

Amino Acid Sidechain List

Dual Color Scheme:

1. Color of amino acid name and sidechain shading indicate: hydrophobic amino acids (yellow); hydrophilic non-charged amino acids (white); positive charged amino acids (blue); negative charged amino acids (red); cysteine (green).
2. Atom type indicates carbon (gray), oxygen (red), nitrogen (blue), and sulfur (yellow).

Name	Amino Acid	Sidechain	Name	Amino Acid	Sidechain	Name	Amino Acid	Sidechain	Name	Amino Acid	Sidechain
Alanine A	<chem>C[C@@H](N)C(=O)[O-]</chem>		Glutamine Gln Q	<chem>NC(=O)CC[C@@H](N)C(=O)[O-]</chem>		Leucine Leu L	<chem>CC(C)[C@H](N)C(=O)[O-]</chem>		Serine Ser S	<chem>OC[C@H](N)C(=O)[O-]</chem>	
Arginine Arg R	<chem>NC(=[NH2+])NCCC[C@@H](N)C(=O)[O-]</chem>		Glutamic Acid Glu E	<chem>OC(=O)CC[C@@H](N)C(=O)[O-]</chem>		Lysine Lys K	<chem>NC(=[NH2+])CCCC[C@@H](N)C(=O)[O-]</chem>		Threonine Thr T	<chem>CC(O)[C@H](N)C(=O)[O-]</chem>	
Asparagine Asn N	<chem>NC(=O)CC[C@@H](N)C(=O)[O-]</chem>		Glycine Gly G	<chem>NCC(=O)[O-]</chem>		Methionine Met M	<chem>CSCCC[C@@H](N)C(=O)[O-]</chem>		Tryptophan Trp W	<chem>c1ccc2c(c1)c(c[nH]2)C[C@@H](N)C(=O)[O-]</chem>	
Aspartic Acid Asp D	<chem>OC(=O)CC[C@@H](N)C(=O)[O-]</chem>		Histidine His H	<chem>c1c[nH]cn(Cc1)[C@@H](N)C(=O)[O-]</chem>		Phenylalanine Phe F	<chem>c1ccccc1C[C@@H](N)C(=O)[O-]</chem>		Tyrosine Tyr Y	<chem>c1ccc(cc1)C[C@@H](N)C(=O)[O-]</chem>	
Cysteine Cys C	<chem>SC[C@@H](N)C(=O)[O-]</chem>		Isoleucine Ile I	<chem>CC[C@H](C)[C@@H](N)C(=O)[O-]</chem>		Proline Pro P	<chem>C1CCNCC1[C@@H](N)C(=O)[O-]</chem>		Valine Val V	<chem>CC(C)[C@H](N)C(=O)[O-]</chem>	

Modeling Proteins Directions:

1. Using the Amino Acid Sidechain List, organize the sidechains on the circular magnetic mat according to their name or properties.
2. Examine the sidechains and their positions on the circle. Describe your observations on your answer sheet by answering questions #1-6 under Modeling Proteins.
3. Now you have explored the chemical properties and atomic composition of each sidechain, you are ready to predict how proteins spontaneously fold up into their 3D shapes. Answer questions #7-8 on your answer sheet.
4. Unwind the yellow toober. Notice the blue and red end caps. The blue end cap represents the N-terminus (the beginning) and the red end cap represents the C-terminus (the end) of the protein.
5. Select 15 metal u-shaped clips from your kit. Beginning at the N-terminus, place the 15 u-clips three inches apart on the toober.
6. Select methionine from the mat and place it on the clip closest to the blue end cap. Choose six hydrophobic sidechains, two acidic sidechains, two basic sidechains, two cysteine sidechains, and two other polar sidechains. Place them in any order you choose on your toober's u-clips.
Sidenote: This sequence of amino acid sidechains that you determined is called the primary structure of your protein. As a general rule the final shape of a protein is determined by its primary structure.
7. Answer question #9 on your answer sheet.
8. Now begin to fold your protein according to the chemical properties of the sidechains. Remember all of these chemical properties affect the protein at the same time.
 - a. Fold your protein so that all of the hydrophobic sidechains are buried on the inside of your protein where they will be hidden from polar water molecules.
 - b. Fold your protein so the acidic and basic (charged) sidechains are on the outside surface of the protein and pair one negative sidechain with one positive sidechain so they come within one inch of each other and neutralize each other. This positive-negative pairing helps stabilize your protein.
 - c. Continue to fold your protein applying these new properties: make sure your polar sidechains are also on the outside surface of your protein where they can hydrogen bond with water and finally, fold your protein so the two cysteine sidechains are positioned opposite each other on the inside of the protein where they can form a covalent disulfide bond that helps stabilize your protein.
Sidenote: This final shape of your protein is called the tertiary structure.
9. Answer questions #10-15 on your answer sheet.