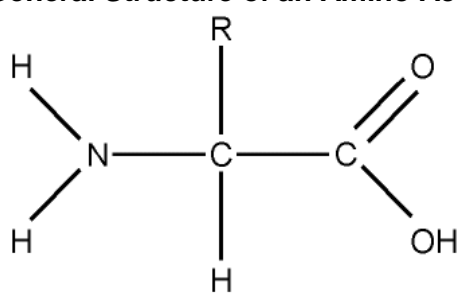


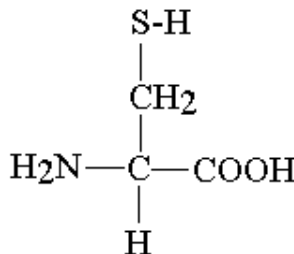
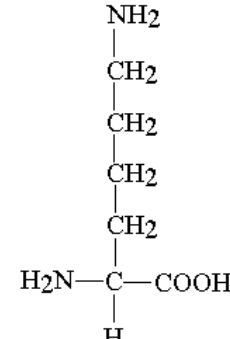
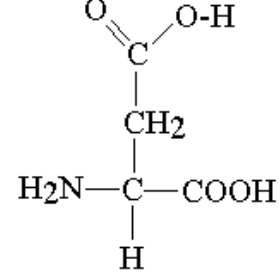
# Amino Acids

Name: \_\_\_\_\_

Amino acids are the basic units from which proteins are made. Plants can manufacture all of the amino acids they required from simpler molecules, but animals must obtain a number of ready-made amino acids (called **essential amino acids**) from their diet. All other amino acids can be constructed from these essential amino acids. The order in which the different amino acids are linked together to form proteins is controlled by genes on the DNA.

<p><b>Structure of Amino Acids</b></p> <p>There are over 150 amino acids found in cells, but only 20 occur commonly in proteins. The remaining, non-protein amino acids have specialized roles as intermediates in metabolic reactions, or as neurotransmitters and hormones. All amino acids have a common structure (see right). The only difference between the different types lies with the 'R' group in the general formula ('R' stands for radical). This group is variable, which means that it is different in each kind of amino acid.</p>	<p><b>General Structure of an Amino Acid</b></p> 
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1. Explain what is meant by essential amino acid.
2. On the general structure of an amino acid shown above, circle and label the carboxyl group. The carboxyl group makes the molecule behave like a weak acid (hence "amino **acid**").
3. On the general structure of an amino acid shown above, circle and label the amine group (hence "**amino acid**").
4. What is the chemical formula for a generalized amino acid?
5. How is the chemical make up of amino acids different from lipids and carbohydrates?
6. What makes each of the 20 amino acids found in proteins unique?

<p><b>Properties of Amino Acids</b></p> <p>Three examples of amino acids with different chemical properties are shown right, with their specific 'R' groups outlined. The 'R' groups can have quite diverse chemical properties.</p>	 <p style="text-align: center;"><b>cysteine</b></p>	 <p style="text-align: center;"><b>lysine</b></p>	 <p style="text-align: center;"><b>aspartic acid</b></p>
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7. Circle the 'R' group on each of the amino acids shown in the previous table.

8. In the spaces below, draw each amino acid. Use two colors, one for the structure common to all amino acids, and one for the 'R' group on each amino acid.

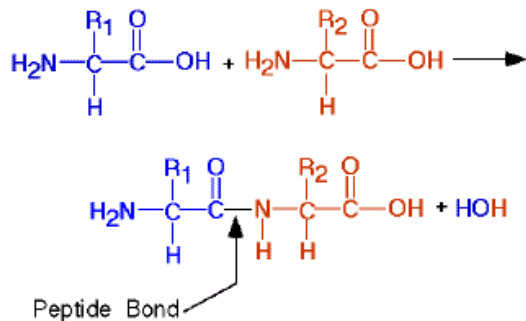
<b>Amino acids are grouped according to the chemical properties of the 'R' group.</b>		
<b>Nonpolar R group</b> hydrophobic	Glycine (Gly)	Methionine (Met)
	Alanine (Ala)	Phenylalanine (Phe)
	Valine (Val)	Tryptophan (Trp)
	Leucine (Leu)	Proline (Pro)
	Isoleucine (Ile)	

<b>Polar R group</b> hydrophilic	Serine (Ser)	Tyrosine (Tyr)
	Threonine (Thr)	Asparagine (Asn)
	Cysteine (Cys)	Glutamine (Gln)
<b>Ionic R group</b> hydrophilic	Aspartic acid (Asp)	Arginine (Arg)
	Glutamic acid (Glu)	Histidine (His)
	Lysine (Lys)	

9. For each amino acid with an ionic R group, indicate whether the ion is positively or negatively charged by adding a + or – sign next to the name in the table.

10. Explain why polar and ionic R groups are hydrophilic.

### Peptide Bond Formation



A **dipeptide** is formed when two amino acids bond together. Peptide bonds link amino acids together in long polymers called polypeptide chains. These chains may be functional units (complete by themselves) or they may need to join other polypeptide chains before they can carry out their function.

11. What molecule is the byproduct of peptide bond formation?
12. What type of reaction occurs when amino acids are joined to form a polypeptide?
13. Draw the molecular structure of the polypeptide chain created from the bonding of glycine to valine to serine to proline. Then circle the peptide bonds in the polypeptide chain.
14. When amino acids are joined together in a polypeptide, one end of the polypeptide chain is a free carboxyl group and at the opposite end is a free amino group. The ends are called the **N-terminus** and **C-terminus**. Label the N-terminus and C-terminus on your polypeptide drawn above.
15. A protein consisting of four amino acids undergoes hydrolysis. How many water molecules must be broken down and reattached to amino acids molecules during this process?