# Amino Acids- Properties, Structure, Classification and Functions

August 9, 2018 by Sagar Aryal

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Last Updated on January 12, 2020 by Sagar Aryal

- Amino acids constitute a group of neutral products clearly distinguished from other natural compounds chemically, mainly because of their ampholytic properties, and biochemically, mainly because of their role as protein constituents.
- An amino acid is a carboxylic acid-containing an aliphatic primary amino group in the α position to the carboxyl group and with a characteristic stereochemistry.
- **Proteins** are biosynthesized from 20 amino acids in a system involving strict genetic control. Thus, amino acids are the basic unit of proteins.
- More than 300 amino acids are found in nature but only 20 amino acids are standard and present in protein because they are coded by genes. Other amino acids are modified amino acids and called non-protein amino acids.
- Some are residues modified after a protein has been synthesized by posttranslational modifications; others are amino acids present in living organisms but not as constituents

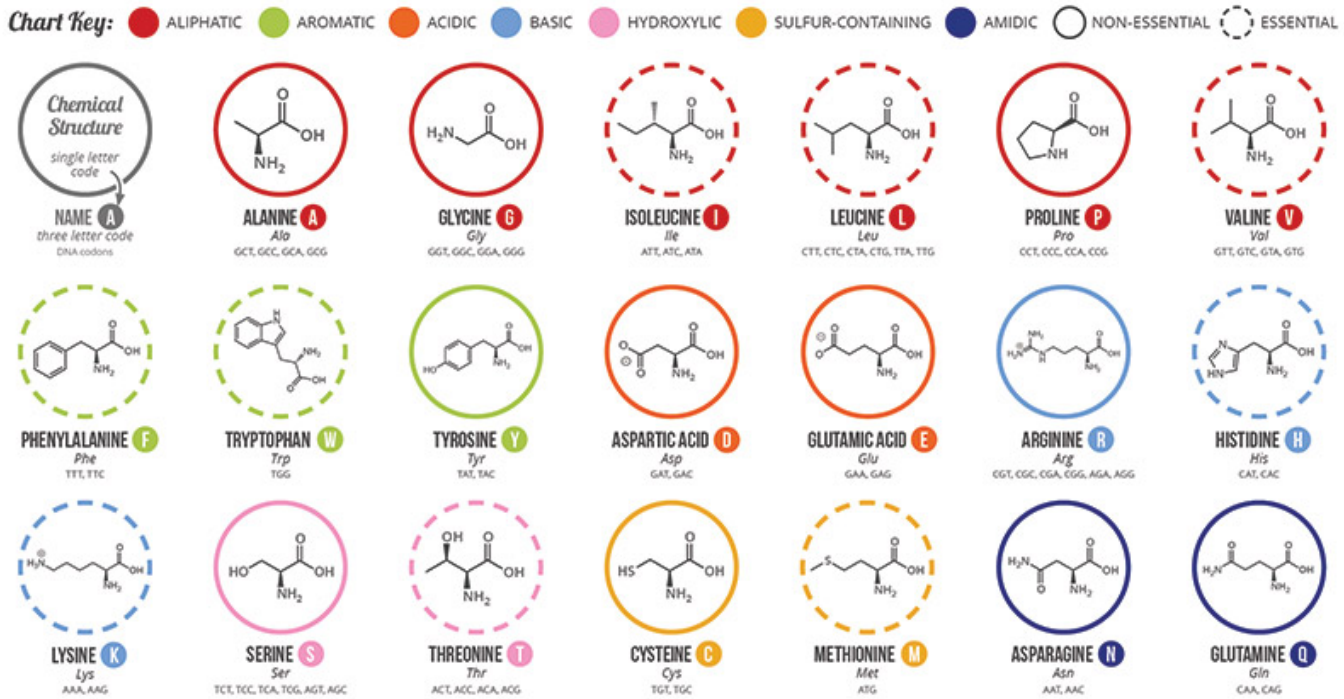



Image Source: Compound Interest

# Properties of Amino acids

### Physical Properties

1. Amino acids are colorless, crystal
2. All amino acids have a high melti
3. Solubility: They are soluble in wa
   with difficulty in methanol, ethan
   pH of the solvent play important
4. On heating to high temperatures,
5. All amino acids (except glycine) a

6. Peptide bond formation: Amino acids can connect with a peptide bond involving their amino and carboxylate groups. A covalent bond formed between the alpha-amino group of one amino acid and an alpha-carboxyl group of other forming -CO-NH-linkage. Peptide bonds are planar and partially ionic.

**Chemical Properties**

1. **Zwitterionic property**

A zwitterion is a molecule with functional groups, of which at least one has a positive and one has a negative electrical charge. The net charge of the entire molecule is zero. Amino acids are the best-known examples of zwitterions. They contain an amine group (basic) and a carboxylic group (acidic). The -NH2 group is the stronger base, and so it picks up H+ from the -COOH group to leave a zwitterion. The (neutral) zwitterion is the usual form amino acids exist in solution.

2. **Amphoteric property**

Amino acids are amphoteric in nature that is they act as both acids and base since due to the two amine and carboxylic group present.

3. **Ninhydrin test**

When 1 ml of Ninhydrin solution is added to a 1 ml protein solution and heated, the formation of a violet color indicates the presence of α-amino acids.

4. **Xanthoproteic test**

The xanthoproteic test is performed for the detection of aromatic amino acids (tyrosine, tryptophan, and phenylalanine) in a protein solution. The nitration of benzoid radicals present in the amino
acid, giving the solution yellow colora

5. **Reaction with Sanger's reage**

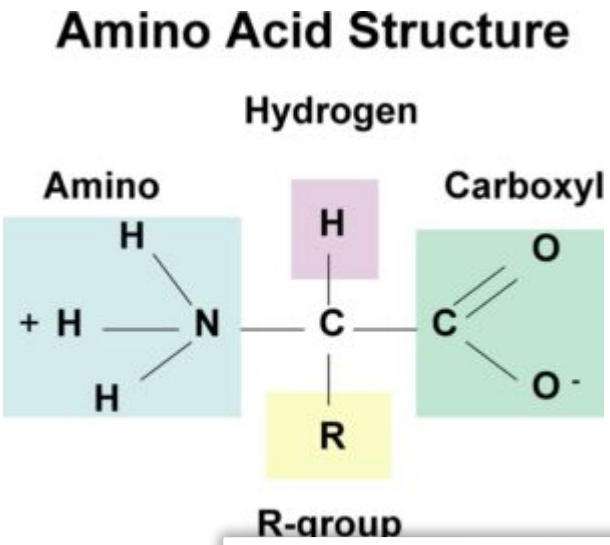
Sanger's reagent (1-fluoro-2, 4-dinitr
the peptide chain in a mild alkaline m

6. **Reaction with nitrous acid**

Nitrous acid reacts with the amino group to liberate nitrogen and form the corresponding hydroxyl.

## Structure of Amino acids

- All 20 of the common amino acids are alpha-amino acids. They contain a carboxyl group, an amino group, and a side chain (R group), all attached to the α-carbon.





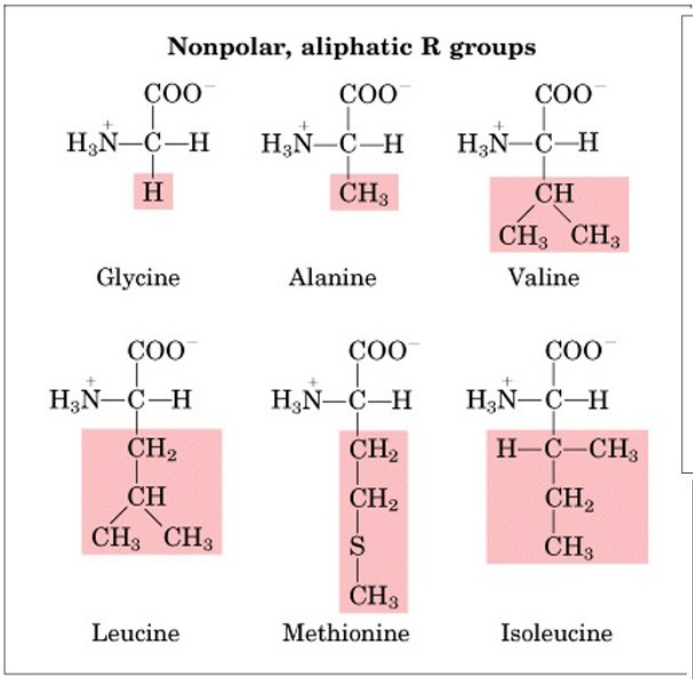

**Exceptions are:**

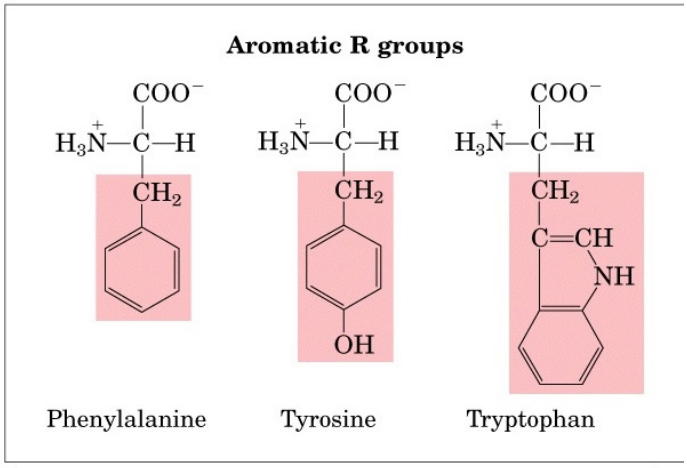
- Glycine, which does not have a si
hydrogens.
- Proline, in which the nitrogen is p
- Thus, each amino acid has an am
other and a distinctive side chain

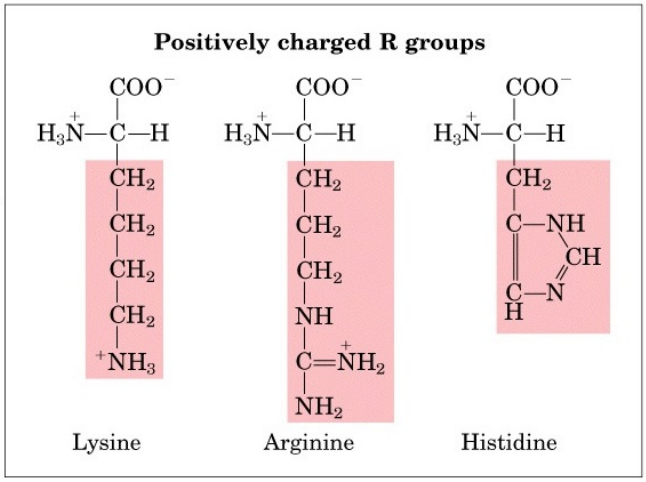
while the side chain differs from one amino acid to the next.

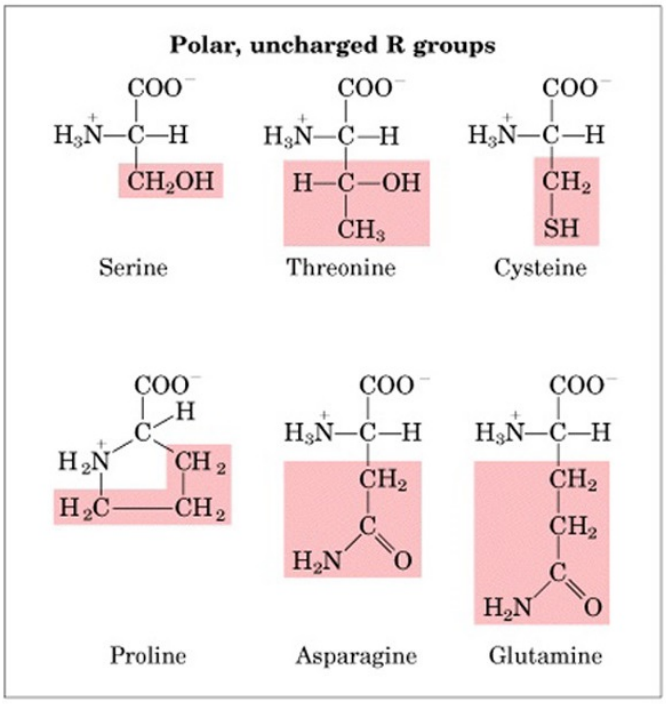
- All of the 20 amino acids except glycine are of the L-configuration, as for all but one amino acid the α-carbon is an asymmetric carbon. Because glycine does not contain an asymmetric carbon atom, it is not optically active and, thus, it is neither D nor L.

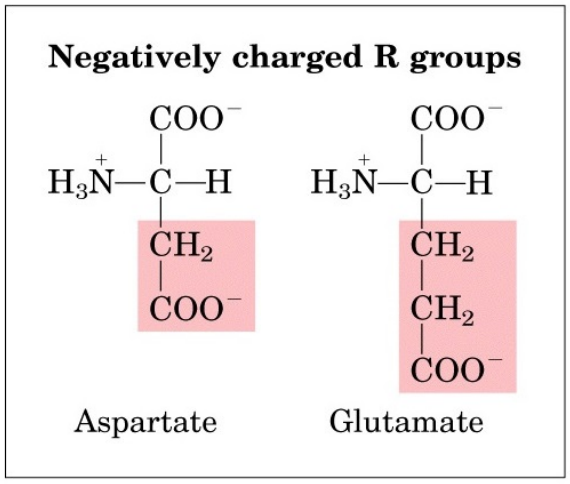
## Classification of amino acids on the basis of R-group




1. **Nonpolar, Aliphatic amino aci**
   are nonpolar and hydrophobic. G
   Methionine, Proline.
2. **Aromatic amino acids:** Phenyla
   aromatic side chains, are relative
   in hydrophobic interactions.
3. **Polar, Uncharged amino acids**
   soluble in water, or more hydrop

because they contain functional groups that form hydrogen bonds with water. This class of amino acids includes serine, threonine, cysteine, asparagine, and glutamine.

4. **Acidic amino acids:** Amino acids in which R-group is acidic or negatively charged. Glutamic acid and Aspartic acid
5. **Basic amino acids:** Amino acids in which R-group is basic or positively charged. Lysine, Arginine, Histidine

## Classification of amino acids on the basis of nutrition

| Essential | Conditionally Non-Essential | Non-Essential |
|---|---|---|
| Histidine | Arginine | Alanine |
| Isoleucine | Cystine | Asparagine |
| Leucine | Glutamine | Aspartate |
| Lysine | Glycine | Glutamate |
| Methionine | Proline | Serine |
| Phenylalanine | | |
| Threonine | | |
| Tryptophan | | |
| Valine | | |



1. **Essential amino acids (Nine)**

Nine amino acids cannot be synthesiz
present in the diet in order for protei

These essential amino acids are histidine, isoleucine, leucine, lysine, methionine, phenylalanine, threonine, tryptophan, and valine.

2. **Non-essential amino acids (Eleven)**

These amino acids can be synthesized in the body itself and hence not necessarily need to be acquired through diet.

Arginine, glutamine, tyrosine, cysteine, glycine, proline, serine, ornithine, alanine, asparagine, and aspartate.

3. Conditionally

## Classification of amino acids on the basis of the metabolic fate

| Glucogenic amino acids | Glucogenic and ketogenic | Ketogenic amino acids |
|---|---|---|
| Alanine, Arginine, Asparagine, Aspartate | Tyrosine Isoleucine | Leucine Lysine |
| Asparagine, Cysteine, Methionine | | |
| Glutamate, Glutamine, Glycine, Histidine | | |
| Proline, Serine, Threonine,Valine | | |

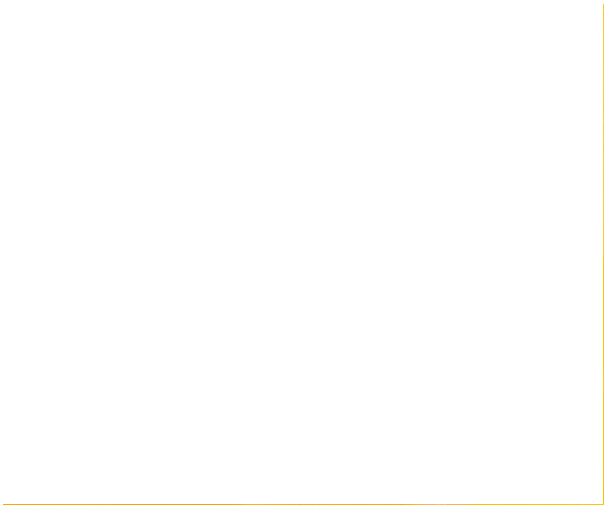


1. **Glucogenic amino acids**: These
gluconeogenesis for glucose form

asparagine, glutamic acid, glutamine, proline, valine, methionine, cysteine, histidine, and arginine.

2. **Ketogenic amino acids:** These amino acids breakdown to form ketone bodies. Leucine and Lysine.
3. **Both glucogenic and ketogenic amino acids:** These amino acids breakdown to form precursors for both ketone bodies and glucose. Isoleucine, Phenylalanine, Tryptophan, and tyrosine.

# Functions of Amino acids



1. In particular, 20 very important amino acids are crucial for life as they contain peptides and proteins and are known to be the building blocks for all living things.
2. The linear sequence of amino acid residues in a polypeptide chain determines the three-dimensional configuration of a protein, and the structure of a protein determines its function.
3. Amino acids are imperative for sustaining the health of the human body. They largely promote the:
   Production of hormones
   • Structure of muscles
   • Human nervous system's healt
   • The health of vital organs
   • Normal cellular structure
4. The amino acids are used by vari
   produce nitrogen-containing com
   epinephrine), or they are oxidize

5. The breakdown of both dietary and tissue proteins yields nitrogen-containing substrates and carbon skeletons.
6. The nitrogen-containing substrates are used in the biosynthesis of purines, pyrimidines, neurotransmitters, hormones, porphyrins, and nonessential amino acids.
7. The carbon skeletons are used as a fuel source in the citric acid cycle, used for gluconeogenesis, or used in fatty acid synthesis.

# References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- Proteins- Properties, Structure, Classification and Functions
- RNA- Properties, Structure, Types and Functions
- Lipids- definition, properties, structure, types, examples, functions
- DNA- Structure, Properties, Types, Forms, Functions
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- Lewis Acids and Bases
- Soil- Definition, Composition, Properties, Types and Uses
- Complement- Properties and Nomenclature

Biochemistry

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‹ Nucleic Acids- Nucleosides and Nu

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## 2 thoughts on “Amino Acids- Properties, Structure, Classification and Functions”

**Kartheesh**

October 28, 2020 at 9:10 PM

Nice and clean explanation

Reply

**usama**

October 3, 2020 at 3:19 AM

proline is non-polar

Reply

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