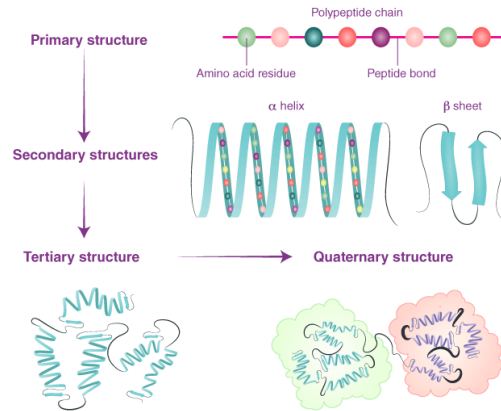


PROTEINS

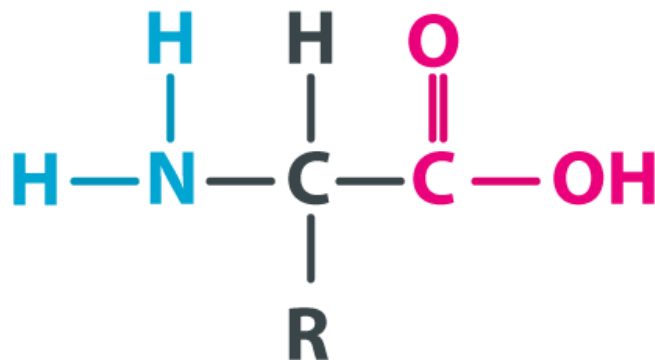
Proteins are known as the building blocks of life because they are the most abundant molecules present in the body and form about 60% of the dry weight of cells.



They make up the majority of the cells in all living things. Aside from cells, proteins make up the majority of the body's structural, regulatory, and enzyme components. They are therefore crucial for an individual's development. Food like eggs, pulses, milk and other milk products form the major high-protein foods for the body.

Proteins Structure

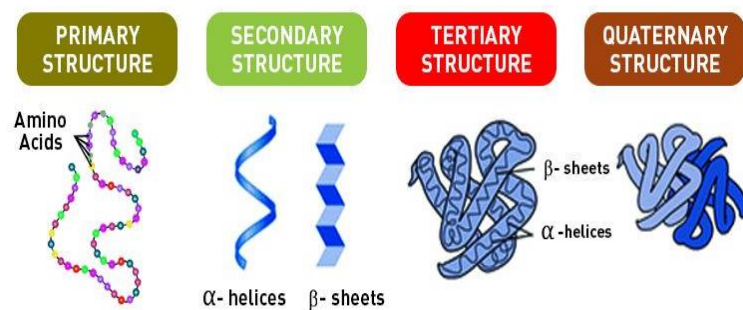
A polymeric chain of amino acid residues constitutes proteins. A protein's structure is primarily made up of long chains of amino acids. The arrangement and placement of amino acids give proteins certain characteristics. All amino acid molecules contain an amino ($-\text{NH}_2$) and a carboxyl ($-\text{COOH}$) functional group. Hence, the name "Amino-Acid".



Polypeptide chains are synthesized by linking together amino acids. A protein is created when one or more of these chains fold in a specific way. Methane is substituted by amino acids, with hydrogen, amino groups, carboxyl groups, and a variable R- group filling the first three valencies of the – alpha carbon.

There are many sorts of amino acids depending on the R-group, and a polypeptide chain contains 20 of them. The final structure and purpose of proteins are determined by all these characteristics of amino acids.

The structure of the protein is classified at 4 levels:-



- **Primary** – The primary structure of a protein is the linear polypeptide chain formed by the amino acids in a particular sequence. Changing the position of even a single amino acid will result in a different chain and hence a different protein.
- **Secondary** – The secondary structure of a protein is formed by hydrogen bonding in the polypeptide chain. These bonds cause the chain to fold and coil in two different conformations known as the α -helix or β -pleated sheets. The α -helix is like a single spiral and is formed by hydrogen bonding between every fourth amino acid. The β -pleated sheet is formed by hydrogen bonding between two or more adjacent polypeptide chains.
- **Tertiary** – The tertiary structure is the final 3-dimensional shape acquired by the polypeptide chains under the attractive and repulsive forces of the different R-groups of each amino acid. This is a coiled structure that is very necessary for protein functions.
- **Quaternary** – This structure is exhibited only by those proteins which have multiple polypeptide chains combined to form a large complex. The individual chains are then called subunits.

Functions of Proteins

The body uses proteins for a variety of purposes, and their structure determines how they work. Several notable functions include:

1. **Digestion** – The digestive enzymes, which are primarily proteinaceous in origin, carry out digestion.
2. **Movement** – Muscles include a protein called myosin, which helps muscles contract, allowing for movement.
3. **Structure and Support** – The structural protein known as keratin is what gives humans and other animals hair, nails, and horns.
4. **Cellular communication** – Through receptors on their surface, cells can communicate with other cells and the outside world. These receptors are made of proteins.
5. **Act as a messenger** – These proteins serve as chemical messengers that facilitate communication among cells, tissues, and organs.

Amino Acids

Amino Acids are the organic compounds that combine to form proteins, hence they are referred to as the building components of proteins. These biomolecules are involved in several biological and chemical functions in the human body and are the necessary ingredients for the growth and development of human beings. There are about 300 amino acids that occur in nature.

Amino acids are organic compounds containing the basic amino groups (-NH₂) and carboxyl groups (-COOH). The ingredients present in proteins are amino acids. Both peptides and proteins are long chains of amino acids. Altogether, there are twenty amino acids, which are involved in the construction of proteins.

List of 20 Amino acids with the chemical formula

Listed below are the names of twenty amino acids along with their chemical formula.

Alanine	C ₃ H ₇ NO ₂	Leucine	C ₆ H ₁₃ NO ₂
Aspartic Acid	C ₄ H ₇ NO ₄	Lysine	C ₆ H ₁₄ N ₂ O ₂
Asparagine	C ₄ H ₈ N ₂ O ₃	Methionine	C ₅ H ₁₁ NO ₂ S
Arginine	C ₆ H ₁₄ N ₄ O ₂	Proline	C ₅ H ₉ NO ₂

Cytosine	C4H5N3O	Phenylalanine	C9H11NO2
Cysteine	C3H7NO2S	Serine	C3H7NO3
Glycine	C2H5NO2	Tyrosine	C9H11NO3
Glutamine	C5H10N2O3	Threonine	C4H9NO3
Histidine	C6H9N3O2	Tryptophan	C11H12N2O2
Isoleucine	C6H13NO2	Valine	C5H11NO2

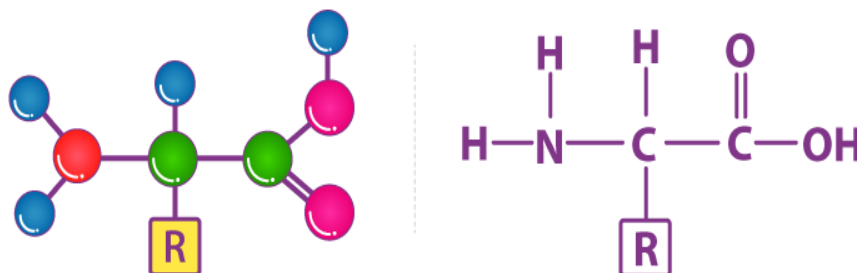
General properties of Amino acids

- They have a very high melting and boiling point.
- Amino acids are white crystalline solid substances.
- In taste, few Amino acids are sweet, tasteless, and bitter.
- Most of the amino acids are soluble in water and are insoluble in organic solvents.

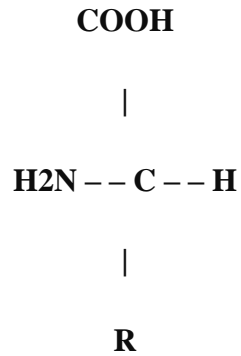
Essential and Non-essential Amino acids

Out of 20 amino acids, our body can easily synthesize a few on its own, which are called non-essential amino acids. These include alanine, asparagine, arginine, aspartic acid, glutamic acid, **cysteine**, glutamine, proline, glycine, serine, and tyrosine. Apart from these, there are other nine amino acids, which are very much essential as they cannot be synthesized by our body. They are called essential amino acids, and they include isoleucine, histidine, lysine, leucine, phenylalanine, tryptophan, methionine, threonine, and valine.

Structure of Amino acids



The general structure of Amino acids is $\text{H}_2\text{NCH(R)COOH}$, and it can be written as:



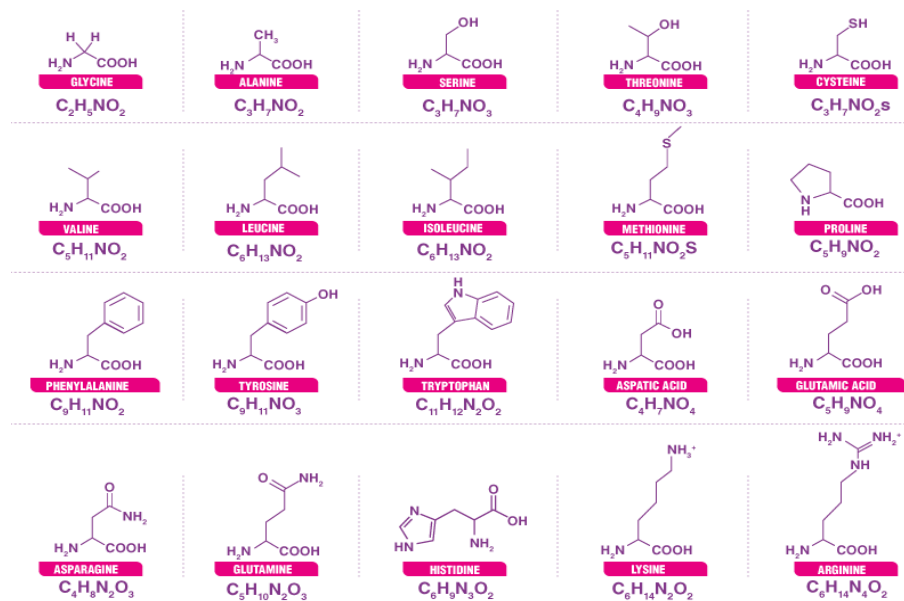
There are 20 naturally occurring amino acids and all have common structural features – an amino group ($-\text{NH}_3^+$), a carboxylate ($-\text{COO}^-$) group and a hydrogen bonded to the same carbon atom. They differ from each other in their side-chain called the R group. Each amino acid has 4 different groups attached to α - carbon.

These 4 groups are:

- Amino group,
- COOH ,
- Hydrogen atom,
- Sidechain (R).

Structure of 20 Amino acids with their chemical formula

Here is the structure of twenty amino acids with their chemical formula.



Sources of Amino acids



Amino acids play an important role in performing several biological and chemical functions in different parts of our body, including building and repairing the tissues, the formation and function of **enzymes**, food digestion, the transportation of molecules, etc. Our body can synthesize only certain amino acids and the rest of the amino acids which are called essential amino acids should be supplied through protein-rich foods in our daily diet. Foods rich in amino acids include plant-based products like broccoli, beans, beetroots, pumpkin, cabbage, nuts, dry fruits, chia seeds, oats, peas, carrots, cucumber, green leafy vegetables, onions, soybeans, whole grain, peanuts legumes, lentils, etc. Fruits rich in amino acids are apples, bananas, berries, figs, grapes, melons, oranges, papaya, pineapple, and pomegranates. Other animal products include dairy products, eggs, seafood, chicken, meat, pork etc.

Functions of Amino acids

- Phenylalanine helps in maintaining a healthy nervous system and in boosting memory power.
- Valine acts as an important component in promoting muscle growth.
- Threonine helps in promoting the functions of the immune system.
- Tryptophan is involved in the production of vitamin B3 and serotonin hormones. This serotonin hormone plays a vital role in maintaining our appetite, regulating sleep and boosting our moods.
- Isoleucine plays a vital role in the formation of haemoglobin, stimulating the pancreas to synthesize insulin, and transporting oxygen from the lungs to the various parts.
- Methionine is used in the treatment of kidney stones, maintaining healthy skin and also used in controlling invade of pathogenic bacteria.
- Leucine is involved in promoting protein synthesis and growth hormones.
- Lysine is necessary for promoting the formation of antibodies, hormones, and enzymes and in the development and fixation of calcium in bones.
- Histidine is involved in many enzymatic processes and in the synthesizing of both red blood cells (erythrocytes) and white blood cells (leukocytes).

Functions of Non-Essential Amino acids

- Alanine functions by removing toxins from our body and in the production of glucose and other amino acids.
- Cysteine acts as an antioxidant and provides resistance to our body; it is important for making collagen. It affects the texture and elasticity of the skin
- Glutamine promotes a healthy brain function and is necessary for the synthesis of nucleic acids – DNA and RNA.
- Glycine is helpful in maintaining the proper cell growth, and its function, and it also plays a vital role in healing wounds. It acts as a neurotransmitter.
- Glutamic acid acts as a neurotransmitter and is mainly involved in the development and functioning of the human brain.
- Arginine helps in promoting the synthesis of proteins and hormones, detoxification in the kidneys, healing wounds, and maintaining a healthy immune system.

- Tyrosine plays a vital role in the production of the thyroid hormones -T3 and T4, in synthesizing a class of neurotransmitters and melanin, which are natural pigments found in our eyes, hair, and skin.
- Serine helps in promoting muscle growth and in the synthesis of immune system proteins.
- Asparagine is mainly involved in the transportation of nitrogen into our body cells, formations of purines and pyrimidine for the synthesis of DNA, the development of the nervous system and improving our body stamina.
- Aspartic acid plays a major role in metabolism and in promoting the synthesis of other amino acids.
- Proline is mainly involved in the repairing of the tissues in the formation of collagen, preventing the thickening and hardening of the walls of the arteries (arteriosclerosis) and in the regeneration of new skin.

Deficiency of Amino acids

As mentioned above, amino acids are the building blocks of proteins and proteins play a fundamental role in almost all **life processes**. Therefore, it is necessary to include all nine essential amino acids in our daily diet to maintain a healthy and proper function of our body. The deficiency of amino acids may include different pathological disorders, including:

- Edema.
- Anemia.
- Insomnia.
- Diarrhea.
- Depression.
- Hypoglycemia.
- Loss of Appetite.
- Fat deposit in the liver.
- Skin and hair related problems.
- Headache, weakness, irritability, and fatigue.