Chapter 24  Amino Acids and Proteins
24.1 Introduction
Proteins are large biomolecules that occur in every living organism. They’re of many different types, and they have many different biological functions.

All proteins are made up of many amino acid units linked together by amide bonds in a long chain.

Amino acids can link together by forming amide, or peptide, bonds.

Chains with fewer than 50 amino acids are called polypeptides.
24.2 Amino Acids
24.2A Structures and Names

- Most of the important natural amino acids are \( \alpha \)-amino acids.
- 22 \( \alpha \)-amino acids can be obtained from proteins.
- With the exception of glycine, the alpha carbons of amino acids are chiral.
- The naturally occurring \( \alpha \)-amino acids are often referred to as L-amino acids.
24.2B Essential Amino Acids

- The 20 common amino acids can be further classified as either neutral, acidic, or basic, depending on the nature of their side chains.
- All 20 of the amino acids are necessary for protein synthesis, but humans are thought to be able to synthesize only 10 of 20.
- The remaining 10 are called essential amino acids because they must be obtained from dietary sources.
Valine

\[
\begin{align*}
&\text{H}_2\text{N} &- &\text{CH} &\cdot &\text{C} &\cdot &\text{OH} \\
&\text{CH} &\cdot &\text{CH}_3 & & & & \\
&\text{CH}_3 & & & & & & \\
\end{align*}
\]

Valine Val
Leucine

\[
\text{H}_2\text{N}\text{C}^{\text{CHCH}_3\text{CH}_2}_2\text{C}^{\text{CH}_3}_2\text{O}
\]
Isoleucine (Ile)
Tryptophan

\[
\begin{align*}
    &H_2N-\text{CH}::\text{C}==\text{OH} \\
    &\text{CH}_2 \\
    &\text{HN} \\
\end{align*}
\]

Try

Tryptophan   Try
Methionine

\[
\begin{align*}
\text{H}_2\text{N} &- \text{CH} & \text{C} & \text{O} & \text{H} \\
\text{CH}_2 & | & \text{CH}_2 & | & \text{S} \\
\text{CH}_2 & | & \text{CH}_3 & & \\
\end{align*}
\]

Methionine  Met
Lysine

\[
\begin{align*}
\text{H}_2\text{N}-\text{CH} & \text{CH}_2 \text{O} \\
\text{CH}_2 & \\
\text{CH}_2 & \\
\text{CH}_2 & \\
\text{NH}_2 & \\
\end{align*}
\]

Lysine  Lys
Phenylalanine

\[
\text{H}_2\text{N}-\text{CH}-\text{C}=\text{O} \quad \text{OH}
\]

\[
\text{CH}_2
\]

\[
\text{Phenylalanine} \quad \text{Phe}
\]
Threonine

\[ \text{H}_2\text{N} - \text{CH} - \text{C} - \text{OH} \]
\[ \text{CH} - \text{OH} \]
\[ \text{CH} - \text{CH}_3 \]

Threonine  Thr
Histidine

H2N–CH\text{C}–\text{O}H

\text{His}
Amino Acids as Dipolar Ions

In acid solution:

\[ \text{H}_2\text{N}^+\text{CH}\cdot\text{C}^\cdot\text{O}^- + \text{H}_3\text{O}^+ \rightleftharpoons \text{H}_2\text{N}^+\text{CH}\cdot\text{C}^\cdot\text{OH} + \text{H}_2\text{O} \]

In base solution:

\[ \text{H}_2\text{N}^+\text{CH}\cdot\text{C}^\cdot\text{O}^- + \text{OH}^- \rightleftharpoons \text{H}_2\text{N}^+\text{CH}\cdot\text{C}^\cdot\text{O}^- + \text{H}_2\text{O} \]

A zwitterion

两性离子
Isoelectric Point

- In acid solution at low pH, an amino acid exists primarily as a cation.
- In basic solution at high pH, an amino acid exists primarily as an anion.
- At some intermediate point, the amino acid must be exactly balanced between anionic and cationic forms and exist primarily as the neutral, dipolar zwitterion.

—— pH —— isoelectric point.