



# *Department of Biology*

**2025-2026**

**((Biochemistry))**

**Stage (-2-)**

**LEC- ((3))**

**AMINO ACID**

**By**

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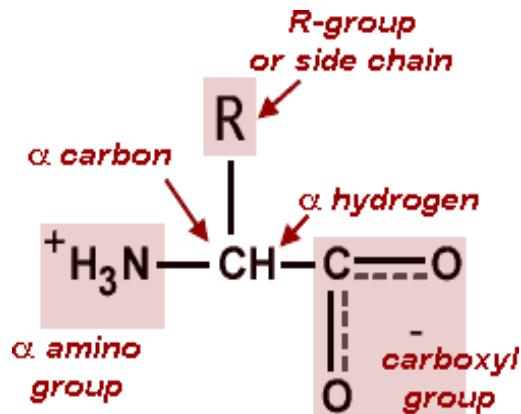
## AMINO ACID: STRUCTURE AND CLASSIFICATION.

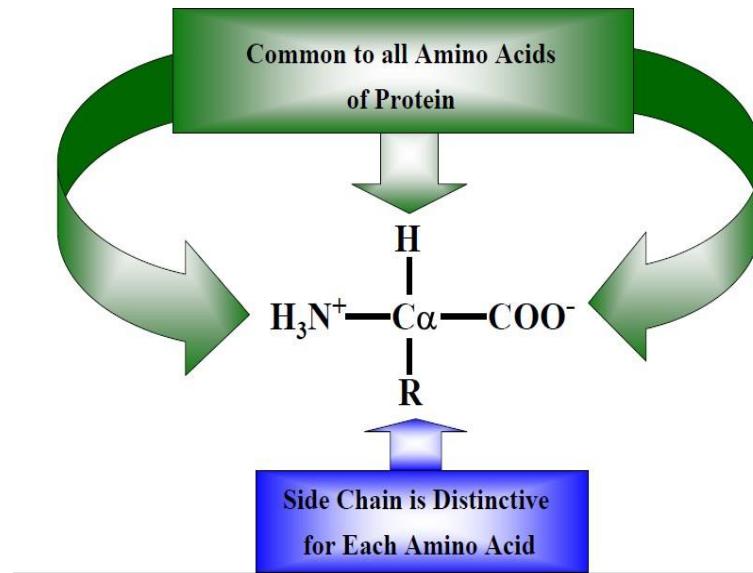
Amino Acids are the building units of proteins. There are about 300 amino acids occur in nature. Only 20 of them enter in proteins synthesis.

### Structure of amino acids:

Each amino acid has 4 different groups attached to  $\alpha$ - 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<sup>-</sup>) and amino group is protonated forming positively charged ion (NH<sub>3</sub><sup>+</sup>) 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 H<sub>2</sub>O. 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 aspargine
- 4- NH<sub>2</sub> 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.

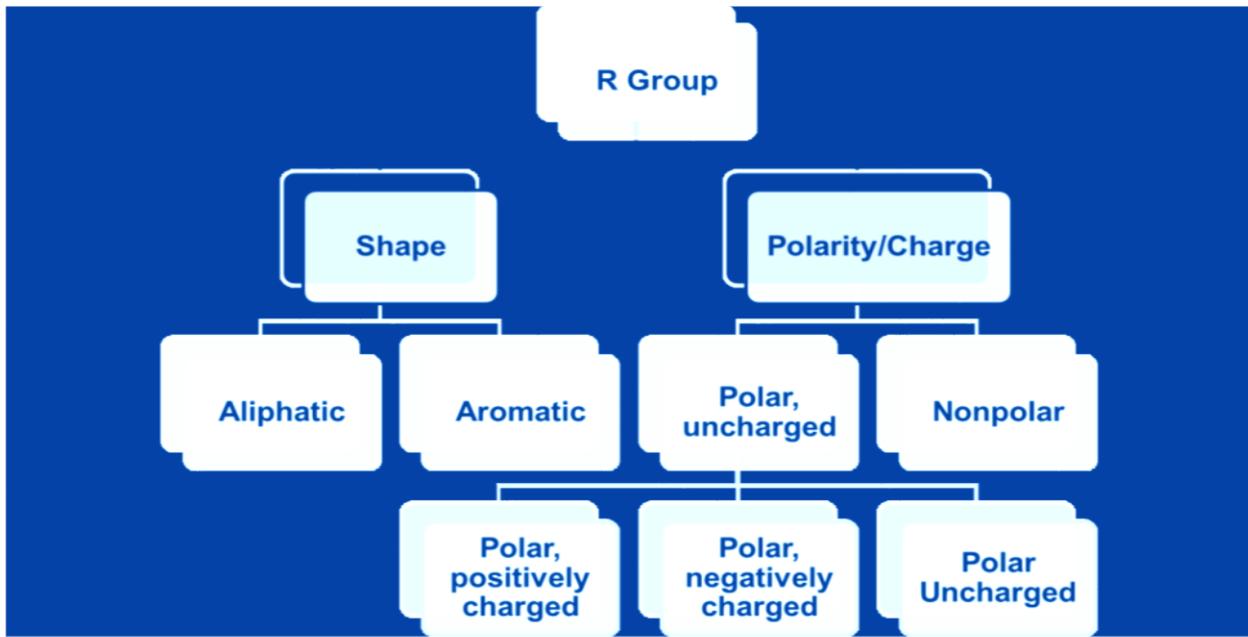


Figure: Classification by R group

**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***.

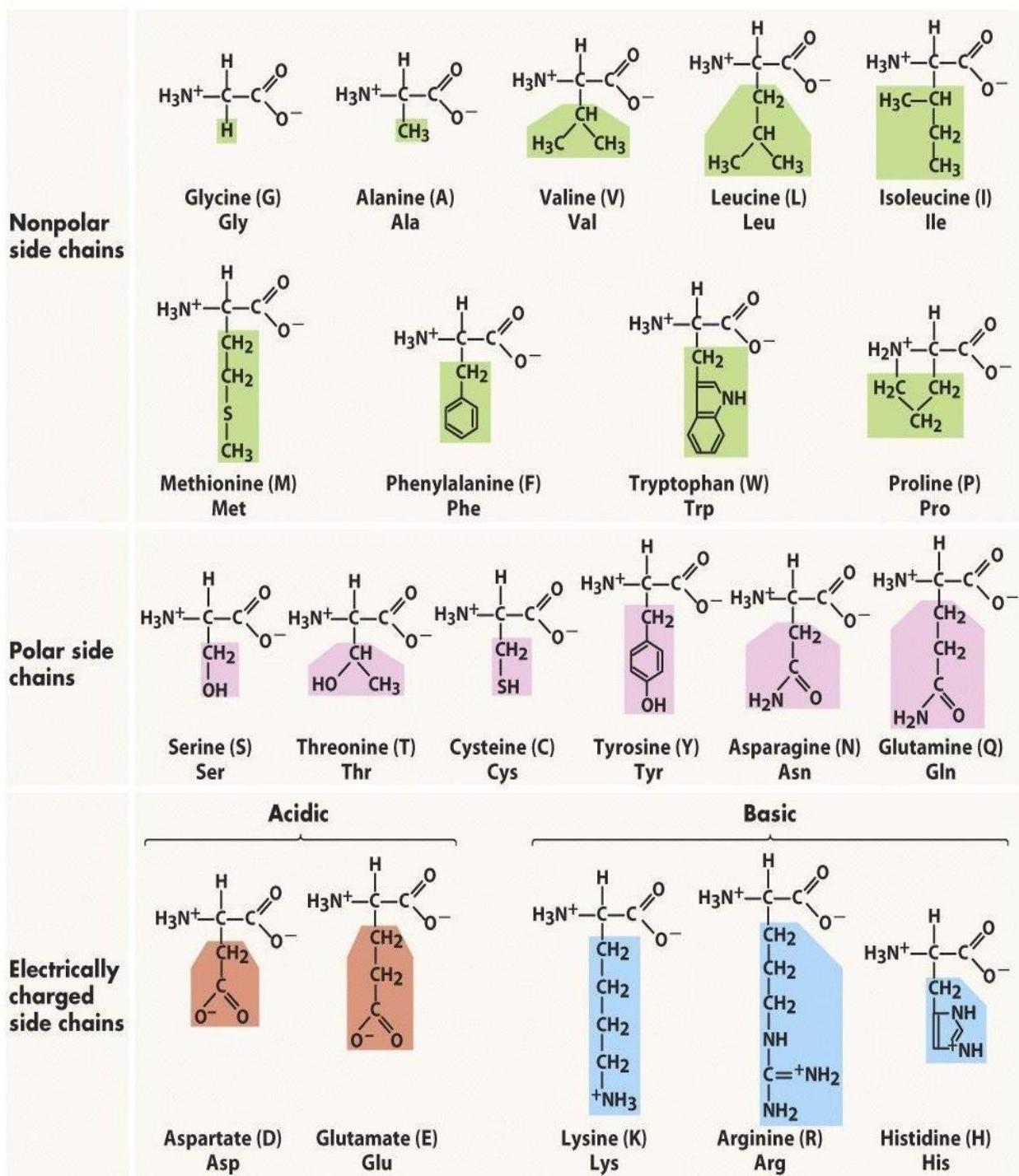


Figure 3-5 Biological Science, 2/e

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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
Phenylalanine	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.

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

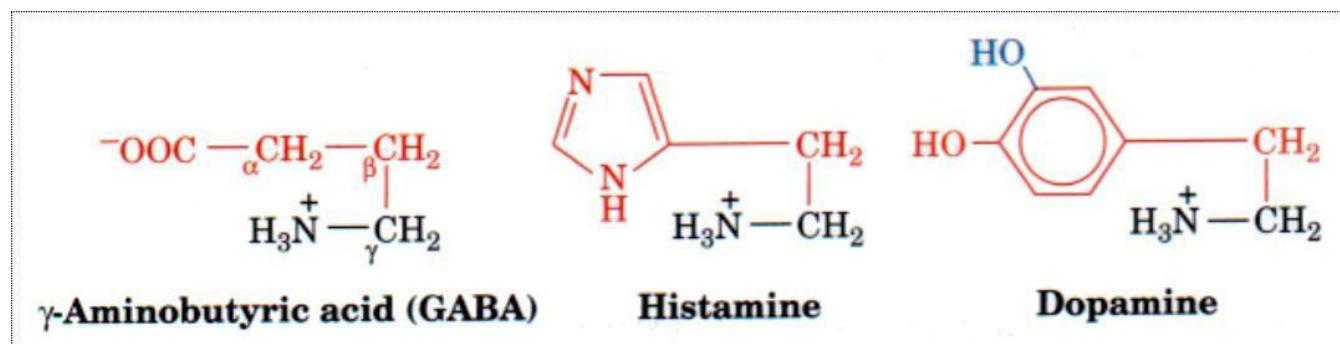
3- Non-essential can be synthesized in the body.

### 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**.



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**(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