

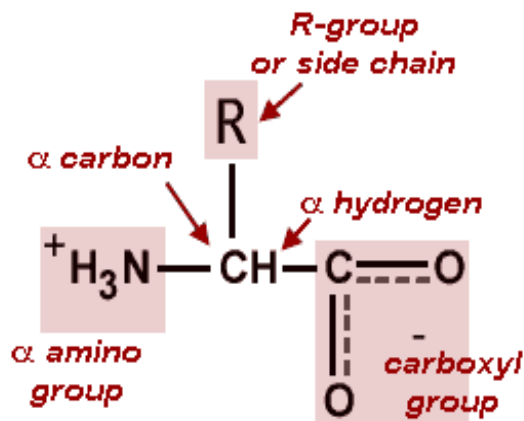
AMINO ACID: STRUCTURE AND CLASSIFICATION.

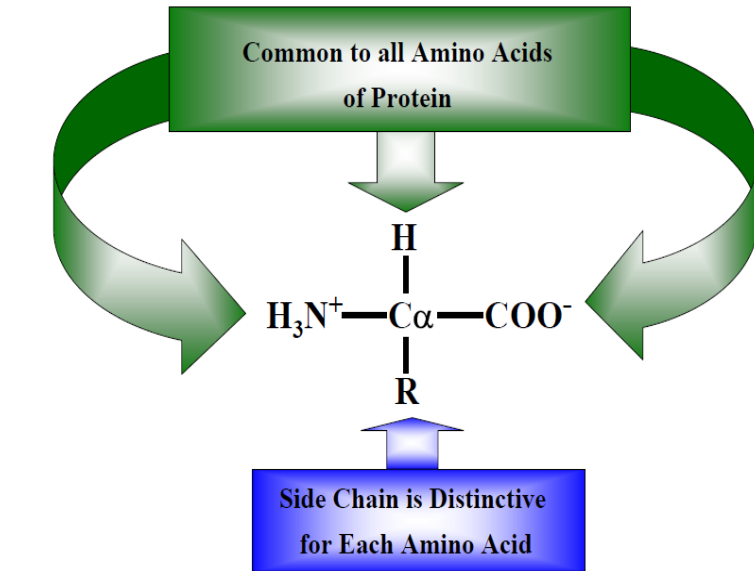
Amino Acids are the building units of proteins. There are about 300 amino acids occur in nature. Only 20 of them enter in proteins synthesis.

Structure of amino acids:

Each amino acid has 4 different groups attached to α - carbon (which is C-atom next to COOH). These 4 groups are: amino group, COOH group, Hydrogen atom and side Chain (R). At physiological pH (7.4), -COOH group is dissociated forming a negatively charged carboxylate ion (COO-) and amino group is protonated forming positively charged ion (NH₃⁺) forming Zwitter ion .

- Proline is an imino acid not amino acid.





Classification of Amino Acids:

- I. Classification by R group
- II. Chemical Classification
- III. Nutritional Classification
- IV. Metabolic Classification

Classification according to polarity of side chain (R):

A- Polar amino acids: in which R contains polar hydrophilic group so can forms hydrogen bond with H₂O. In those amino acids, R may contain:

- 1- OH group : as in serine, threonine and tyrosine
- 2- -SH group : as in cysteine
- 3- amide group: as in glutamine and asparagine
- 4- NH₂ group or nitrogen act as a base (basic amino acids): as lysine, arginine and histidine
- 5- COOH group (acidic amino acids): as aspartic and glutamic.

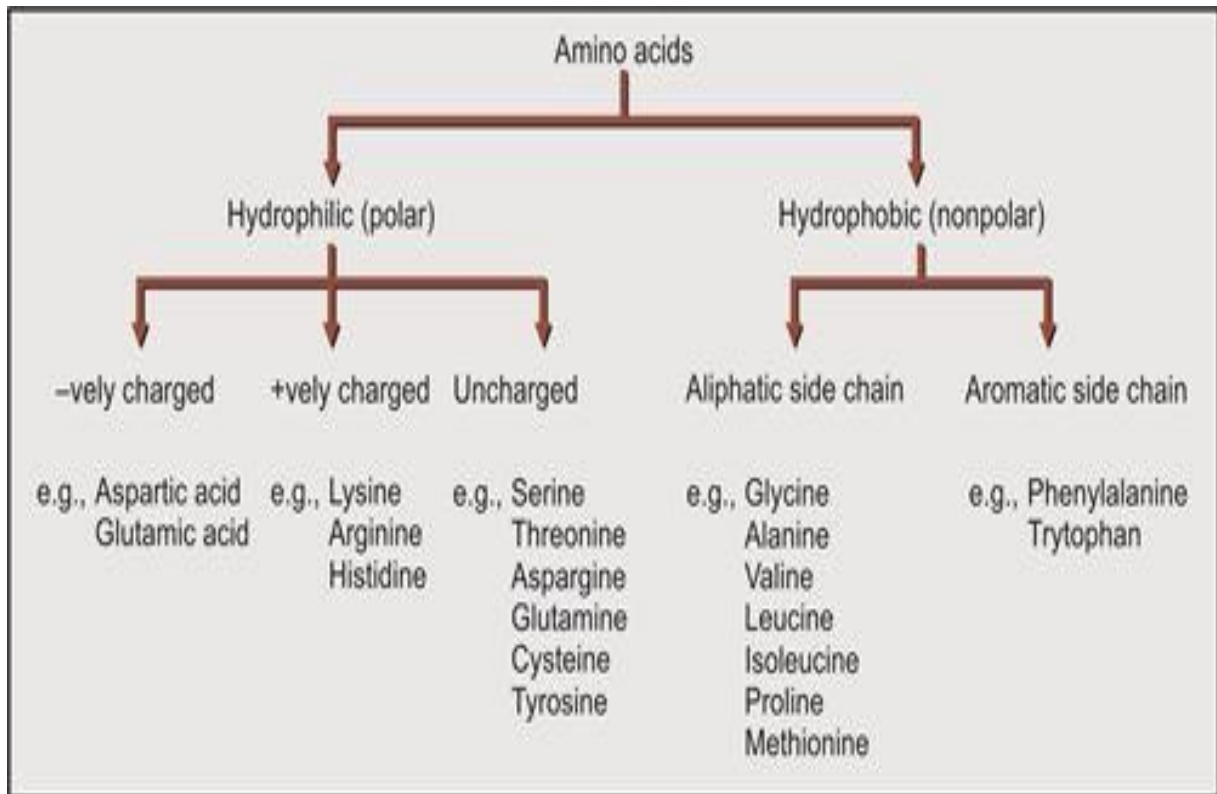


Figure: Classification by R group

B- Non polar amino acids: R is alkyl hydrophobic group which can't enter in hydrogen bond formation. 9 amino acids are non-polar (glycine, alanine, valine, leucine, isoleucine, phenyl alanine, tryptophan, proline and methionine).

The *twenty common amino acids* are often referred to using three-letter abbreviations. The structures, names, and abbreviations for the twenty common amino acids are shown below. Note that they are all **α -amino acids**.

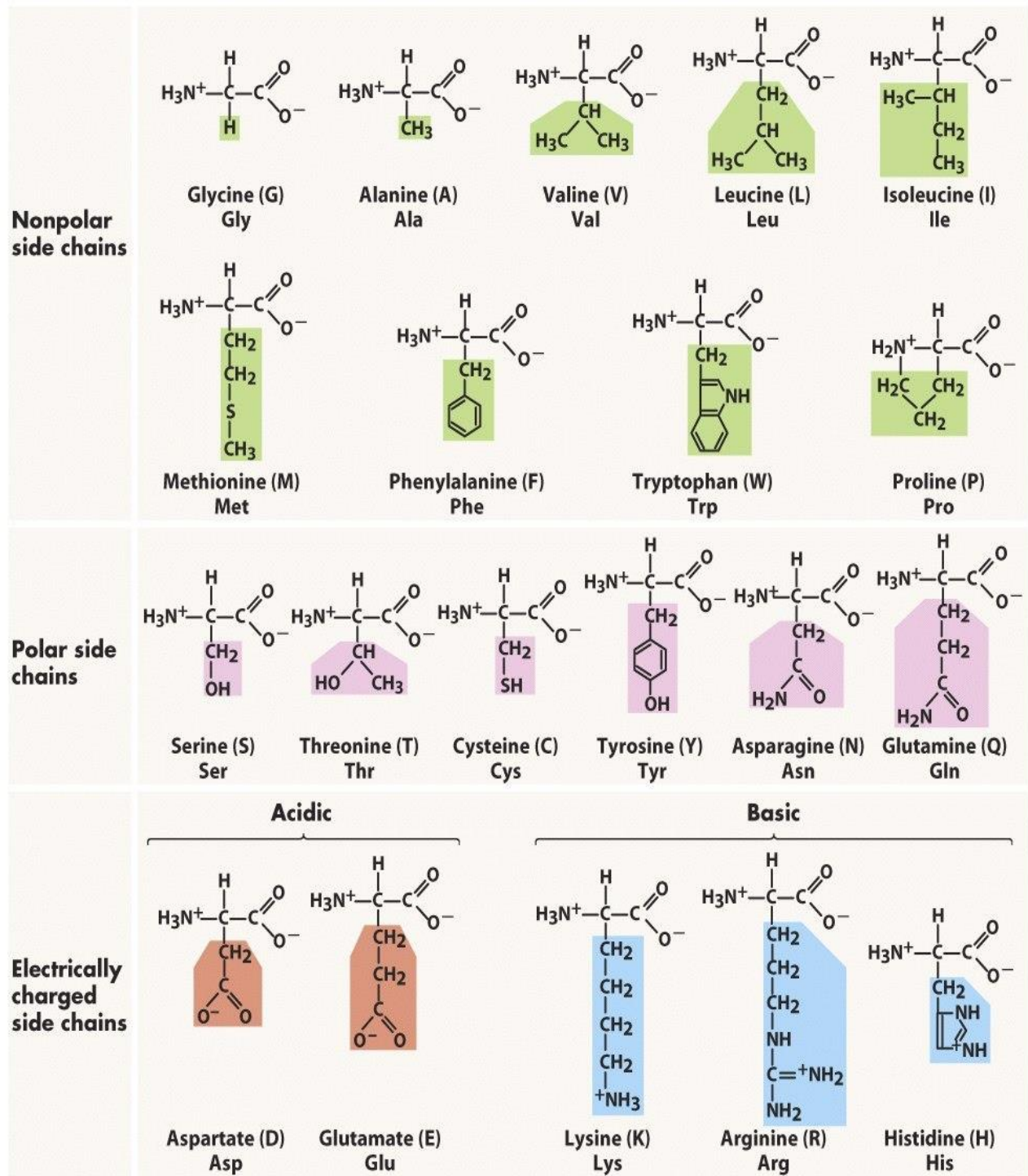


Figure 3-5 Biological Science, 2/e

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Each amino acid, aside from its name, has a three letter abbreviation and a one letter code.

Nomenclature

Amino Acid	3 letter code	1 letter code	Amino Acid	3 letter code	1 letter code
Glycine	Gly	G	Threonine	Thr	T
Alanine	Ala	A	Cysteine	Cys	C
Valine	Val	V	Tyrosine	Tyr	Y
Leucine	Leu	L	Asparagine	Asn	N
Isoleucine	Ile	I	Glutamine	Gln	Q
Methionine	Met	M	Aspartic Acid	Asp	D
Proline	Pro	P	Glutamic Acid	Glu	E
Phenyl alanine	Phe	F	Lysine	Lys	K
Tryptophan	Trp	W	Arginine	Arg	R
Serine	Ser	S	Histidine	His	H

Nutritional Classification

1- Essential Amino Acids 10 in number can't be synthesized in the body, essential to be taken in diet. Their deficiency affects growth, health and protein synthesis. Thus, Isoleucine, Leucine, Threonine, Lysine, Methionine, Phenylalanine, Tryptophan, and Valine are essential amino acids

2- Semi-essential formed in the body but not in sufficient amount for body requirements especially in children. Arginine and histidine are semi-essential

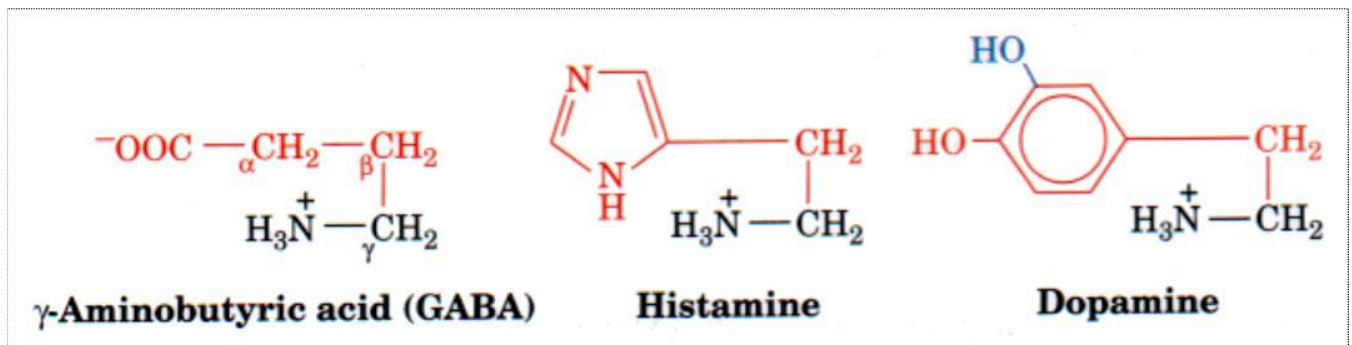
3- Non-essential can be synthesized in the body. The non-essential amino acids are Alanine, Asparagine, Aspartic acid, Cysteine, Glutamine, Glutamic Acid, Glycine, Proline, Serine and Tyrosine. All body proteins do contain all the non-essential amino acids.

Non Standard Amino Acids

A nonstandard amino acid is an amino acid that occurs naturally in cells but do not participate in peptide synthesis. Many are metabolic intermediates *eg.* ornithine and citrulline are intermediates in urea biosynthesis

Amino Acid Derivatives

Chemical derivatives of amino acids also have important biological functions, *eg.* Catecholamines (below) lack the carboxylate of amino acids



GABA & Dopamine are neurotransmitters. Histamine mediates parts of the immune response.

Functions of Amino Acids

Apart from being the monomeric constituents of proteins and peptides, amino acids serve variety of functions.

(a) Some amino acids are converted to carbohydrates and are called as **glucogenic amino acids**.

(b) Specific amino acids give rise to specialized products, e.g.

- **Tyrosine** forms hormones such as **thyroid hormones**, (T3, T4), **epinephrine** and **norepinephrine** and a pigment called **melanin**.

- **Tryptophan** can synthesize a vitamin called **niacin**.

- Glycine, arginine and methionine synthesis **creatine**.

- Glycine and cysteine help in **synthesize of Bile salts**.

- Glutamate, cysteine and glycine synthesis **glutathione**.

- **Histidine** changes to **histamine** on decarboxylation.

- **Serotonin** is formed from tryptophan.

- Glycine is used for the synthesis of **haem**.

- Pyrimidines and purines use several amino acids for their synthesis such as aspartate and glutamine for pyrimidines and glycine, aspartic acid, Glutamine and serine for purine synthesis.

(c) Some amino acids such as glycine and cysteine are used as detoxicants of specific substances.

(d) Methionine acts as “active” methionine (S-adenosylmethionine) and transfers methyl group to various substances by transmethylation.

(e) Cystine and methionine are sources of Sulphur.

Summary of lecture

Amino Acids are the building units of proteins. There are about 300 amino acids occur in nature. Only 20 of them enter in proteins synthesis. Each amino acid has 4 different groups attached to α - carbon: amino group, COOH group,

Hydrogen atom and side Chain (R). Amino acids can be classified based on their (i) Side chain characters (ii) Chemical properties (iii) Metabolic fate (iv) Nutritional requirements. Based on the variable group, amino acids can be classified into four categories: nonpolar, polar, negatively charged, and positively charged. Of the set of twenty amino acids, eleven can be made naturally by the body and are termed nonessential amino acids. Amino acids that cannot be naturally made by the body are called essential amino acids. Amino acids serve variety of functions such as synthesis of hormone, neurotransmitter, niacin, haem, and creatine.