

Chapter 1 Biological molecules

1.5 Proteins

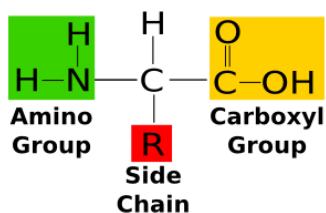
- Sources: meat, egg, milk, beans and etc
- Elements: C, H, O, N, most proteins also contain S and P
- Types of amino acids (氨基酸):
 - Amino acids are subunits of all proteins
 - There are 20 different types of amino acids, and can be classified into two groups
 - Essential amino acids (必需氨基酸): Cannot be synthesised in human body
 - Non-essential amino acids (非必需氨基酸): Can be synthesised by humans
- Functions:

Type of proteins	Functions	Examples
Enzymatic protein (酶蛋白)	Selective acceleration of chemical reactions	Digestive enzymes such as carbohydrase, protease
Storage protein (储藏蛋白)	Storage of amino acids	Casein (酪蛋白), ovalbumin (卵白蛋白)
Defensive protein (防御蛋白)	Protection against disease	Immunoglobulin / antibody
Transport protein (转运蛋白)	Transport of substances	Membrane transport protein; haemoglobin (血红蛋白)
Hormonal protein (激素蛋白)	Coordination of an organism's activities	Non-steroid hormones such as insulin (胰岛素), glucagon (胰高血糖素)
Receptor protein (受体蛋白)	Response to chemical stimuli	Receptors on nerve cell membrane
Contractile protein (收缩蛋白)	Movement	Actin (肌动蛋白), myosin (肌球蛋白)
Structural protein (结构蛋白)	Support	Collagen (胶原蛋白), elastin (弹性蛋白), keratin (角蛋白)

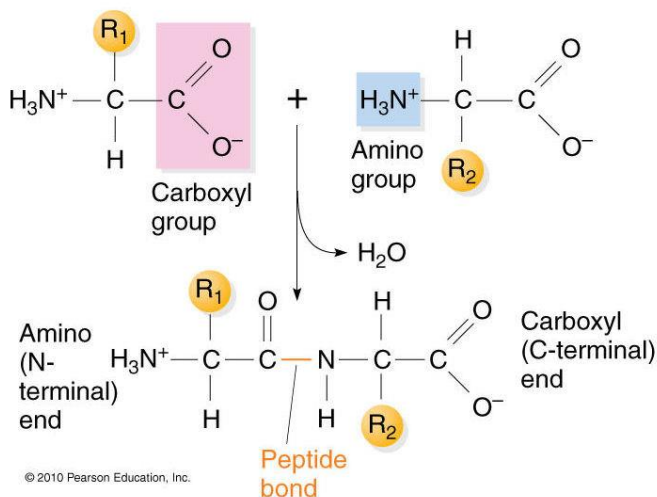
General structure of an amino acid

- Amino acids are small group organic molecules with an amino group (氨基), a carboxyl group (羧基), and one of twenty varying R-groups / R-side chains (R基 / R侧链基团)
- The amino group is basic (碱性) and the carboxyl group is acidic (酸性) which make them amphoteric (两性: 两性的物质是指既可跟酸反应, 又能跟碱反应的物质) (having both basic and acidic properties)

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Formation of a peptide bond (肽键)



Dipeptides (二肽), tripeptides (三肽) and polypeptides (多肽)

- When two amino acids bind together through condensation, a dipeptide is formed
- When one or more amino acids are linked to the dipeptide, a tripeptide or a polypeptide is formed

Protein structures

- There are four levels of structure of protein molecules
 - Primary structure
 - Secondary structure
 - Tertiary structure
 - Quaternary structure

Level of protein structure	Characteristic	Example
Primary structure (一级结构)	The linear sequence of amino acids in a polypeptide chain	
Secondary structure (二级结构)	<p>α-helix: a delicate coil held together by hydrogen bonding between amino acid</p> <p>β-pleated sheet: two or more segments of the polypeptide chain lying side by side are connected by hydrogen bonds between parts of the two parallel segments</p>	<p>α-helix: keratin (角蛋白)</p> <p>β-pleated sheet: fibroin (丝蛋白)</p>
Tertiary structure (三级结构)	The tertiary structure of a polypeptide is the result of four types of bonds and interaction among R-groups of a	Enzymes, hormones,

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	polypeptide, e.g., disulphide bonds (二硫键), ionic bonds (离子键), hydrogen bonds, and hydrophobic interactions (疏水用力)	antibodies, plasma protein
Quaternary structure (四级结构)	More than one polypeptide chain which are held together by hydrogen bonds, ionic bonds, and hydrophobic interactions	Haemoglobin, collagen

Denaturation of proteins (蛋白质变性)

- Denaturation of proteins involves the loss of their specific conformation (three-dimensional shape) and is usually irreversible
- Weak chemical bonds and interactions within a protein may be destroyed but their amino acids sequence remain unchanged
- The denatured protein is biologically inactive
- Causes of protein denaturation:
 - High temperature
 - Extreme pH
 - Organic solvent and detergent
 - etc

