

Amino Acid Highlights

1. Amino acids are the building blocks of proteins. They all contain an alpha carboxyl group and an alpha amino group. The carbon attached to the alpha carboxyl and the alpha amino group is known as the alpha carbon.
2. All amino acids except glycine have four different groups attached to the alpha carbon. As a result, all amino acids have at least one asymmetric center (the alpha carbon). We call a compound with such an arrangement 'chiral.' The two chiral forms of amino acids are called 'D' and 'L'. If one uses ordinary chemistry to make amino acids, mixtures of D and L are always produced. However, cells use enzymes to make amino acids and those enzymes always give the same configuration - L.
3. Glycine is the only amino acid with no asymmetric (chiral) carbon because it has two hydrogens attached to alpha carbon.
4. Only L amino acids are found in proteins formed biologically. We can think of D and L forms similar to left and right hands. Indeed, sometimes the two possible forms are referred to as 'handedness'. D and L alanine are mirror images of each other. Simple amino acids with only one asymmetric center will always have D and L forms as mirror images of each other.
5. Twenty amino acids are commonly found in proteins. The properties of the amino acids are determined by the composition of the R groups on each of them.
6. Amino acids with non-polar side chains can be amphipathic (amphiphilic) because part of them is hydrophobic (water hating) and part is hydrophilic (water liking).
7. Amino acids are grouped according to the properties of their R groups. You are responsible for knowing the names of the 20 amino acids, the groups they belong to as shown in class and the composition of any groups with ionizing side chains. For example, so-called acidic amino acids have carboxyl groups (COOH/COO⁻) in their side chain. These include glutamic acid and aspartic acid. Loss of a proton from the side chain causes the side chain to be charged negatively. Gain of the proton causes the side chain to have no charge.
8. Amino acids with amine-containing side chains (arginine, lysine, histidine) have groups that vary in charge from +1 (proton on) to 0 (proton off). Loss of a proton from the side chain causes the side chain to have no charge. Gain of the proton causes the side chain to have a positive charge.
9. Hydroxyl amino acids include serine, tyrosine and threonine, which contain hydroxyl groups in their side chains.
10. Proline is an amino acid with a ring structure as part of its side chain AND its. It is the only amino acid with an alpha amino group that is not a primary amine (it is a secondary amine).
11. Cysteine is the only amino acid with a sulfhydryl group.
12. Glycine is the simplest amino acid with only a hydrogen as its side chain.
13. The other amino acids (tryptophan, phenylalanine, methionine, alanine, leucine, isoleucine, valine, asparagine, glutamine) have varying properties.

14. Amino acids with acid side chains have R groups that 1) can lose/gain a proton and 2) are negatively charged upon losing the proton (and neutral when they have the proton). Two examples you should know are aspartic acid and glutamic acid, both of which have carboxyl groups in the R group.

15. Some amino acids are modified after they are incorporated into proteins. The best examples are hydroxylysine and hydroxyproline. Both of these are found in the protein called collagen. Thyroxine is a modified form of tyrosine found in the thyroid gland.

16. Because amino groups and carboxyl groups can gain or lose protons, amino acids can have a variety of charges. Figure 3-5 shows the ionization of two different amino acids. Note that the top one doesn't have an R group that can ionize, whereas the bottom one does.

17. The pI of a molecule is the pH at which its charge is exactly equal. A molecule with a net charge of zero is known as a zwitterion.