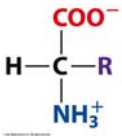
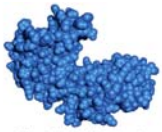
Amino Acids

Stryer Short Course
Chapter 3

Amino Acid Structure

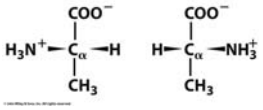
- Alpha carbon
- Sidechain
- Proteins
- peptides

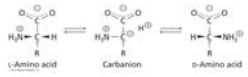


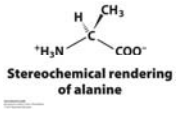


Stereochemisty

- L-amino acids
  - Glycine
  - R/S vs D/L
  - L-isoleucine
- racemization

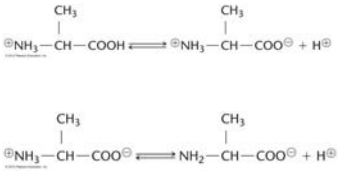




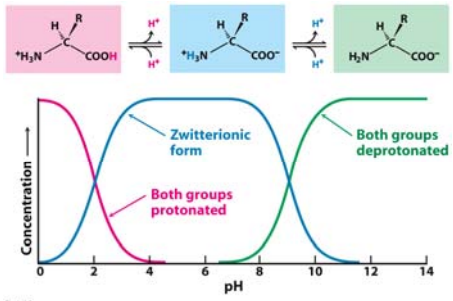


Ionization of Amino Acids

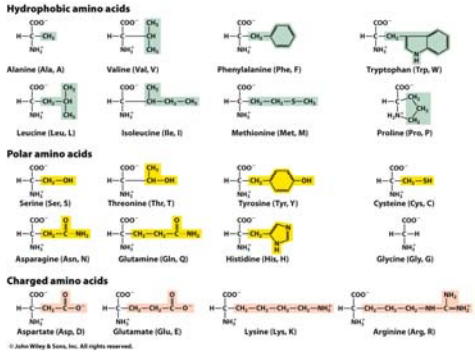
- Polyprotic acids
- Alanine
  - $pKa_1 = 2.4$
  - $pKa_2 = 9.9$
- Zwitterion
- Isoelectric point
- More acidic than typical carboxylic acid



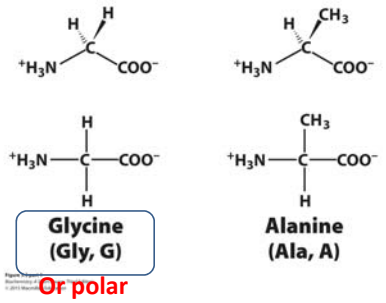
Polyprotic Acids



Common Amino Acids

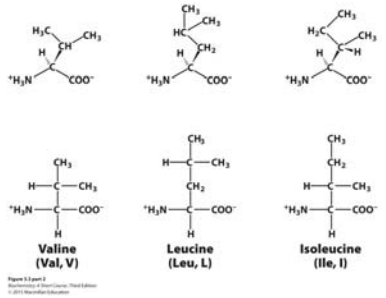


Hydrophobic

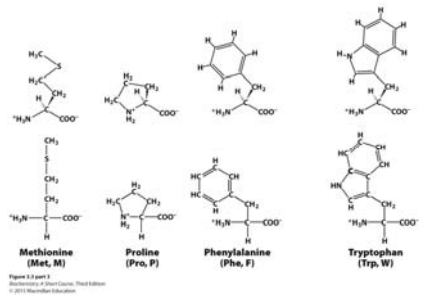


Or polar

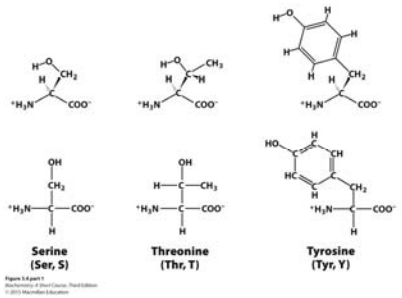
Hydrophobic



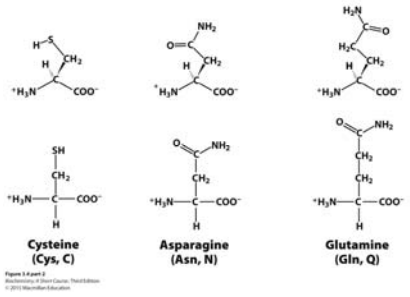
Hydrophobic



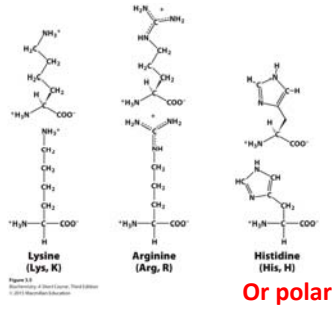
Polar



Polar

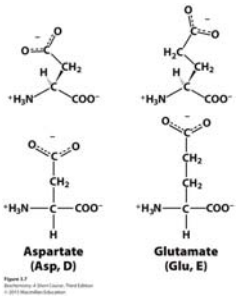


Positively Charged



Or polar

Negatively Charged



Acid/base chemistry

- Charged amino acids
- Other amino acids are ionizable

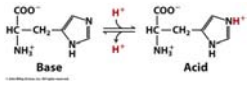
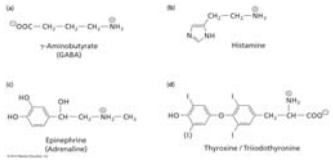


Table 3.1 Typical pK_a values of ionizable groups in proteins

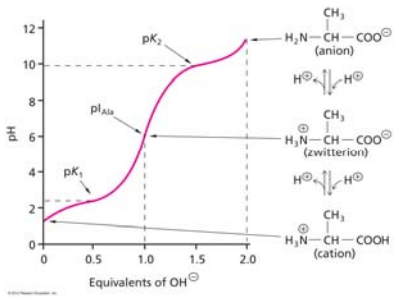
Group	Acid	Base	Typical pK_a
Terminal α-carboxyl group			3.1
Aspartic acid Glutamic acid			4.1
Histidine			6.0
Terminal α-amino group			8.0
Cysteine			8.3
Tyrosine			10.9
Lysine			10.8
Arginine			12.5

Which amino acid(s)...

- Is achiral?
- Has a secondary amino group?
- Has a chiral sidechain?
- Form these derivatives:



Titration Curve



Titration Curve

Which amino acid?

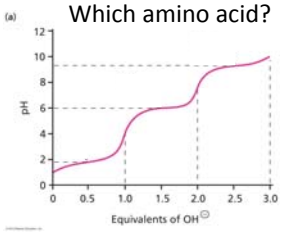
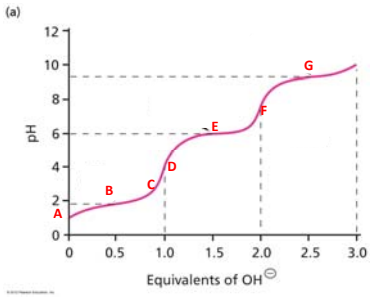


Table 3.2 pK_a values of acidic and basic constituents of free amino acids at 25°C

Amino acid	pKa value		
	Carboxyl group	Amino group	Side chain
Glycine	2.4	9.8	
Alanine	2.4	9.9	
Valine	2.3	9.7	
Leucine	2.3	9.7	
Isoleucine	2.3	9.8	
Methionine	2.1	9.3	
Proline	2.0	10.6	
Phenylalanine	2.2	9.3	
Tryptophan	2.5	9.4	
Serine	2.2	9.2	
Threonine	2.1	9.1	
Cysteine	1.9	10.7	8.4
Tyrosine	2.2	9.2	10.5
Asparagine	2.1	8.7	
Glutamine	2.2	9.1	
Aspartic acid	2.0	9.9	3.9
Glutamic acid	2.1	9.5	4.1
Lysine	2.2	9.1	10.5
Arginine	1.8	9.0	12.5
Histidine	1.8	9.3	6.0

Ionization States Of Amino Acids



Essential Amino Acids

- Dietary Term
- Can change in stage of life
- Depends on definition of biosynthetic building blocks

Table 3.2 Basic set of 20 amino acids

Nonessential	Essential
Alanine	Histidine
Arginine	Isoleucine
Asparagine	Leucine
Aspartate	Lysine
Cysteine	Methionine
Glutamate	Phenylalanine
Glutamine	Threonine
Glycine	Tryptophan
Proline	Valine
Serine	
Tyrosine	