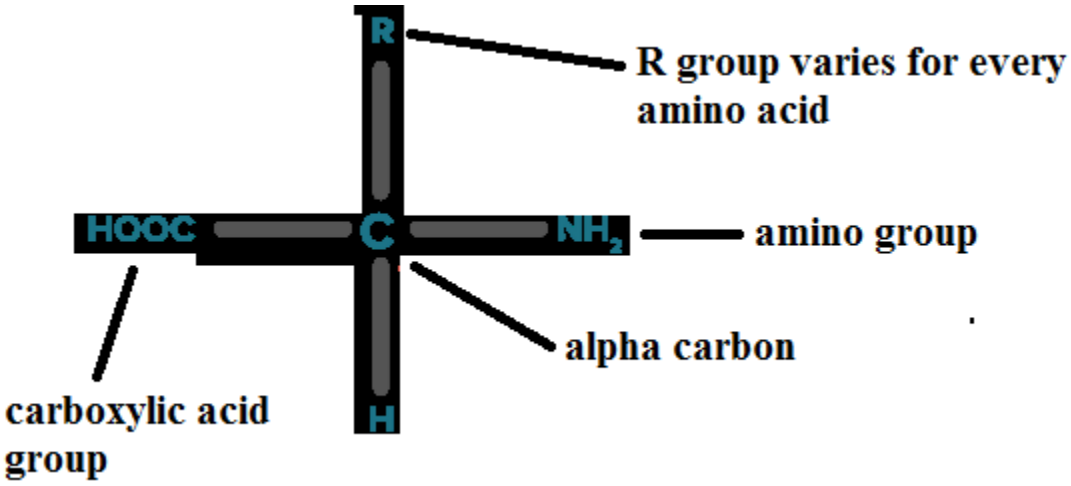
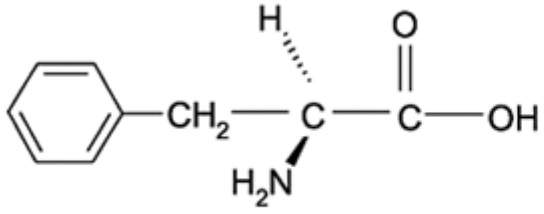
Amino acids and proteins

An amino acid contains both a carboxylic group and an amino group. Amino acids that have an amino group bonded directly to the alpha-carbon are referred to as **alpha amino acids.**

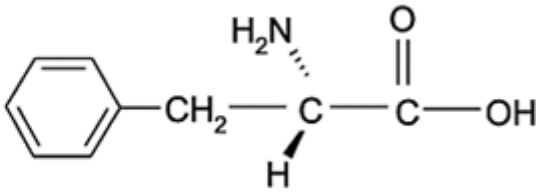
•Every alpha amino acid has a carbon atom, called an **alpha carbon**, C*α*; bonded to a **carboxylic acid**, –COOH group; an **amino**, –NH2 group; a hydrogen atom; and an R group that is unique for every amino acid.



There is two isomer for amino acid D and L. only L-amino acid are used as building blocks for proteins.

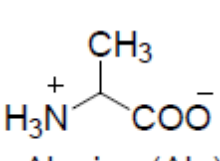


D-(-)-phenylalanine

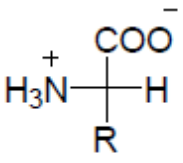


L-(+)-phenylalanine

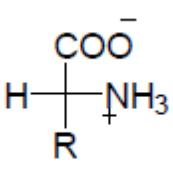
Usually amino acids found as zwitter ions



Alanine (Ala)



L-Amino acid



D-Amino Acid

Classification of amino acids

Group 1: non polar side chain (R).

Group 2: polar uncharged side chain ± R-group contains polar (hydroxyl, thiol or carboxyamide)

Group 3: acidic side chain – charged R

Group 4: basic side chain + charged R

The chemical reactivity of α-amino acids is characteristic of their functional group as acid- base titration due to –COOH and NH_2

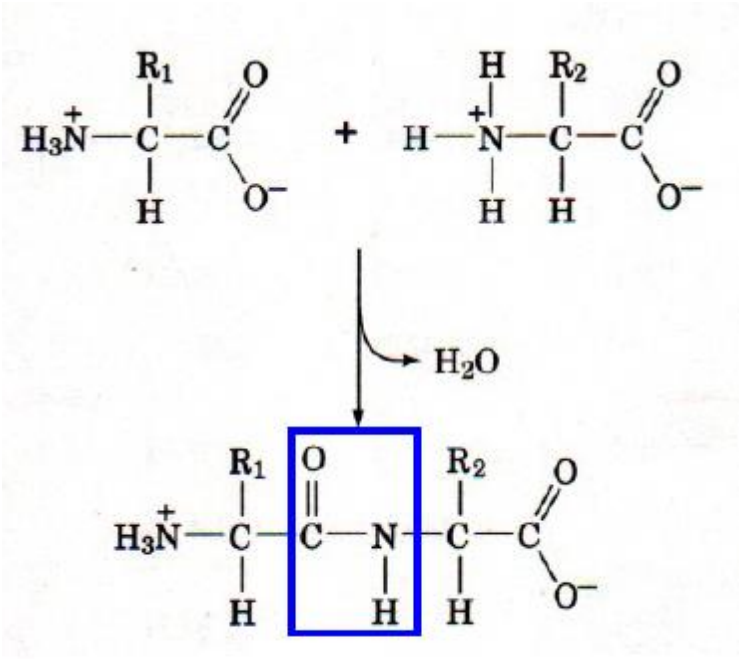
Test for amino acids

Ninhydrin test is the general color test for α-amino acids:-

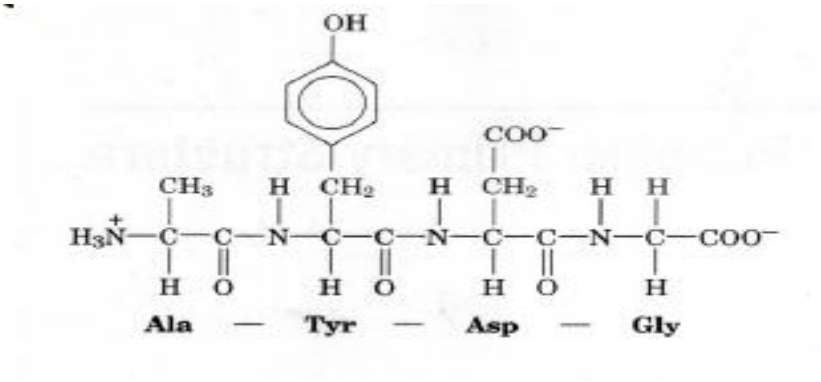
Nin hydrin reagent + α-amino acids $\longrightarrow$ purple pigment

Poly peptides and protein

Two α-amino acids can be linked together by formation of an amide or peptide bond



Products with 10 to 100 amino acids are called poly peptide and those with more than 100 amino acid are called proteins.



Four amino acid, three peptide bonds poly peptide.

- The digestion of protein to amino acid in the lab (hydrolysis) needs 6 M HCl, 100°C for 24 hr. in our body the digestion takes place by enzymes called peptidases or proteases in the stomach and in testiness.
- Glutathione, a tri peptide of glutamic acid, cysteine and glycine-necessary to prtect R.B.C

- The pituitary gland hormones, oxytocin and vasopressin are proteins.
- The hormone insulin, which regulate carbohydrate metabolism contains 51 amino acids.

Protein function

Each type of protein with sequence of amino acids NH_3^+ ----|-------|---------- COO^-

A1 A2 ……

has a characteristic shape, size and biological function.

1- Structural proteins: collagen, keratin, nails, hair, they are insoluble proteins.
2- Enzymes: amylase, hexokinase…… they are soluble proteins.
3- Transport proteins: lipoproteins to transport cholesterol in blood item globin to transport O_2.
4- Muscle proteins: myosin contractile system in the heart.
5- Immune proteins: antibodies, toxics and sake venoms.

Scheme show the 20 amino acids in protein. They would exist at physiological pH and divided into four classification based on the chemical reactivity and polarity of the side chain R

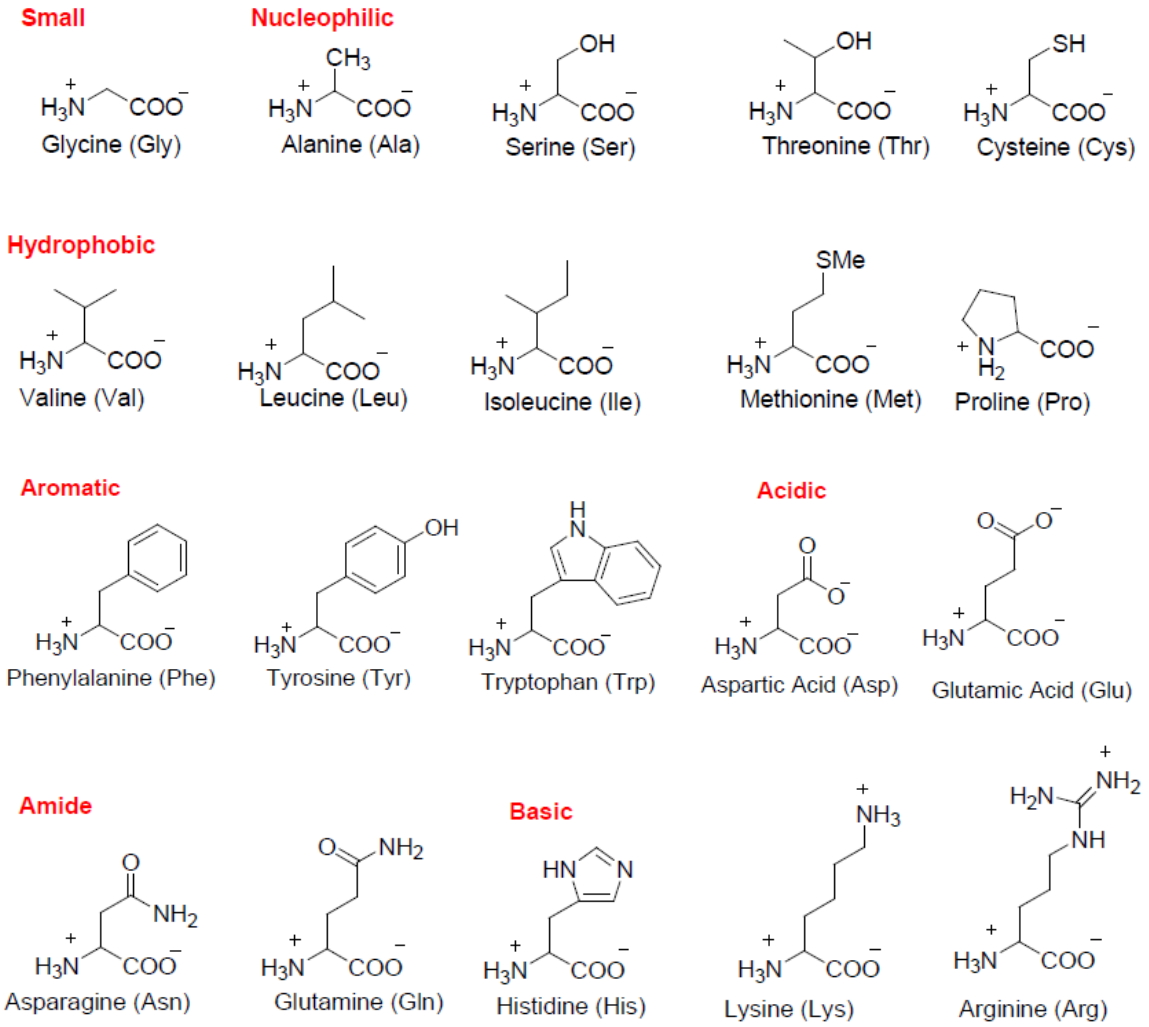


Table 1. Classes of proteins based on their biological functions

protein	Biological function
Enzyme	
6-Phosphofructo-1-kinase	A glycolytic enzyme that catalyzes phosphate group transfer from ATP fructose 6-phosphate
Citrate synthase	An enzyme in the citric acid cycle that catalyzes the condensation of acetyl-CoA and oxaloacetate to from citrate.
Trypsin	A digestive enzyme in vertebrates that catalyzes protein hydrolysis.
Ribonuclease	A hydrolytic enzyme produced by all organisms that catalyzes RNA hydrolysis.
RNA polymerase	An enzyme present in all organisms that catalyzes DNA-directed RNA synthesis.

Reverse transcriptase	An enzyme found in HIV (the virus that causes AIDS) that catalyzes RNA directed DNA synthesis
Structural Proteins	
Collagens	Fibrous proteins found in all animals; from cable networks that serve as scaffolding for support of tissues and organs.
Elastins	Fibrous proteins found in connective tissue of the lungs and in large blood vessels such as the aorta, which have rubberlike properties that allow them to stretch to serval times their normal length.
keratins	Mechanically durable fibrous proteins present in vertebrates as major components of the outer epidermal layer and its appendages such as hair, nails, and feathers.
Defense (Immune) Proteins	
antibodies	Globular proteins produced by the immune system of higher animals that participate in the destruction of biological invaders.
Interferons	Proteins, produced by higher animals, that interfere with viral replication.
Transport and storage proteins	
Hemoglobin	Globular heme-containing protein that carries oxygens from the lungs to other tissues.
Apolipoproteins	Components of lipoproteins such as low density lipoproteins (LDL) that participate in triacylglycerol and cholesterol transport.
Casein	Protein found in milk that stores amino acids.
ferritin	Widely distributed protein that binds iron.
myoglobin	A heme-containing protein found in vertebrates that bind oxygen.
Regulatory and receptor proteins	
Lac repressor	Genetic switch that turns off bacterial genes involved in lactose catabolism.
Insulin	A protein synthesized in the pancreas that acts as a signal for the fed state in higher animals.
Glucagon	A protein synthesized in the pancreas that acts as a signal for the starved state in higer animals.

Muscle Contraction and Mobility	
Actin	Component of skeletal muscle.
Myosin	Component of skeletal muscle.
Dynein	Protein that causes movement of sperm and protozoa by their flagella and cilia