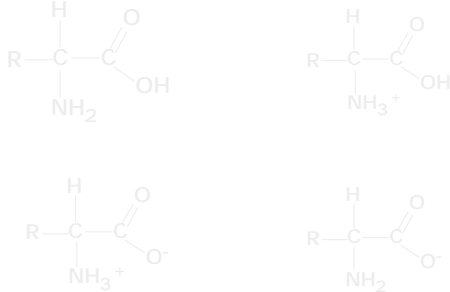
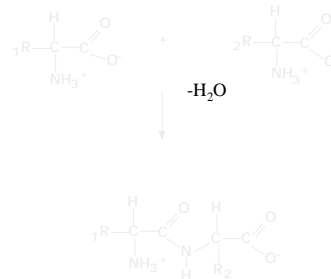


Amino Acids



Peptide Bond Formation



Amino Acid Properties

How much charge does it have?

Will it dissolve in water?

What can it interact with?

Can it form cross-links?

Is it essential?

Henderson-Hasselbalch Equation

Why?

There are 20 amino acids commonly used in proteins.

Why would any given amino acid be selected?

Can you make words?

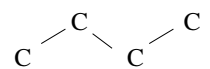
Did you ever play with Legos?

Amino Acid Structure

What conformation does any molecule assume?

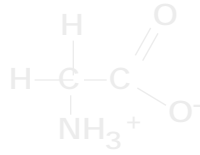


or



Why?

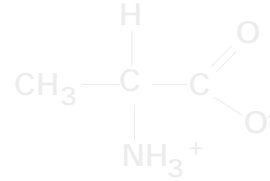
Glycine



GLY

Not Essential Breaks Helix Favors turns
Mass 57 Occurrence 7.2%

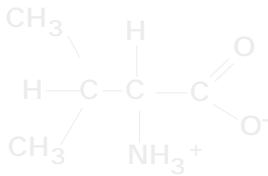
Alanine



ALA

Not essential Slightly hydrophobic Favors helix
H = 0.75 Mass 71.1 7.8%

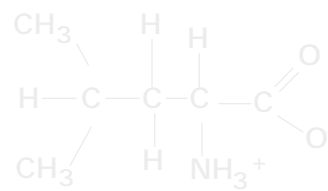
Valine



VAL

Essential Moderately hydrophobic Favors helix
H = 1.70 Mass 99.1 6.6%

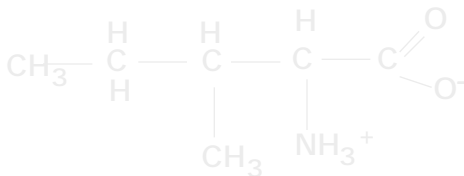
Leucine



LEU

Essential Hydrophobic Favors helix
H = 2.40 Mass 113.2 9.1%

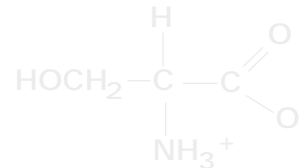
Isoleucine



ILU

Essential Hydrophobic Breaks helix
H = 2.95 Mass 113.2 5.3%

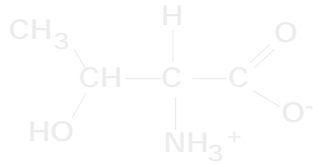
Serine



SER

Not essential Found at surface Mass 87.1
Forms H bonds Breaks helix 6.8%

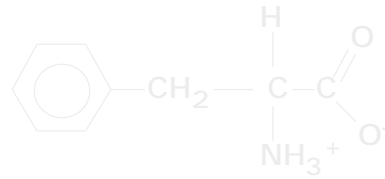
Threonine



THR

Essential Found at surface Mass 101.1
Forms H bonds Helix indifferent H = 0.45 5.9%

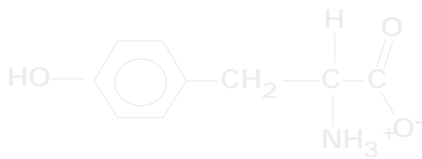
Phenylalanine



PHE

Essential Very hydrophobic electrons H = 2.15
Mass 147.2 3.9%

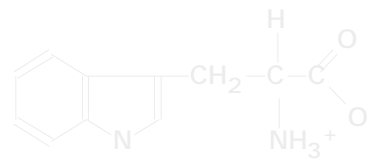
Tyrosine



TYR

Not essential Very hydrophobic electrons 3.2%
Absorbs in UV pK of 9.6 H = 2.85 Mass 163.2

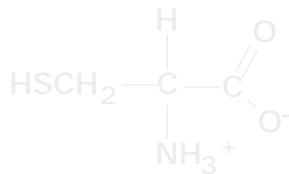
Tryptophan



TRP

Essential H = 3.0 Very hydrophobic 1.4%
Strong UV Absorption Favors helix Mass 186.2

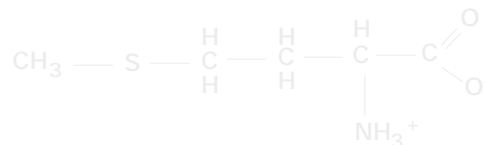
Cysteine



CYS

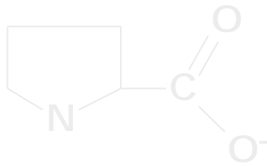
Essential Forms cross-links pK=8.4 H = 1.0
Mass 103.1 1.9%

Methionine



Hydrophobic H = 1.3 Essential Mass 131.2
Can bind metals Favors helix 2.2%

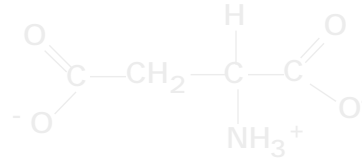
Proline



PRO

Not essential Hydrophobic H = 2.460 Favors turns
Mass 97.1 5.2%

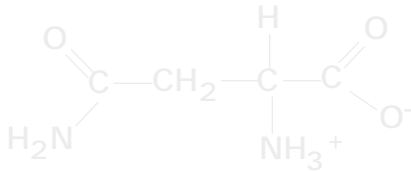
Aspartic Acid



ASP

Not essential Negative charge Hydrophilic
Favors turns pK 3.85 Mass 115.1 5.3%

Asparagine



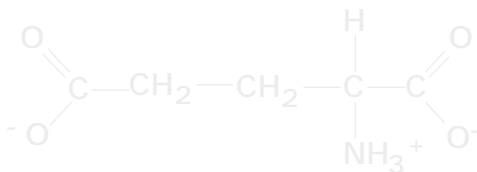
ASN

Modified aspartic Very hydrophilic Favors turns
Mass 114.1 4.3%

Glutamine

Not Essential Dipole Mass 128.1
Hydrophobic Helix Indifferent 4.3%

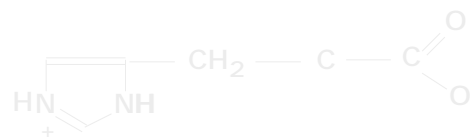
Glutamic Acid



GLU

Not essential Negative charge Mass 129.1
Hydrophilic Favors helix pK 4.25 6.3%

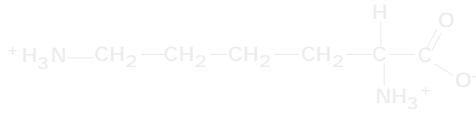
Histidine



HIS

Essential for infants pK=6.0
Often at active site Mass 137.1 2.3%

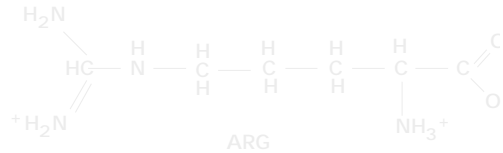
Lysine



LYS

Essential + Charge Mass 128.2
pK=10.5 Favors helix 5.9%

Arginine



ARG

Strong interactions with water pK=12.5
Mass 156.2 5.1%

Hydroxyproline

Important in collagen - posttranslational
requires vitamin C

Selenocysteine

Some organisms use a stop code to UGA to incorporate
directly into formate dehydrogenase

3-Methylhistidine

Found in muscle

Hydroxylysine

Found in collagen

N-Formylmethionine

Starts protein synthesis

Histamine

Messenger

Dopamine

Messenger - Intermediate

Homocysteine

Methionine metabolism - Health concerns

Thyroxine

Isoelectric Points

Protein	Isoelectric pH
Pepsin	<1
Casein	4.6
Insulin	5.4
Collagen	6.6
Ribonuclease	7.8
Histone	10.8
Lysozyme	11.0

Calculated Isoelectric Point

Amino Acid	#	pK
Aspartic	9	3.75
Glutamic	2	4.25
-carboxyl	1	3.6
Histidine	9	6.4
Lysine	13	10.4
Arginine	18	12.0
Tyrosine	3	9.6

At pH 2.0 have 40+ and 0 - charges

pH 2

AA	#	pK	Charge	Total
Asp	9	3.75	0	0
Glu	2	4.25	0	0
-carb	1	3.6	0	0
His	9	6.4	+	9+
Lys	13	10.4	+	13+
Arg	18	12.0	+	18+
Tyr	3	9.6	0	0
				40+

pH 5

AA	#	pK	Charge	Total
Asp	9	3.75	-	9-
Glu	2	4.25	-	2-
-carb	1	3.6	-	1-
His	9	6.4	+	9+
Lys	13	10.4	+	13+
Arg	18	12.0	+	18+
Tyr	3	9.6	0	0
				40+ 12 - 28+

PH 7.5

AA	#	pK	Charge	Total
Asp	9	3.75	-	9-
Glu	2	4.25	-	2-
-carb	1	3.6	-	1-
His	9	6.4	0	0
Lys	13	10.4	+	13+
Arg	18	12.0	+	18+
Tyr	3	9.6	0	0
				31+ 12 - 19+

PH 11

AA	#	pK	Charge	Total
Asp	9	3.75	-	9-
Glu	2	4.25	-	2-
-carb	1	3.6	-	1-
His	9	6.4	0	0
Lys	13	10.4	0	0
Arg	18	12.0	+	18+
Tyr	3	9.6	1	3
				18+ 15 - 3+

Final pH

Must have 3 of 18 arginine losing their charge

A= fraction of groups ionized pK of those groups

Isoionic Point

pH = 11.16 - Measured isoionic is 11.13