



# Biochemistry

## Lecture 1

Course prof.

**Dr. Ahmed Mohamed**  
Lecturer at Dep. Of  
Biochemistry

## CHEMISTRY 2

## Protein:

### ANIMAL SOURCES



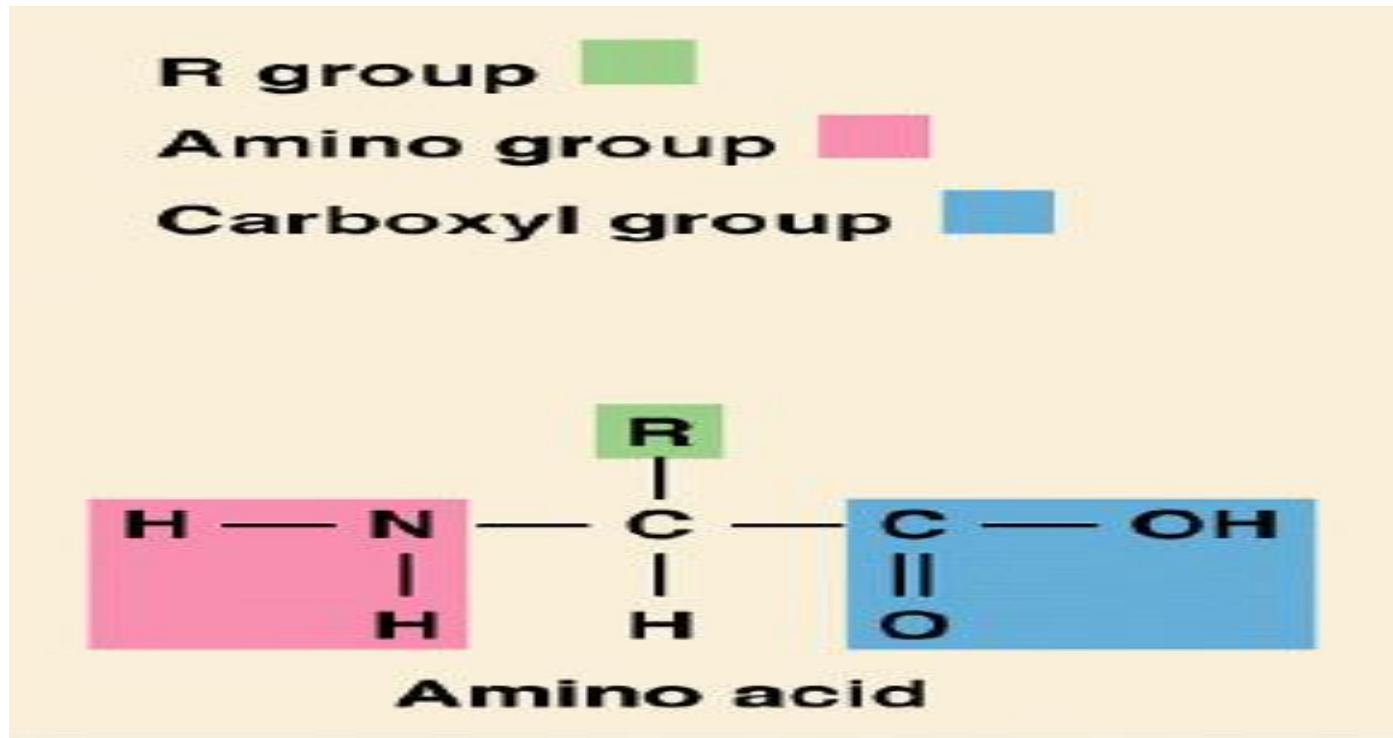
### PLANT SOURCES



<https://study.com/search/text/academy.html?q=Amino+acids&pageType=lesson#/topresults/Amino%20acids>

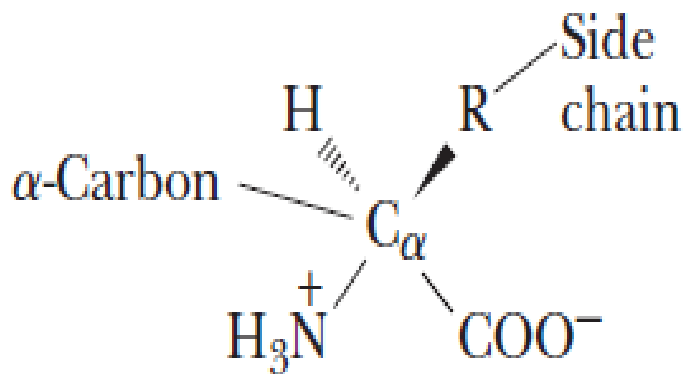
<https://www.youtube.com/watch?v=YO244P1e9QM>

# Amino Acids Share Common Structural Features



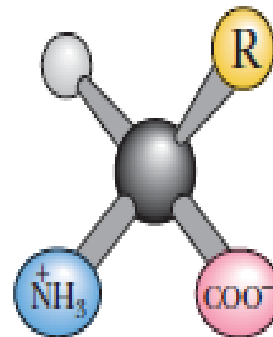
[https://www.youtube.com/watch?v=J6R8zDAI\\_vw](https://www.youtube.com/watch?v=J6R8zDAI_vw)

**Anatomy of an amino acid. Except for proline and its derivatives, all of the amino acids commonly found in proteins possess this type of structure.**

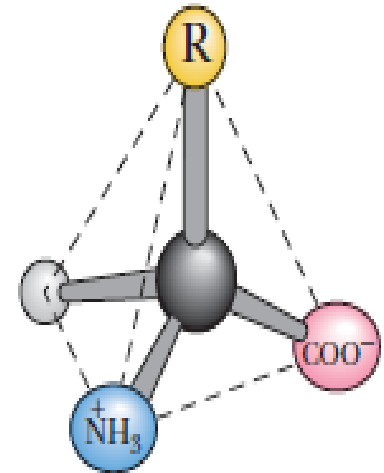


Amino  
group

Carboxyl  
group

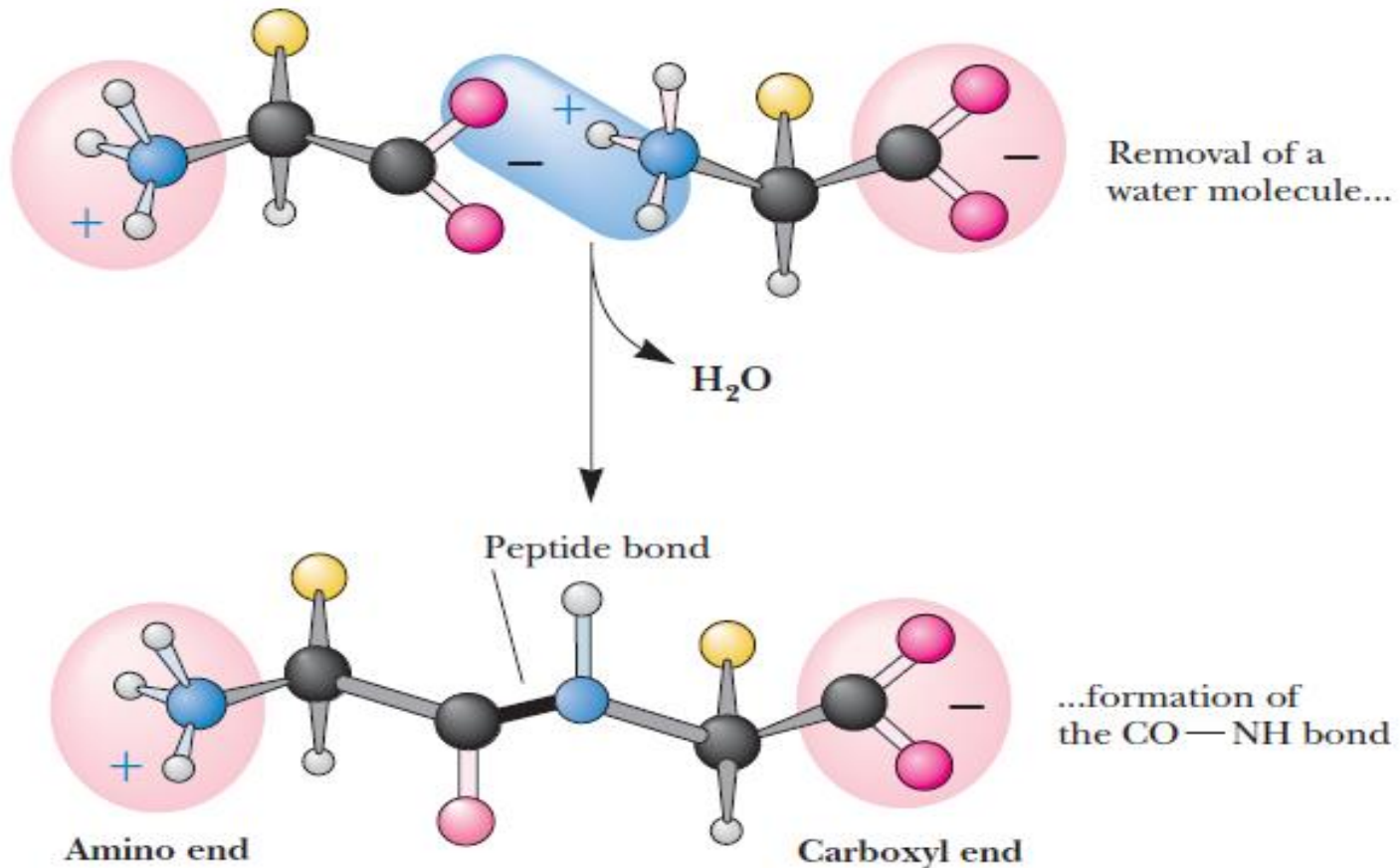


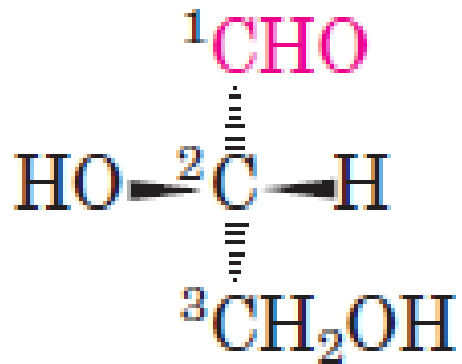
Ball-and-stick  
model



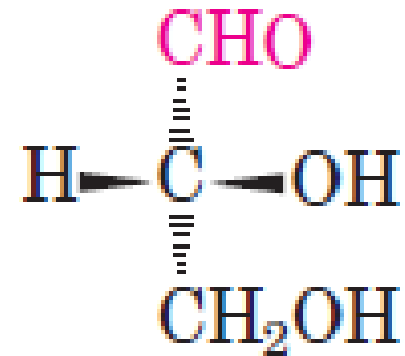
Amino acids are  
tetrahedral structures

The  $\alpha$ -COOH and  $\alpha$ -NH $_3^+$  groups of two amino acids can react with the resulting loss of a water molecule to form a covalent amide bond.

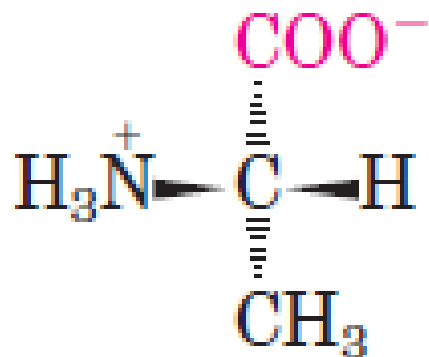




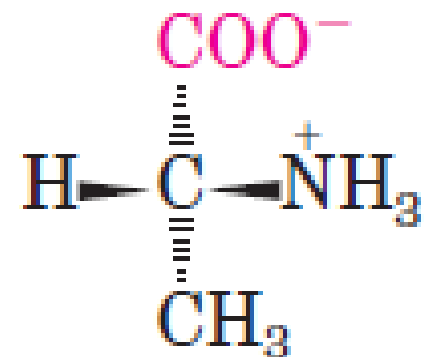
L-Glyceraldehyde



D-Glyceraldehyde

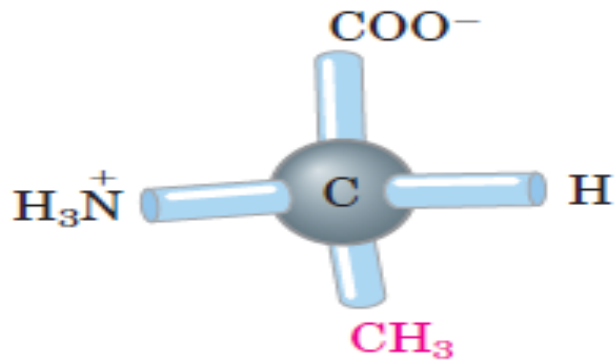


L-Alanine

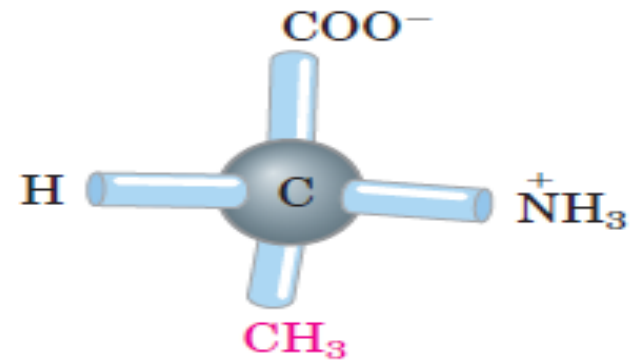


D-Alanine

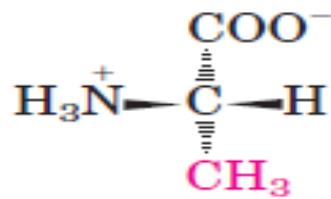
# BIOCHEMISTRY



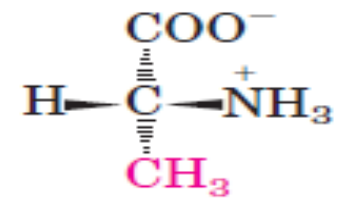
(a) L-Alanine



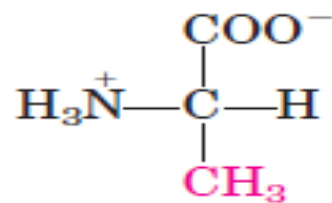
D-Alanine



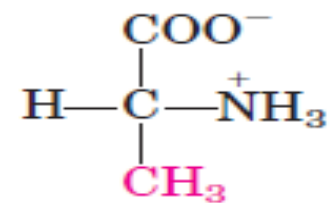
(b) L-Alanine



D-Alanine



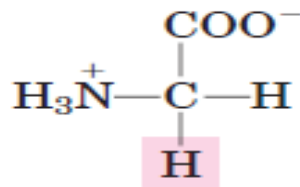
(c) L-Alanine



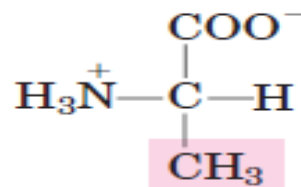
D-Alanine

## Amino Acids Can Be Classified by R Group

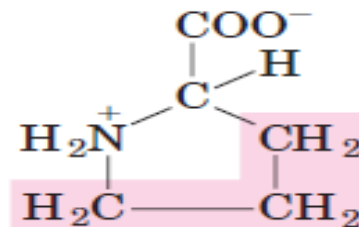
### Nonpolar, aliphatic R groups



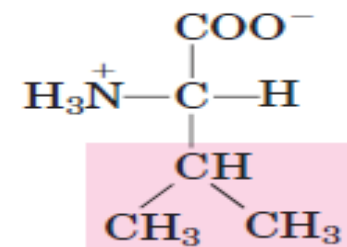
Glycine



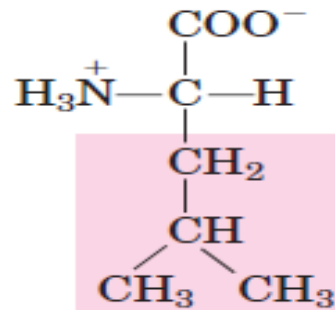
Alanine



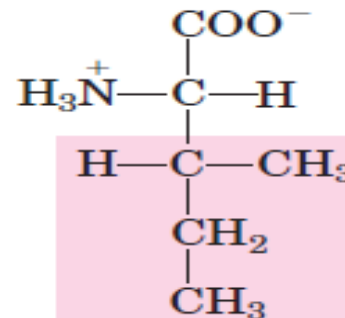
Proline



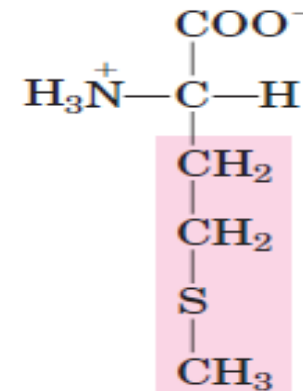
Valine



Leucine



Isoleucine

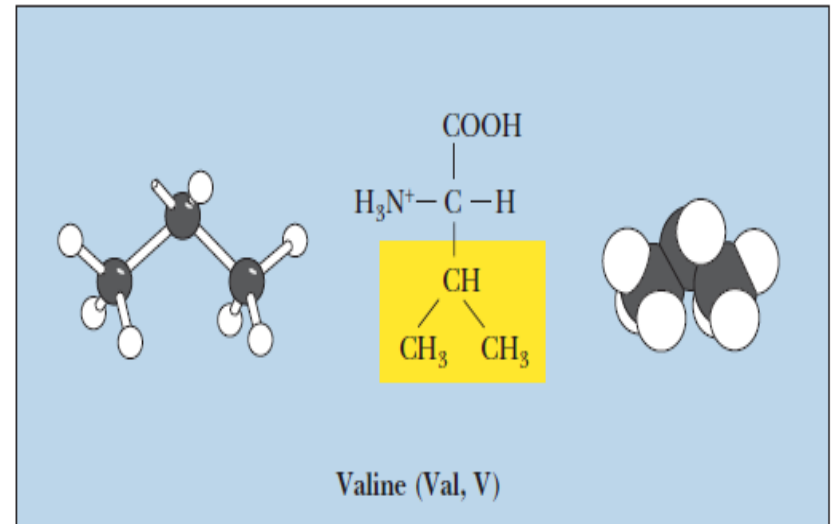
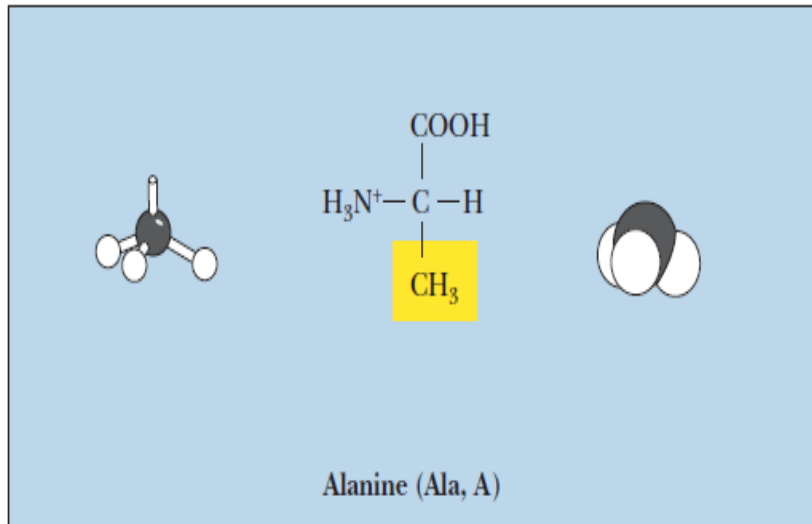
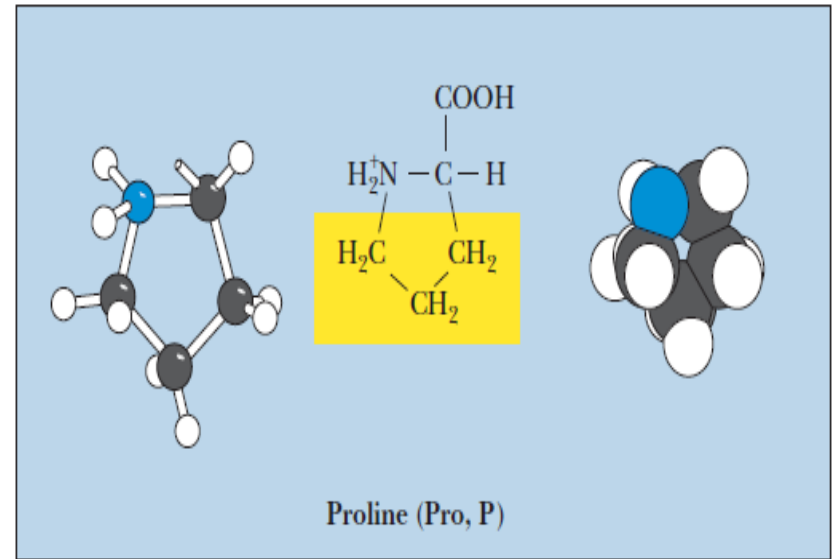
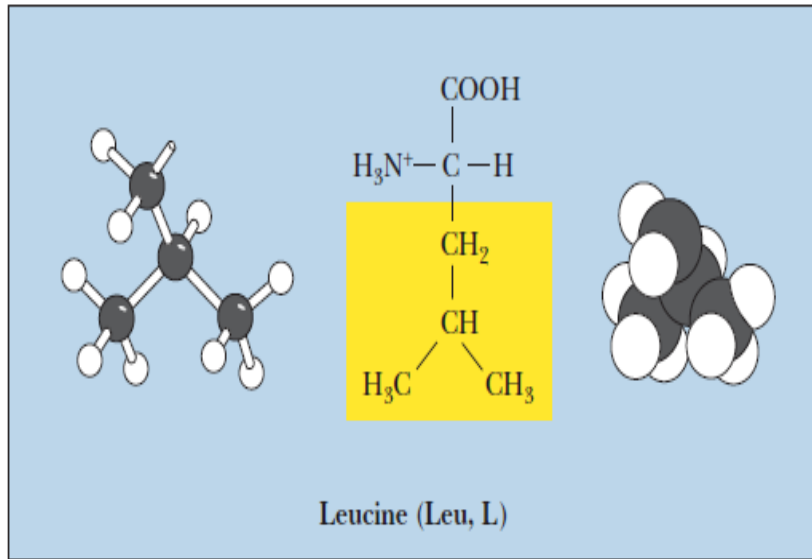


Methionine

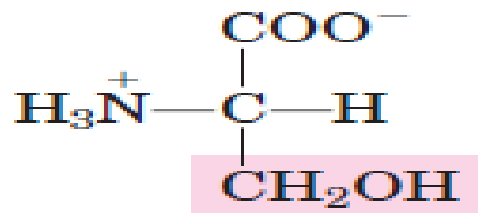


# BIOCHEMISTRY

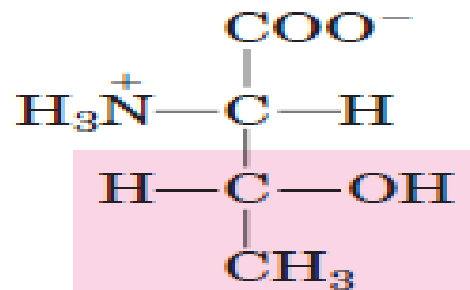
## (a) Nonpolar (hydrophobic)



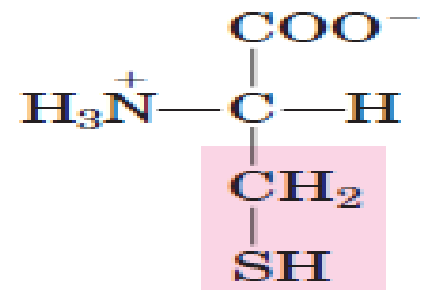
## Polar, uncharged R groups



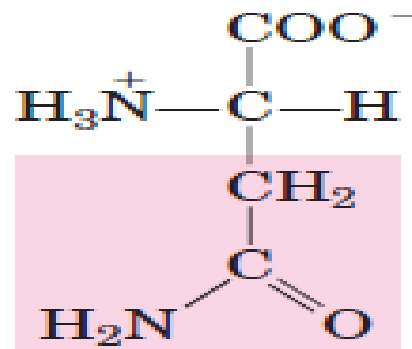
Serine



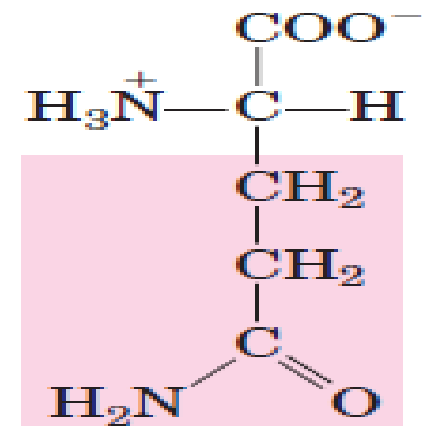
Threonine



Cysteine

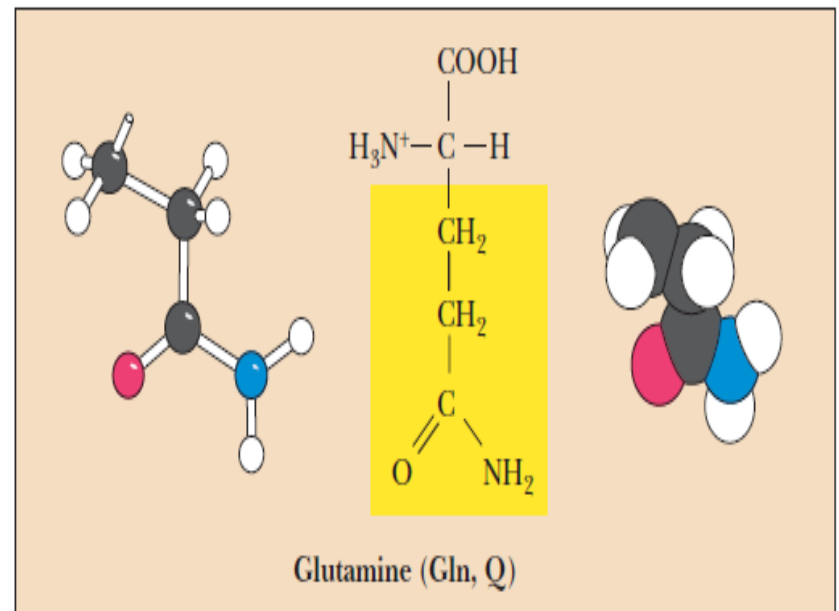
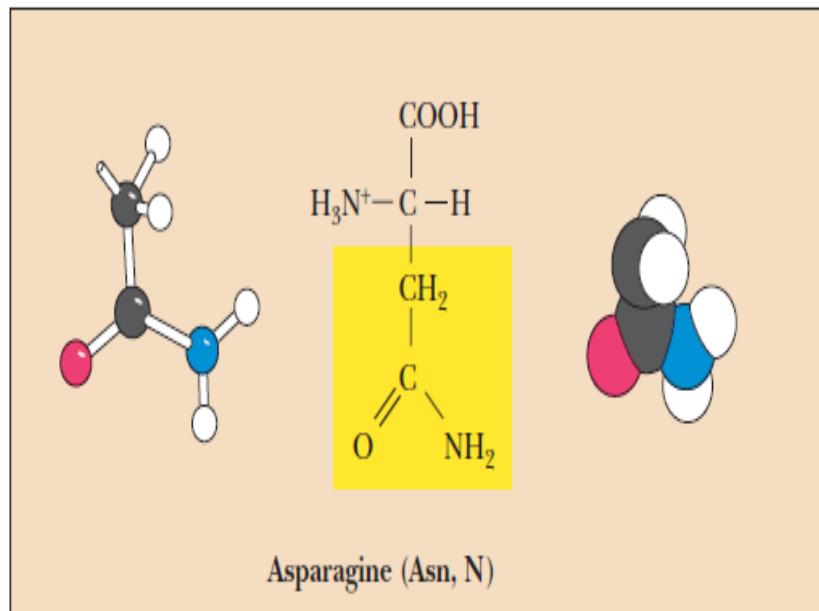
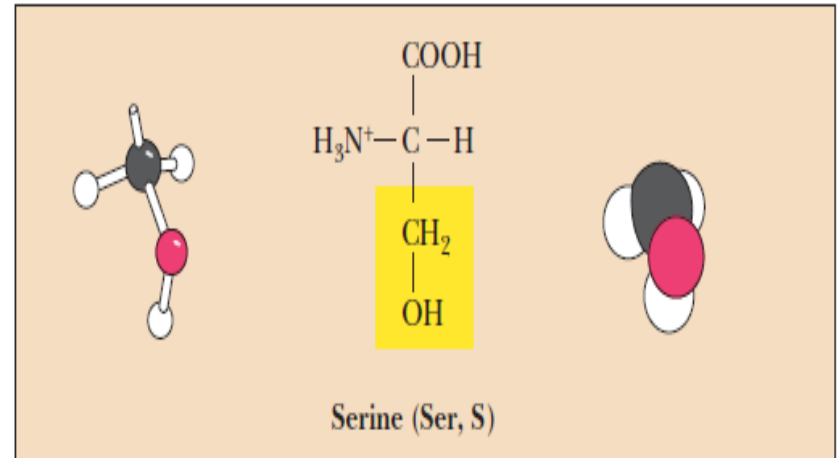
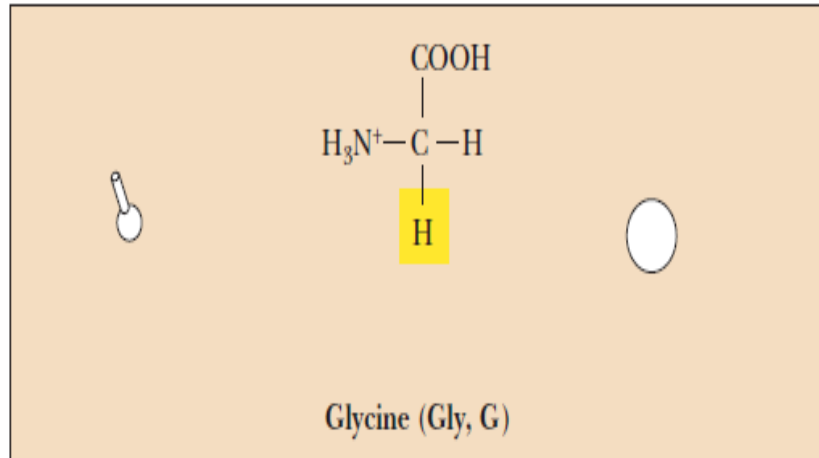


Asparagine

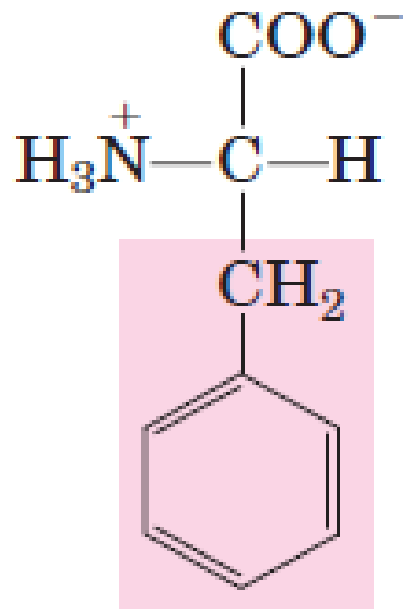


Glutamine

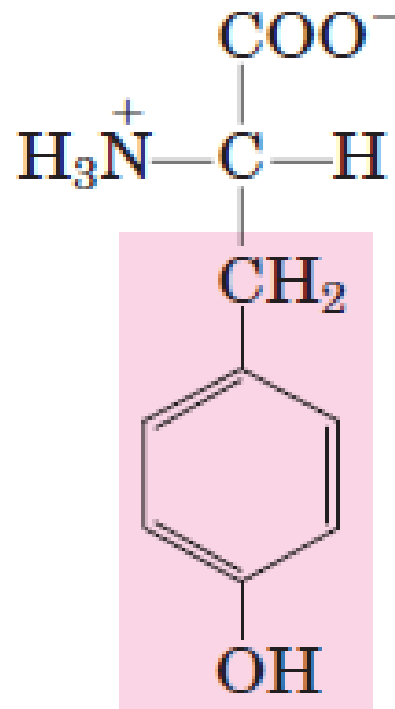
(b) Polar, uncharged



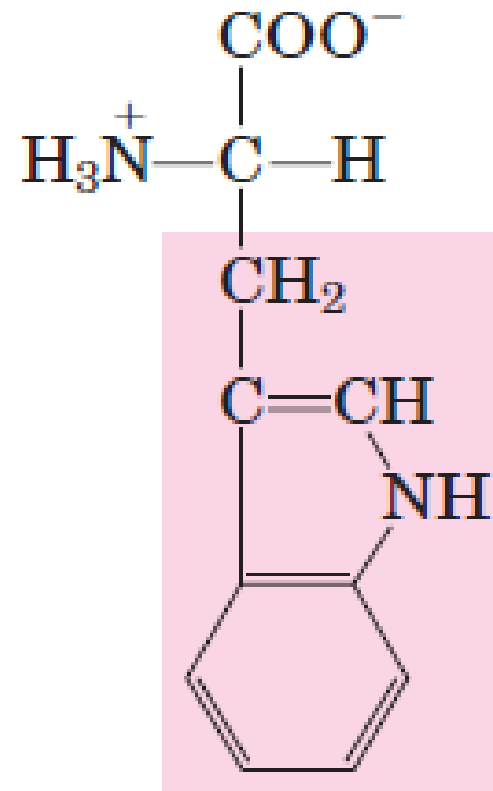
## Aromatic R groups



Phenylalanine

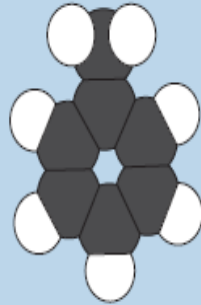
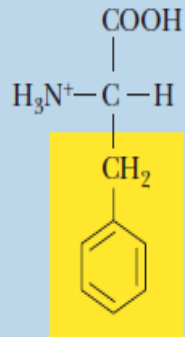
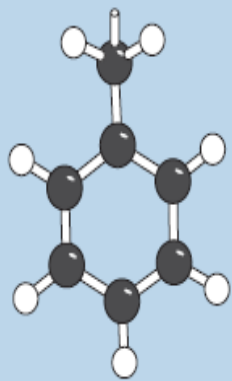


Tyrosine

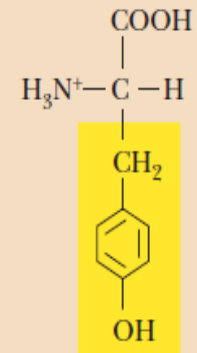
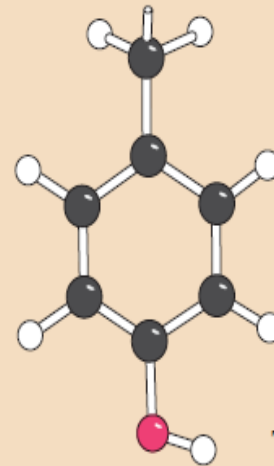


Tryptophan

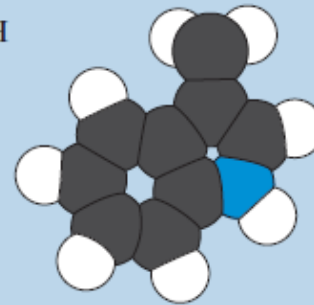
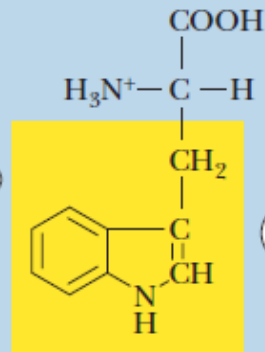
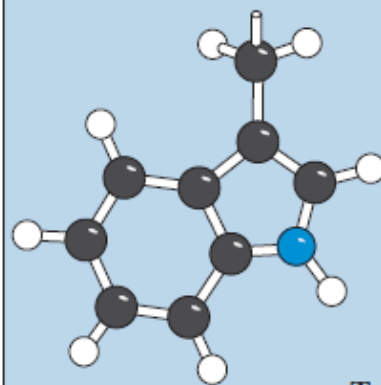
# BIOCHEMISTRY



Phenylalanine (Phe, F)

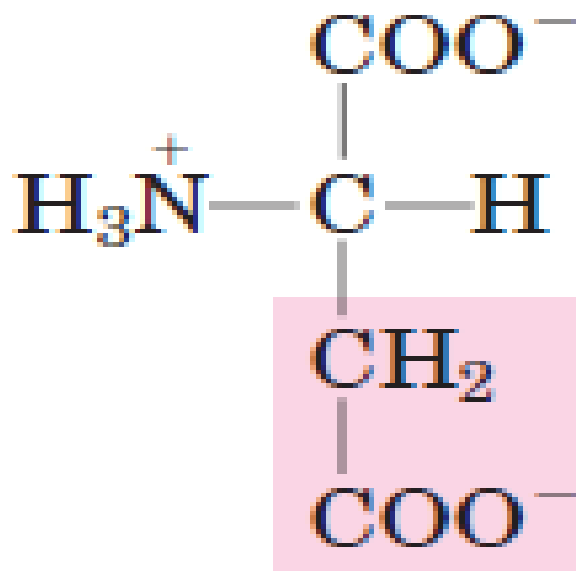


Tyrosine (Tyr, Y)

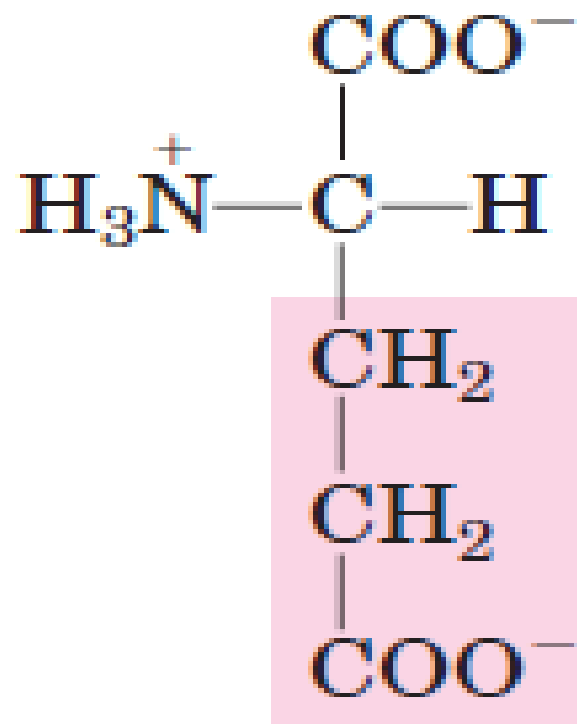


Tryptophan (Trp, W)

## Negatively charged R groups

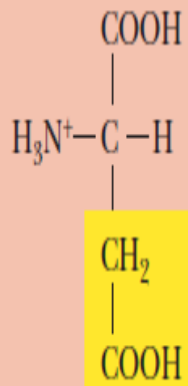


Aspartate

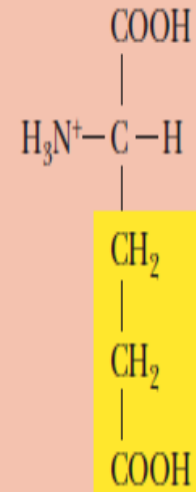


Glutamate

(c) Acidic

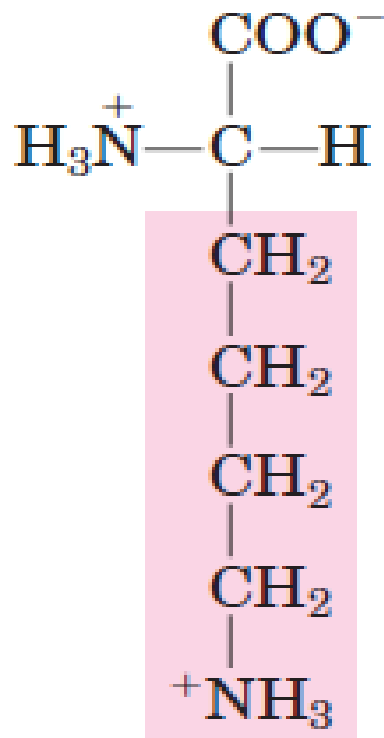


Aspartic acid (Asp, D)

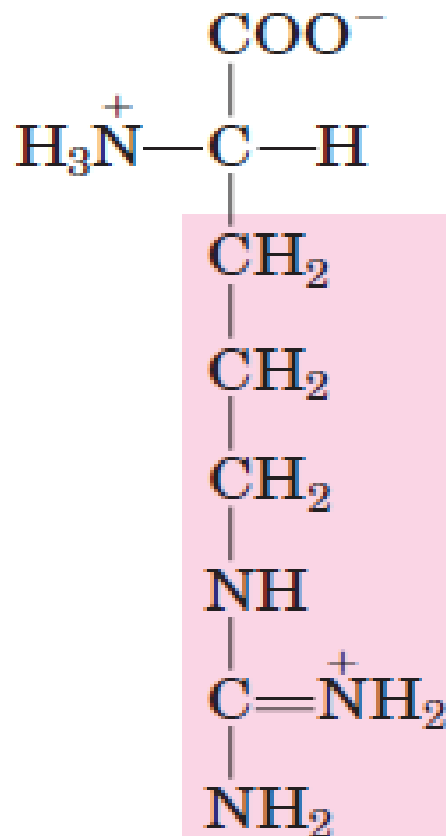


Glutamic acid (Glu, E)

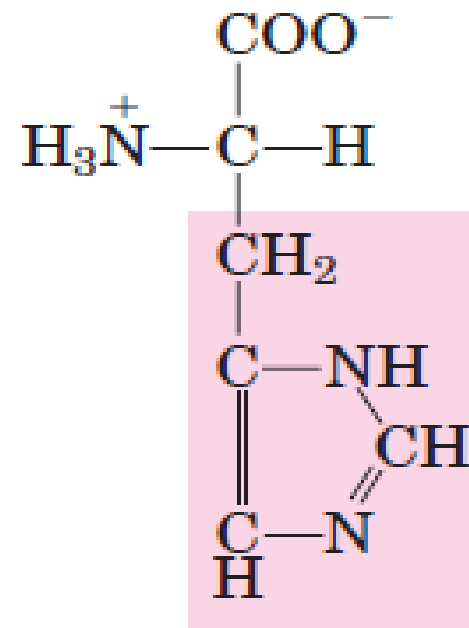
## Positively charged R groups



Lysine



Arginine

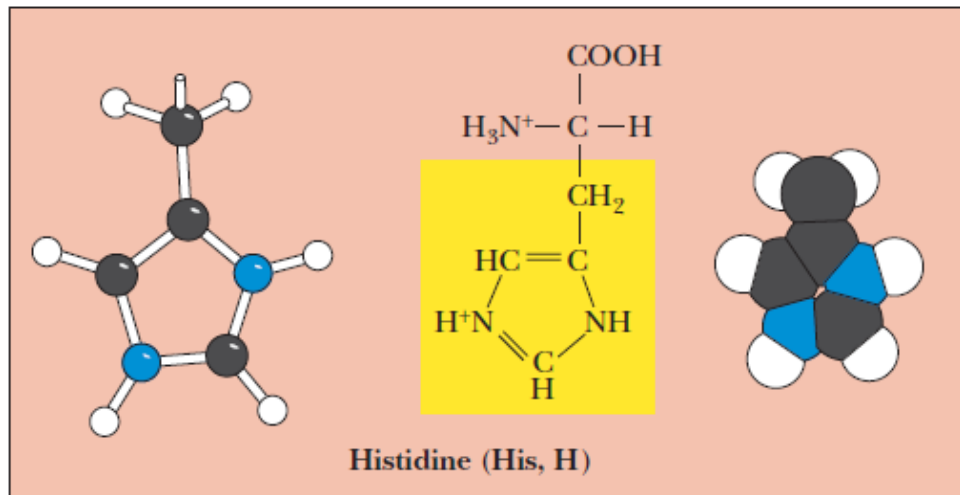
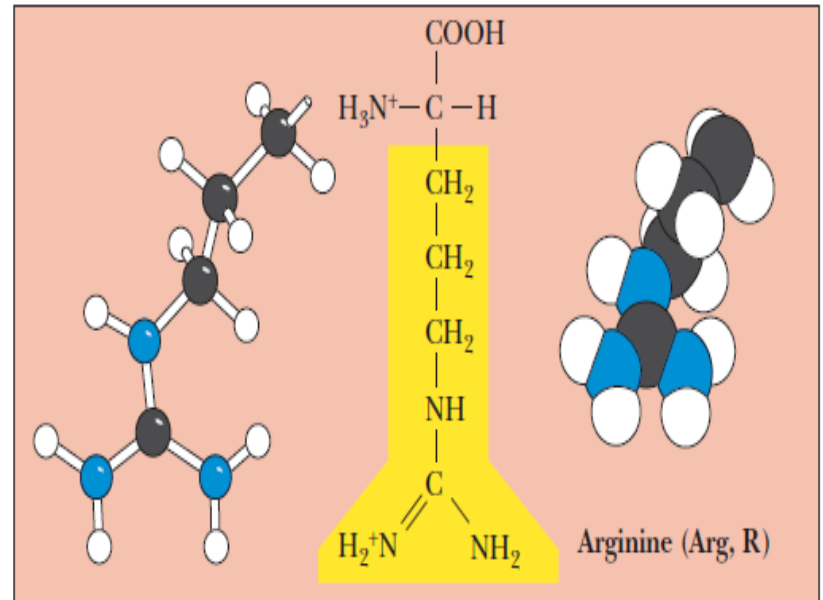
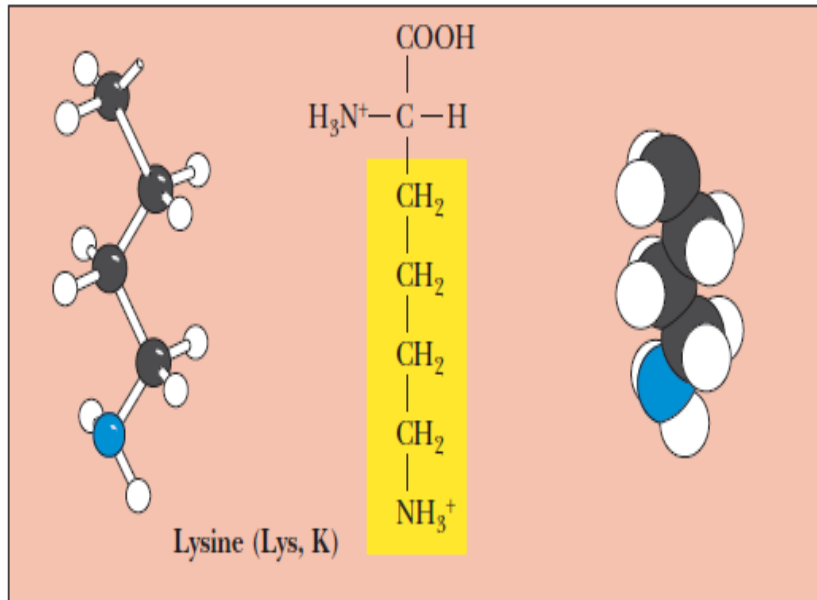


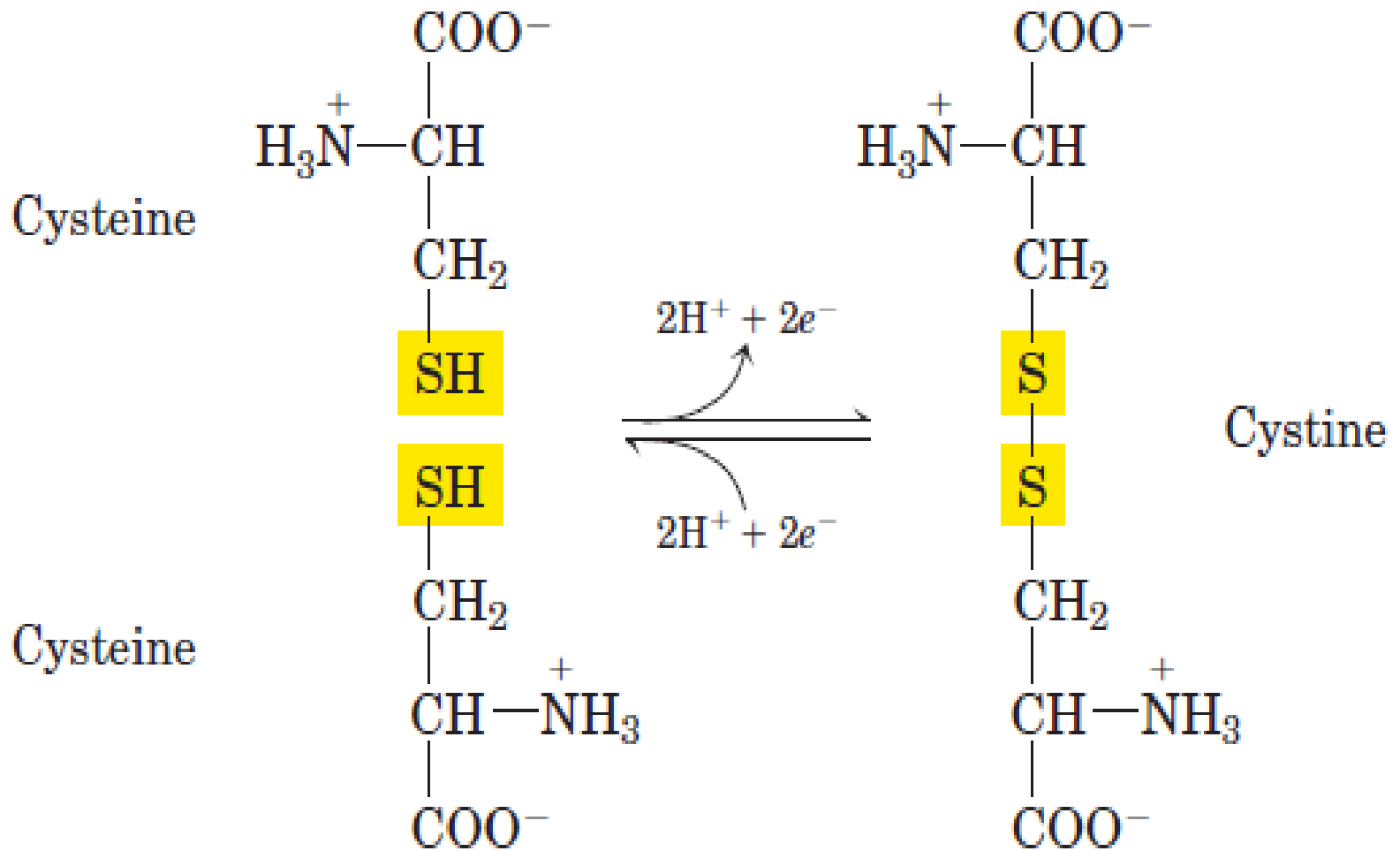
Histidine



# BIOCHEMISTRY

(d) Basic





## NON ESSENTIAL

## ESSENTIAL



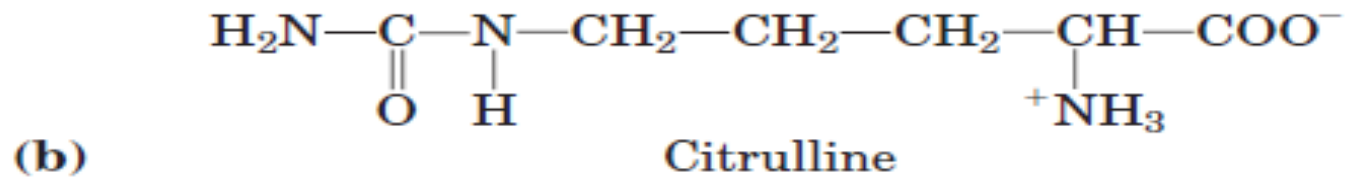
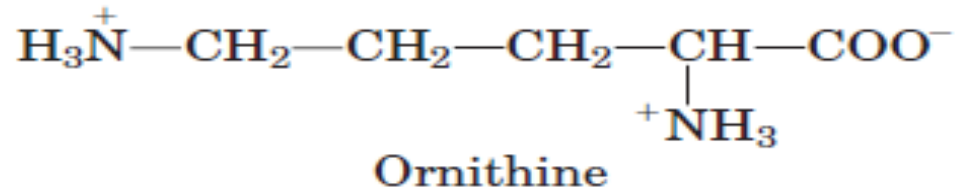
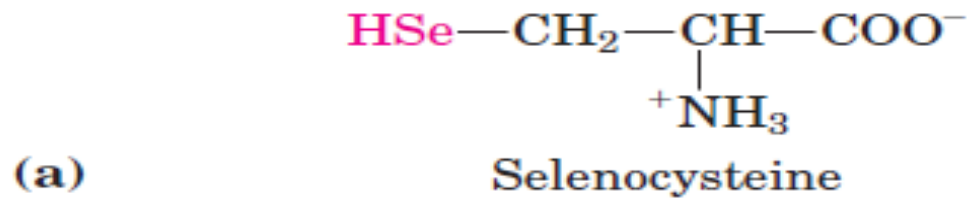
Alanine  
Arginine  
Asparagine  
Aspartate  
Cystine  
Glutamic  
Glycine  
Ornithine  
Proline  
Serine  
Tyrosine

Histidine  
Isoleucine  
Leucine  
Lysine  
Methionine  
Phenylalanine  
Threonine  
Tryptophan  
Valine

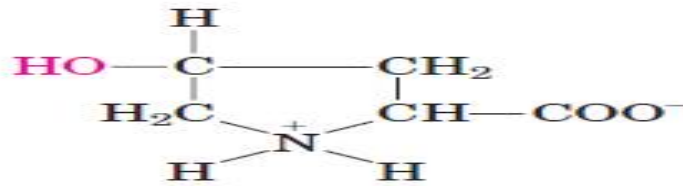


<https://study.com/academy/lesson/essential-nonessential-amino-acids-difference-roles.html>

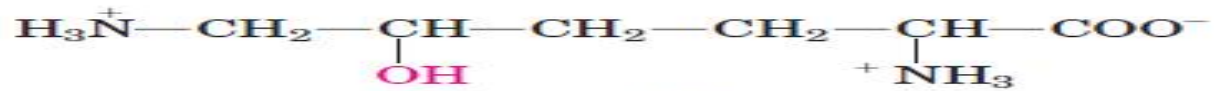
## Uncommon Amino Acids Also Have Important Functions



# BIOCHEMISTRY



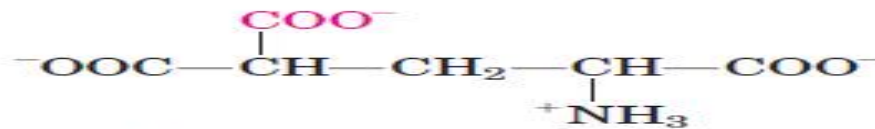
4-Hydroxyproline



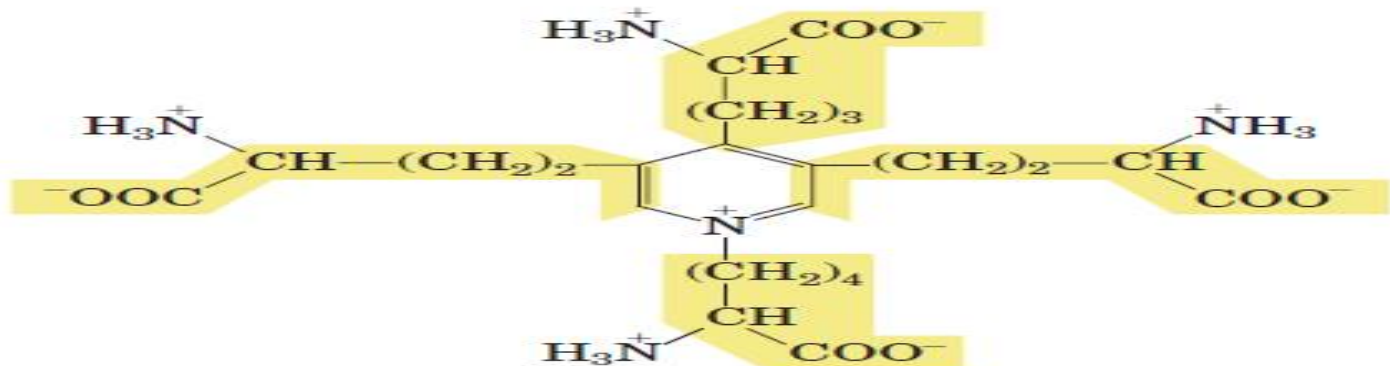
5-Hydroxylysine



6-N-Methyllysine

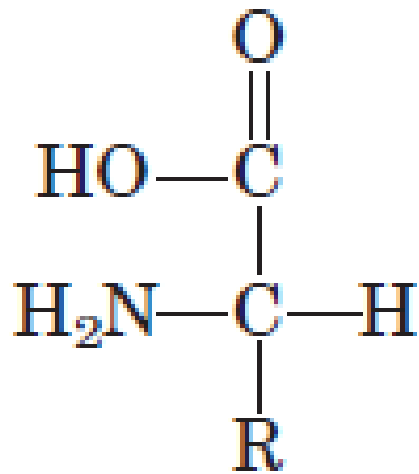


$\gamma$ -Carboxyglutamate

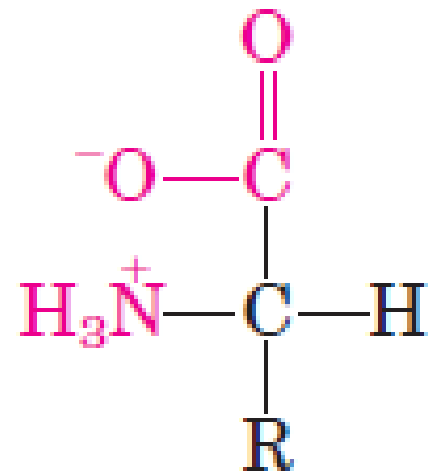


Desmosine

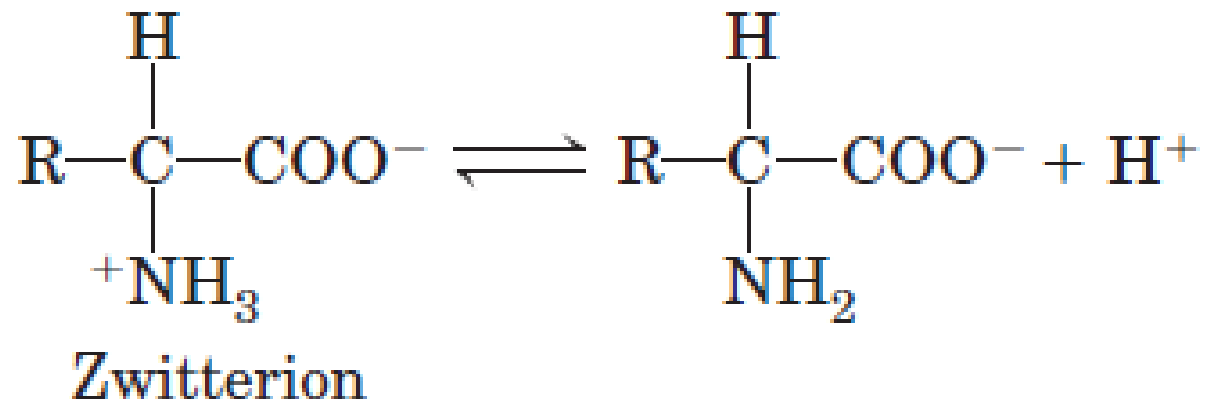
# Amino Acids Can Act as Acids and Bases



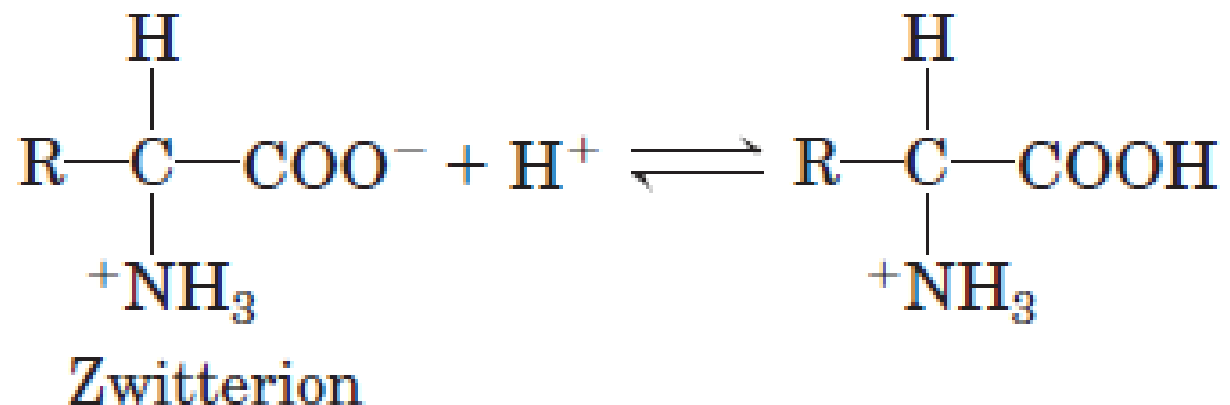
Nonionic  
form



Zwitterionic  
form

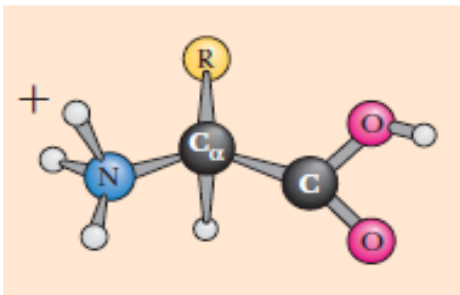


or a base (proton acceptor):

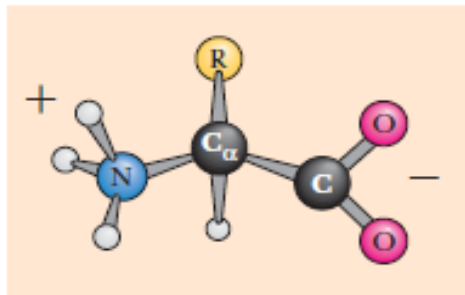


The ionic forms of the amino acids, shown without consideration of any ionizations on the side chain. The cationic form is the low pH form, and the titration of the cationic species with base yields the zwitterion and finally the anionic form.

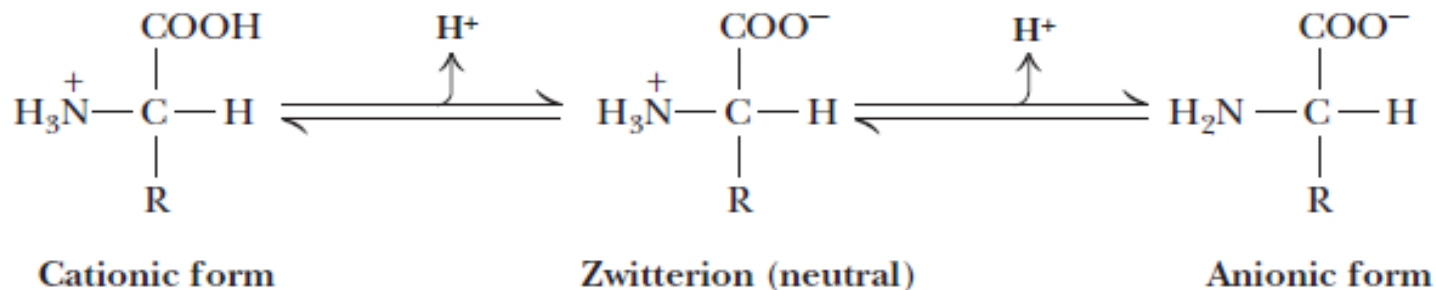
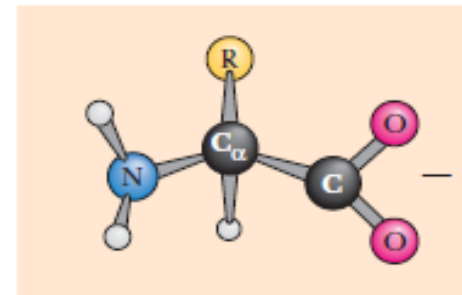
pH 1 Net charge +1



pH 7 Net charge 0



pH 13 Net charge -1





## References:

- Lehninger Principles of Biochemistry (Nelson W. H. Freeman. 4th Ed, 2004).
- Biochemistry (Reginald H. Garrett and Charles M. Grisham, University of Virginia 4th Ed, 2010).
- <https://soe.unipune.ac.in/studymaterial/swapnaGaikwadOnline/aminoacids-171113130407.pdf>

**For communication:**

**ahmed.mohamed@fagr.bu.edu.eg**

**https://bu.edu.eg/portal/index.php?act  
=46&username=ahmedmohamed6**