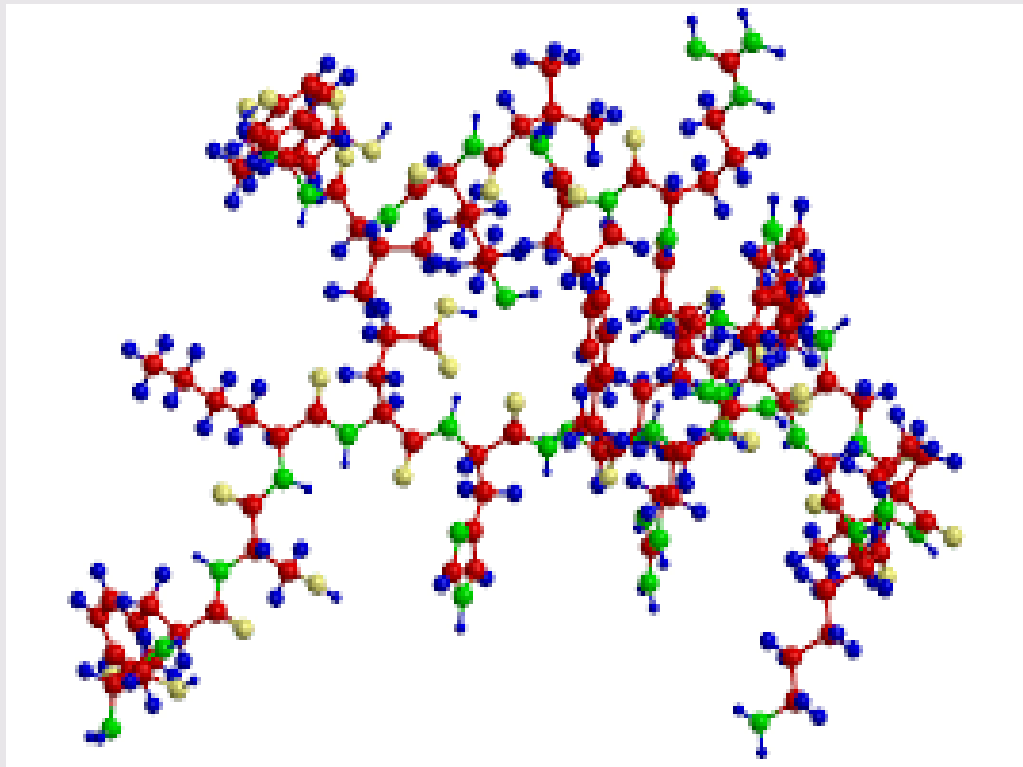




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# PROTEINS





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## Amino Acids with charged R groups

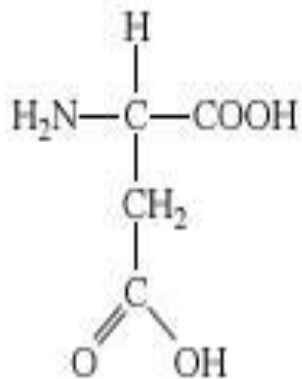
- ❖ **Acidic R groups** – aspartic and glutamic acids  
Have a net negative charge of pH 7.0
- ❖ **Basic R groups** – lysine (Lys), arginine (Arg), and histidine (His)
  - Have a net positive charge of 7.0
  - Lysine has a second amino group
  - Arginine has guanidino group
  - Histidine has imidazole group



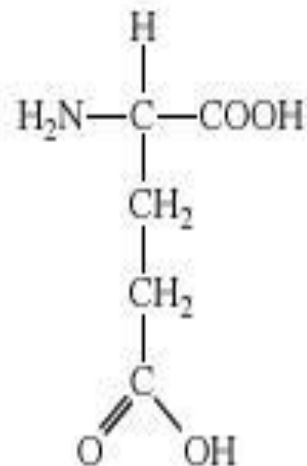
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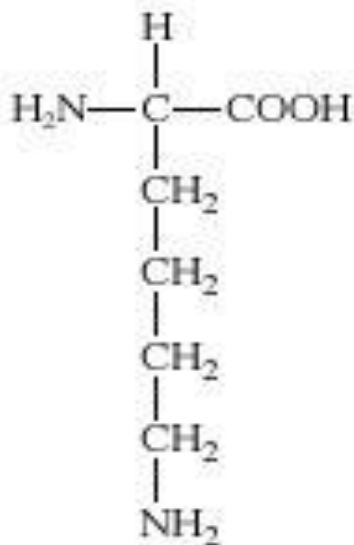
# Charged R Groups



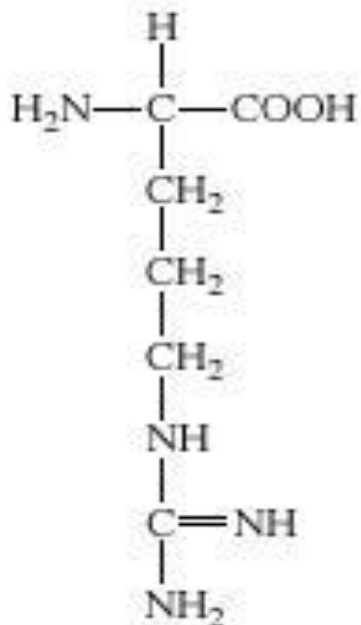
aspartic acid  
(Asp, D, Asx or B)



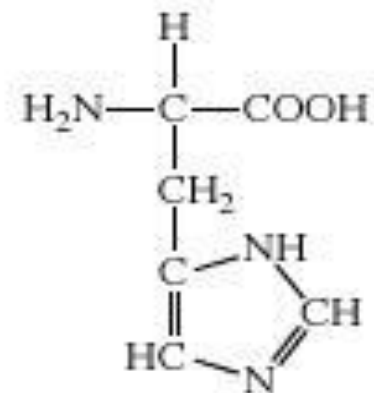
glutamic acid  
(Glu, E, Glx or Z)



lysine  
(Lys, K)



arginine  
(Arg, R)



histidine  
(His, H)



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# Classification of proteins

<b>TABLE 18-1</b>		<b>Nonessential and Essential Amino Acids for Humans and the Albino Rat</b>	
<b>Nonessential</b>	<b>Conditionally essential*</b>	<b>Essential</b>	
<b>Alanine</b>	<b>Arginine</b>	<b>Histidine</b>	
<b>Asparagine</b>	<b>Cysteine</b>	<b>Isoleucine</b>	
<b>Aspartate</b>	<b>Glutamine</b>	<b>Leucine</b>	
<b>Glutamate</b>	<b>Glycine</b>	<b>Lysine</b>	
<b>Serine</b>	<b>Proline</b>	<b>Methionine</b>	
	<b>Tyrosine</b>	<b>Phenylalanine</b>	
		<b>Threonine</b>	
		<b>Tryptophan</b>	
		<b>Valine</b>	

\*Required to some degree in young, growing animals, and/or sometimes during illness.



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## Peptide

- ❖ Amino acids are linked by covalent bonds
- ❖ Formed by the amino group of one amino acid with the carboxyl group of other with the elimination of water
- ❖ Few (2-10) amino acids are joined together by peptide bonds the compound is called an oligopeptide
- ❖ Polypeptide with about 100 amino acid units is called a protein



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# Protein Classification

- ❖ Classified based on:
  - ❖ **Solubility and composition** –
    - **Simple** (give amino acids on hydrolysis)
    - **Conjugated** (simple proteins combined with non-protein prosthetic groups)
    - **Derived** (obtained by partial to complete hydrolysis of simple or conjugated proteins)
  - ❖ **Function – catalytic proteins** – ability to function within the living cells as biocatalysts (enzymes)
    - **Regulatory proteins** – polypeptides that regulate metabolic reactions (growth hormone)
    - **Protective proteins** – defense function (antibodies)



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# Classification

Classification based on function:

- **Storage proteins** – source of essential amino acids that cannot be synthesized by humans (globulins in pulses, prolamins in cereals, glutelins (rice), albumin (egg), and casein (milk))
- **Structural proteins** – important components of extra cellular fluid (myosin of muscle, collagen of connective tissue)
- **Contractile proteins** – essential for skeletal muscle (actin and myosin)
- **Secretory proteins** – Fibroin secreted by silk worms
- ❖ Based on Size and shape:
  - **Globular** – water soluble and fragile in nature (enzymes, hormones, and antibodies)



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## Protein Classification

- ❖ Based on Size and shape:
  - **Globular** – water soluble and fragile in nature (enzymes, hormones, and antibodies)
  - **Fibrous** – Tough and water-insoluble
- ❖ Metalloproteins – Complexes of proteins and heavy metals (haemoglobin, myoglobin)
- ❖ Nucleoproteins – complexes of proteins with nucleic acids
- ❖ Phosphoprotein – proteins conjugated with inorganic phosphate (casein and enzyme pepsin)





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# Protein Structure

- ❖ **Primary structure-** number of amino acids and the order in which they are linked and this is referred as backbone of the protein
- ❖ **Secondary structure** – extended polypeptide that folds into itself in which relatively close members of the protein chain are arranged. The folding is maintained by hydrogen bonds ( $\alpha$  helix,  $\beta$  sheets, collagen helix)
- ❖ **Tertiary Structure** – Specific three dimensional configuration and involves the folding of regular units of the secondary structure
- ❖ **Quaternary Structure** – proteins that have more than one polypeptide chains will exhibit quaternary structure (Haemoglobin)



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# Nutritional Importance

- ❖ Body tissues contain 20 amino acids , of these nine are to be supplied in the human diet
- ❖ Histidine, leucine, isoleucine, lysine, methionine, phenylalanine, threonine, tryptophan, and valine are called essential amino acids. An average individual should consume 0.59 g/kg of body weight, pregnant woman – 20-30 g/kg
- ❖ Protein deficiency causes the following:
  - **Kwashiorkar** – Growth failure, oedema, fatty liver, loss of appetite, diarrhoea, anaemia
  - **Marasmus** – growth retardation, loss of subcutaneous fat, skin is dry, eye lesions, anaemia. Treatment is done by administering liquid diet initially, followed by fat diet with protein intake of 3-5 g/kg