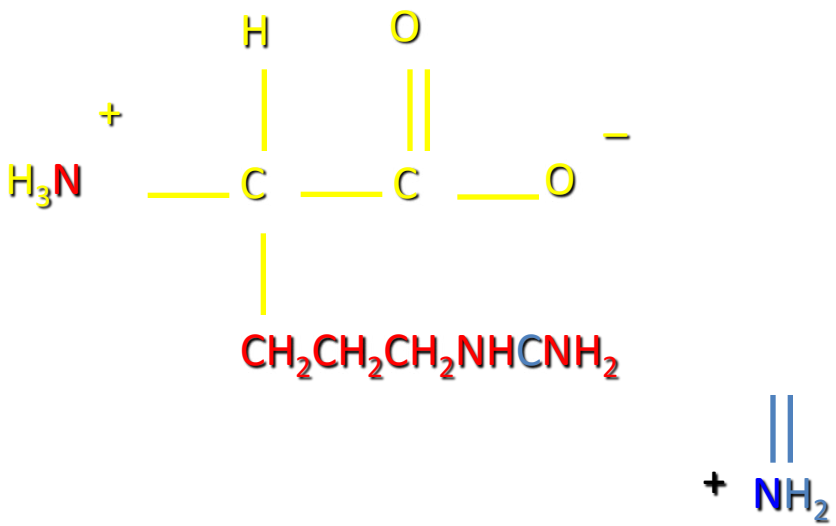
Cysteine

(Cys or C)



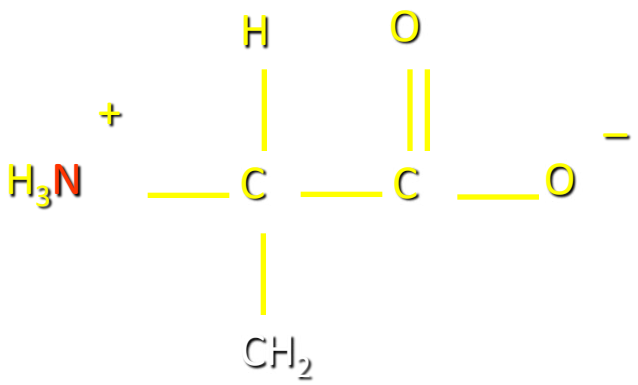
Lysine

(Lys or K)



Arginine

(Arg or R)



N NH

Histidine

(His or H)

Configuration of α-Amino Acids

- Glycine is achiral. All of the other amino acids in proteins have the L-configuration at their α carbon.