**Activity 37: Characteristics of Amino Acids**

***Learning Objectives***

*Draw the general structure of an amino acid in the zwitterion form*

*Distinguish essential and nonessential amino acids*

*Recognize the functional groups protonated amine and carboxylate*

*Recognize the functional groups thiol and amide found in amino acid side chains*

*Introduce the three-letter and one-letter codes for the 20 common amino acids*

*Characterize the amino acid side chains as polar or nonpolar. If polar as acidic, basic, or neutral*

**Estimated Completion Time** 20 Minutes

**Instructor Information**

The skill development allows students to review the 20 common amino acids. Note that different textbooks classify some amino acids differently.

**ANSWERS TO QUESTIONS**

1. Essential amino acids cannot be synthesized in the body and, therefore, must be obtained in the diet.

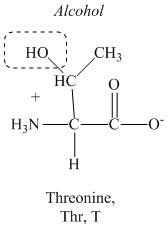
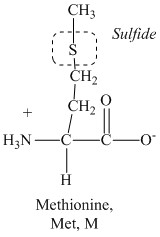
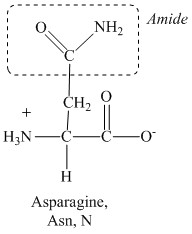
2. An incomplete protein

3.



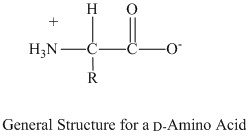
4. Protonated amine and carboxylate

5.



Asparagine is polar neutral, methionine is nonpolar, and threonine is polar neutral.

6.



Activity 37: Skill Development

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Name** | **Three-Letter Code** | **One-Letter Code** | **Functional Group in Side Chain** | **Polar or Nonpolar? If Polar, Basic, Acidic, or Neutral?** | |
| Alanine | **Ala** | **A** | **Alkyl** | **Nonpolar** | |
| Asparagine | **Asn** | **N** | **Amide** | **Polar neutral** | |
| Aspartate | **Asp** | **D** | **Carboxylate** | **Polar acidic** | |
| Arginine | **Arg** | **R** | **Protonated**  **amine** | **Polar basic** | |
| Cysteine | **Cys** | **C** | **Thiol** | **Polar neutral** | |
| Glutamate | **Glu** | **E** | **Carboxylate** | **Polar acidic** | |
| Glutamine | **Gln** | **Q** | **Amide** | **Polar neutral** |
| Glycine | **Gly** | **G** | **Alkyl** | **Nonpolar** |
| Histidine | **His** | **H** | **Imidazole** | **Polar basic** |
| Isoleucine | **Ile** | **I** | **Alkyl** | **Nonpolar** |
| Leucine | **Leu** | **L** | **Alkyl** | **Nonpolar** |
| Lysine | **Lys** | **K** | **Protonated amine** | **Polar basic** |
| Methionine | **Met** | **M** | **Sulfide** | **Nonpolar** |
| Phenylalanine | **Phe** | **F** | **Aromatic** | **Nonpolar** | |
| Proline | **Pro** | **P** | **Alkyl** | **Nonpolar** | |
| Serine | **Ser** | **S** | **Alcohol** | **Polar neutral** | |
| Threonine | **Thr** | **T** | **Alcohol** | **Polar neutral** | |
| Tryptophan | **Trp** | **W** | **Aromatic** | **Nonpolar** | |
| Tyrosine | **Tyr** | **Y** | **Phenol** | **Polar neutral** | |
| Valine | **Val** | **V** | **Alkyl** | **Nonpolar** | |