Proteins

- Proteins are large molecules consist from the combination of amino acids. Proteins found in every cell in the body
- Amino acids contain carbon, hydrogen, oxygen, nitrogen, and sometimes sulfur

- amino acids consist of a central carbon with a carboxyl group, a hydrogen, a nitrogen-containing amine group, and a unique side chain

There are 20 side chains and 20 unique amino acids

- 9 essential amino acids
- 11 nonessential amino acids
  - At time these become conditionally essential

Amino acids link together with peptide bonds by condensation and break apart by hydrolysis

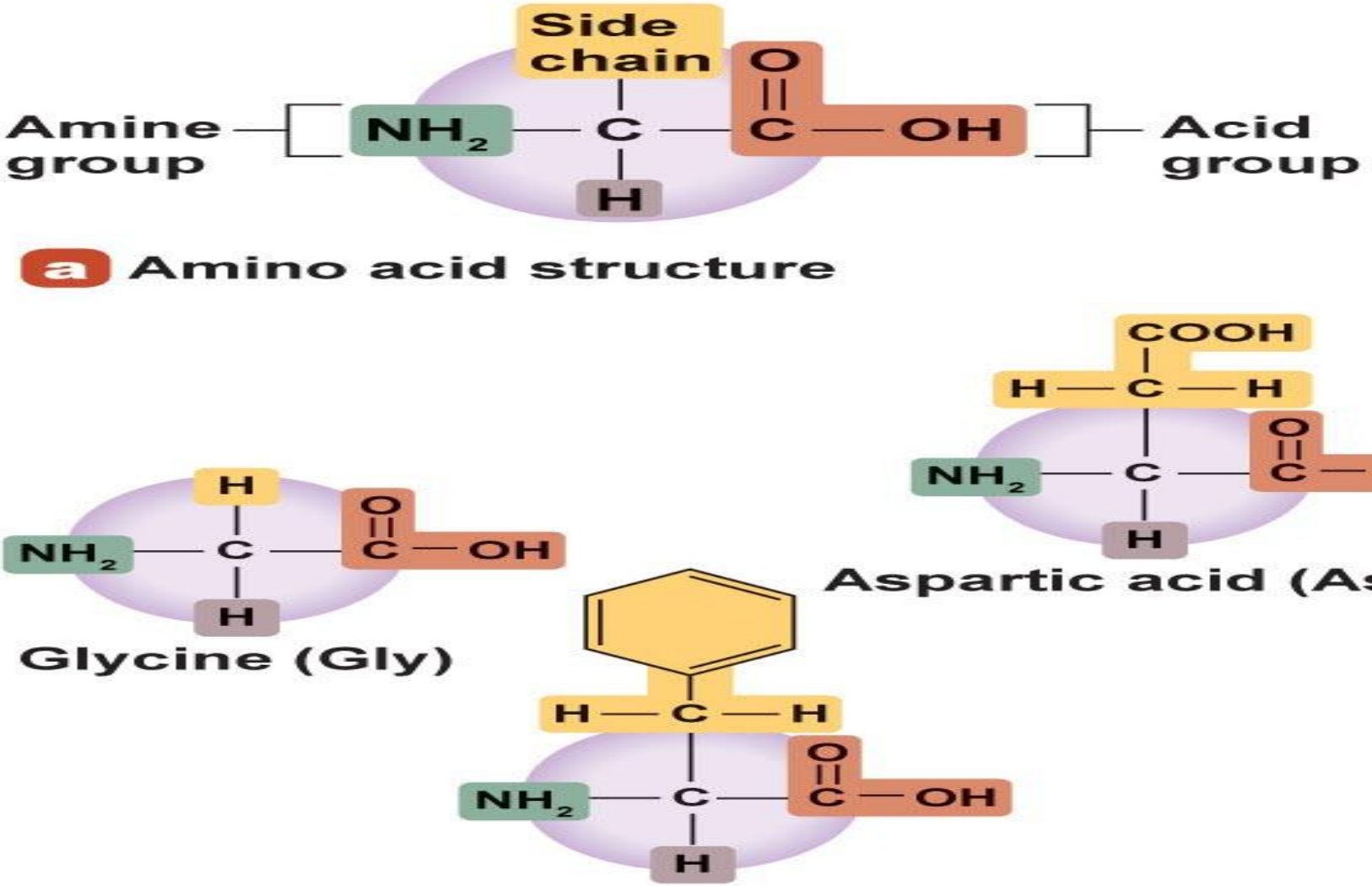
Structure of Proteins

- Made up of chains of amino acids; classified by number of amino acids in a chain
  - Peptides: fewer than 50 amino acids
    - Dipeptides: 2 amino acids
    - Tripeptides: 3 amino acids
    - Polypeptides: more than 10 amino acids
  - Proteins: more than 50 amino acids
    - Typically 100 to 10,000 amino acids linked together
- Chains are synthesizes based on specific bodily DNA

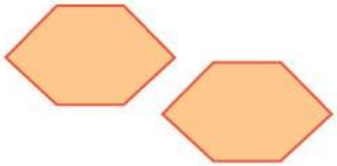
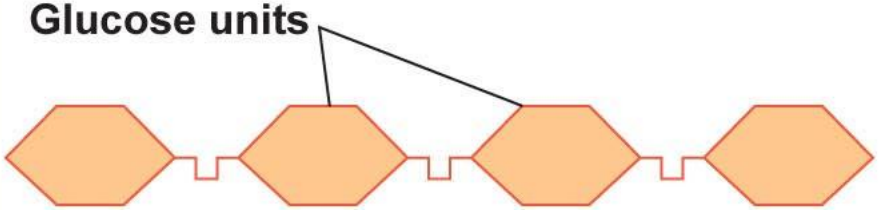
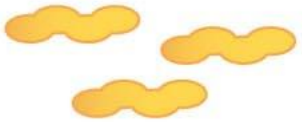
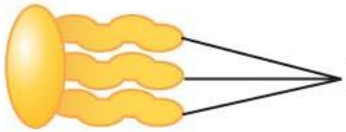
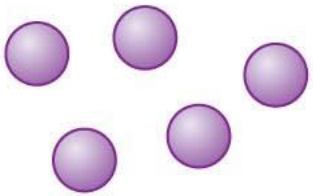
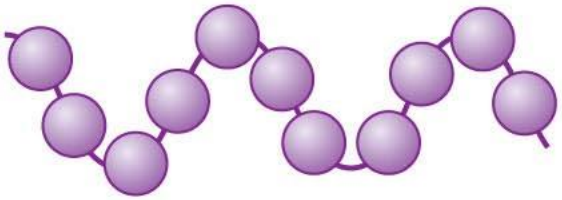
يتم تصنيع السلاسل استنادا على تركيب حامض نووي محدد في الجسم

- Amino acids are composed of carbon, hydrogen, oxygen, and nitrogen

Proteins and Amino Acids

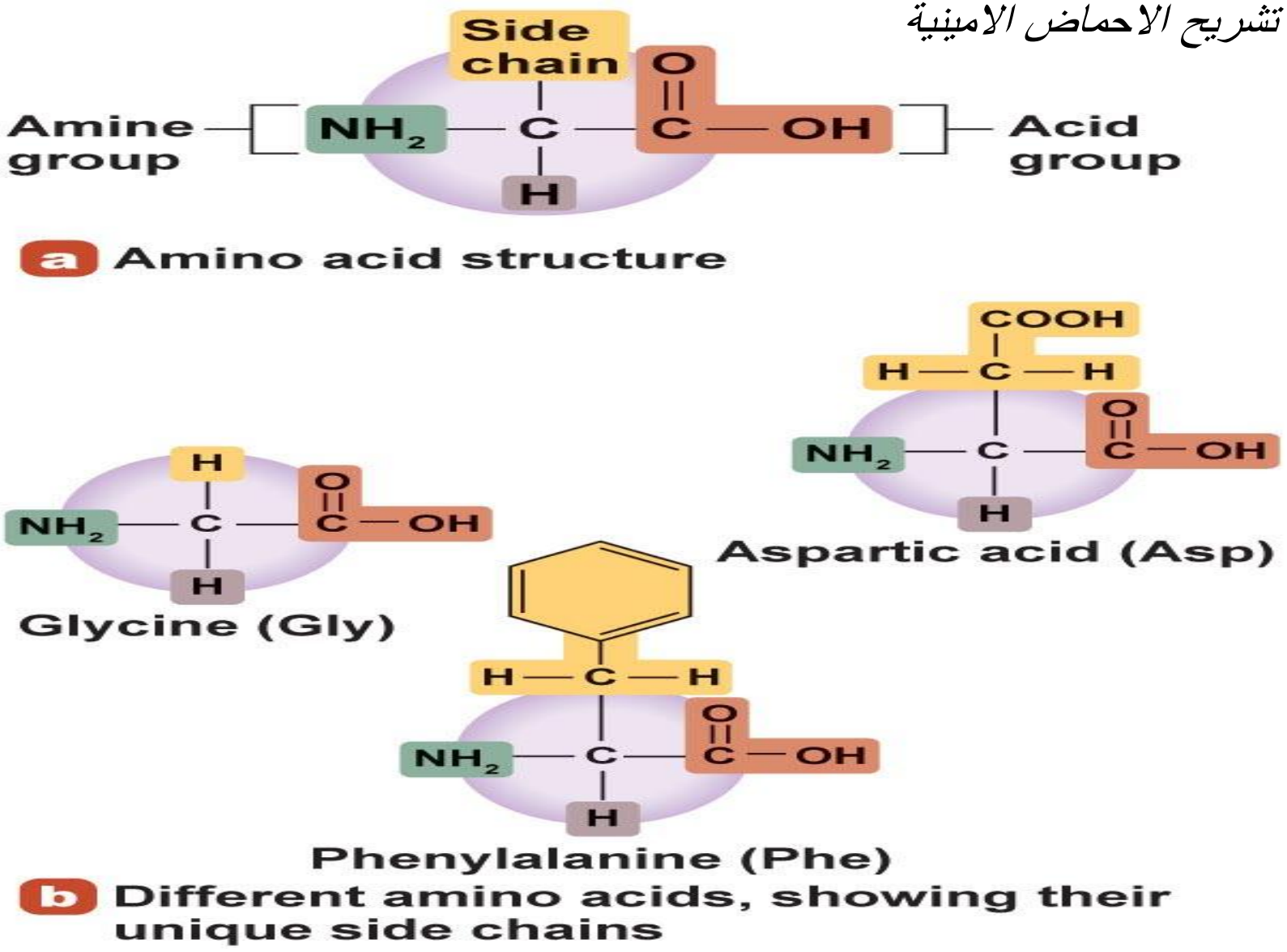


Structural Differences Between Carbohydrates, Lipids, and Proteins

Macronutrients	Chains of	Example
Carbohydrates	Glucose 	Glucose units 
Lipids	Fatty acids 	Triglyceride 
Proteins	Amino acids 	Amino acids 

The Anatomy of an Amino Acid

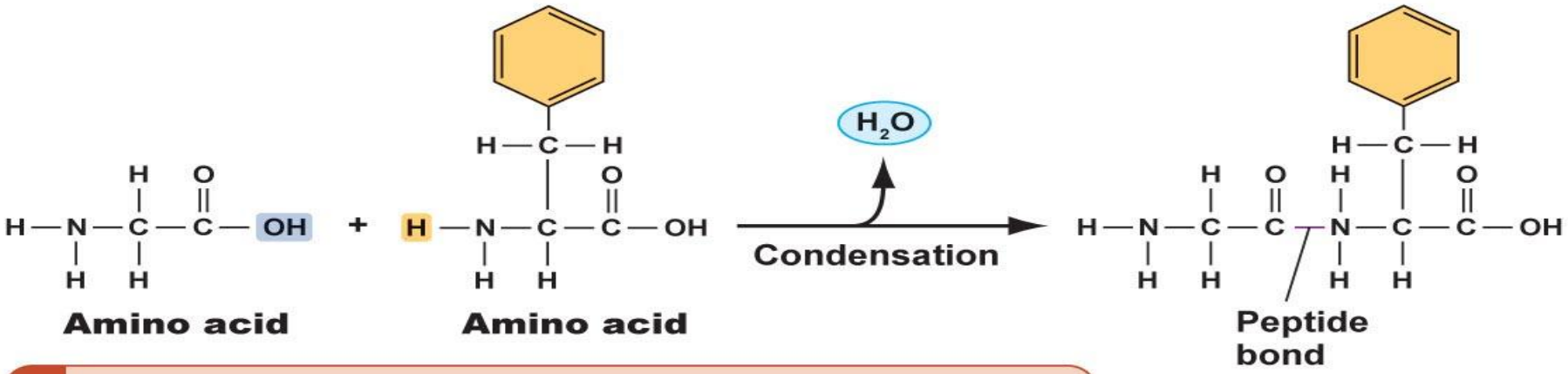
تشريح الاحماض الامينية



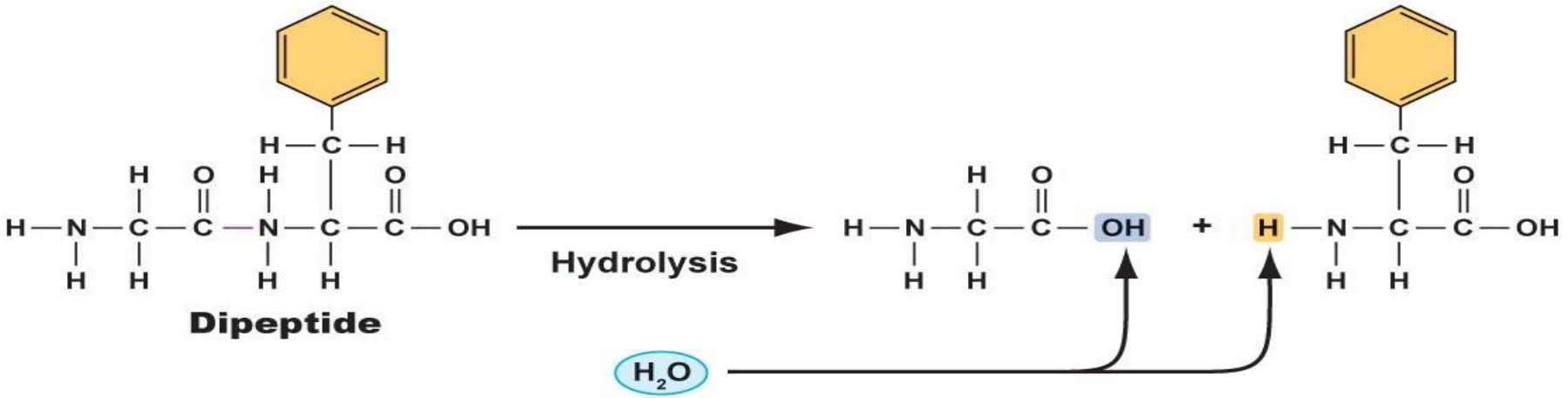
Peptide Bonds Link Amino Acids

- Form when the acid group (COOH) of one amino acid joins with the amine group (NH_2) of a second amino acid
- Formed through condensation
- Broken through hydrolysis

Condensation and Hydrolytic Reactions



a A peptide bond forms by condensation when the acid group (COOH) and amine group of two different amino acids join and release a molecule of water.



b When peptide bonds are broken by hydrolysis, the hydroxyl group (OH) and hydrogen (H) from water are added.

Essential Amino Acids	Nonessential Amino Acids
Histidine (His)[a]	Alanine (Ala)
Isoleucine (Ile)	Arginine (Arg)[b]
Leucine (Leu)	Asparagine (Asn)
Lysine (Lys)	Aspartic acid (Asp)
Methionine (Met)	Cysteine (Cys)[b]
Phenylalanine (Phe)	Glutamic acid (Glu)
Threonine (Thr)	Glutamine (Gln)[b]
Tryptophan (Trp)	Glycine (Gly)[b]
Valine (Val)	Proline (Pro)[b]
	Serine (Ser)
	Tyrosine (Tyr)[b]

Essential – must be consumed in the diet

Nonessential – can be synthesized in the body

Structure of the Protein

- Four levels of structure
  - Primary structure
  - Secondary structure
  - Tertiary structure
  - Quaternary structure

Any alteration in the structure or sequencing changes the shape and function of the protein

أي تغيير في البنية أو التسلسل يغير شكل البروتين ووظيفته

Denaturing تغيير طبيعة البروتين

- Alteration of the protein's shape and thus functions through the use of تغيير شكل البروتين وبالتالي وظائفه من خلال استخدام
- Heat
  - Acids
  - Bases
  - Salts
  - Mechanical agitation
- Primary structure is unchanged by denaturing

Denaturing a Protein