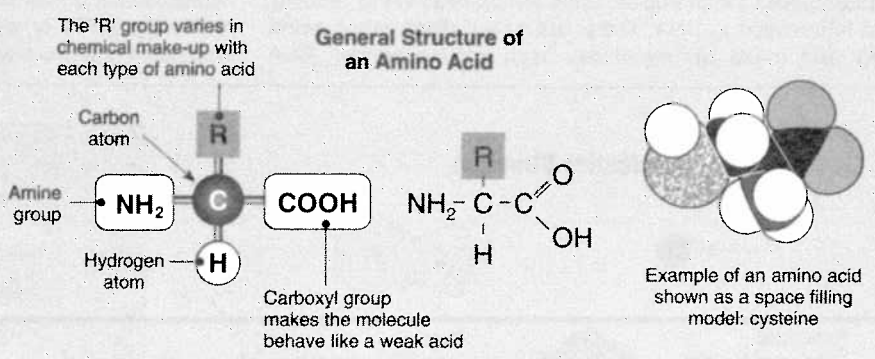
K 1

Amino Acids

Amino acids are the building blocks of proteins. Each carries and amino (NH_2) group, a carboxyl (acidic) group, and a side chain (R group) which is variable in structure. More than 150 different types of amino acids occur in cells, but only 20 are used from making proteins. Many, but not all, amino acids can be manufactured by our bodies. The ten amino acids that cannot be made must be taken in with our diet and are called **essential amino acids**. The order in which the amino acids are linked together into different proteins is controlled by the nucleus (i.e. DNA of the chromosomes) according to the needs of the cell.

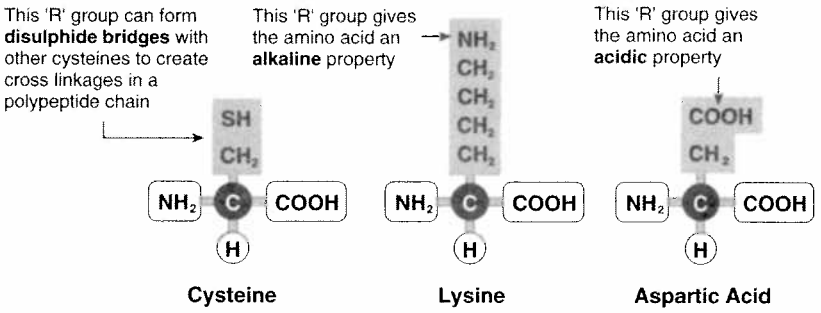
Structure of Amino Acids

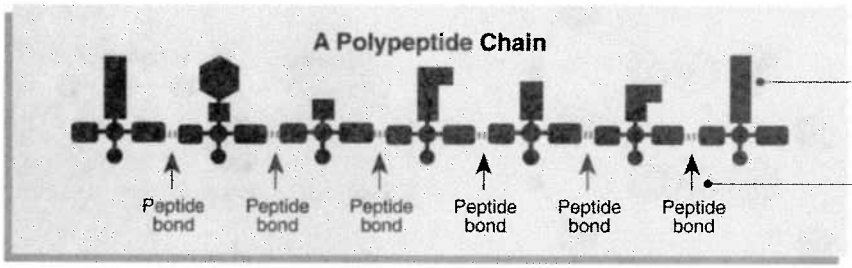
There are over 150 amino acids found in cells, but only 20 occur commonly in proteins. The remaining, non-protein amino acids have specialised roles as intermediates in metabolic reactions, or as neurotransmitters and hormones. All amino acids have a common structure (see right). The only difference between the different types lies with the 'R' group in the general formula. This group is variable, which means that it is different in each kind of amino acid.



Properties of Amino Acids

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.





The amino acids are linked together by peptide bonds to form long chains of up to several hundred amino acids - called polypeptide chains. These chains may be functional units (complete by themselves) or they may need to be joined to other polypeptide chains before they can carry out their function. In humans, not all amino acids can be manufactured by our body: ten must be taken in with our diet (eight in adults). These are the 'essential amino acids' (indicated by the symbol ◆ on the right).

Amino Acids Occurring In Proteins

Alanine	Glycine	Proline
Arginine	Histidine ◆	Serine
Asparagine	Isoleucine ◆	Threonine ◆
Aspartic Acid	Leucine ◆	Tryptophan ◆
Cysteine	Lysine ◆	Tyrosine ◆
Glutamine	Methionine ◆	Valine ◆
Glutamic Acid	Phenylalanine ◆	

1. Describe the biological functions of amino acids: _____

_____

_____

2. Describe what makes each of the 20 amino acids unique: _____

3. Describe why some amino acids are called 'essential amino acids': _____

_____

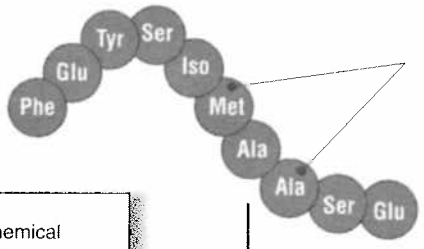
4. Name the type of bond that links amino acids together: _____

A 2

Proteins

Proteins are molecules of central importance in the chemistry of life. The account for more than 50% of the dry weight of most cells, and they are important in almost everything that cells do. Proteins are large, complex **macromolecules**, built up from a linear sequence of amino acids. They serve as structural components in cells and tissues, and, as enzymes, they control the metabolic reactions of the cell. They may occur in globular or fibrous forms. Globular proteins (below) are the most common.

The Structure of a Globular Protein



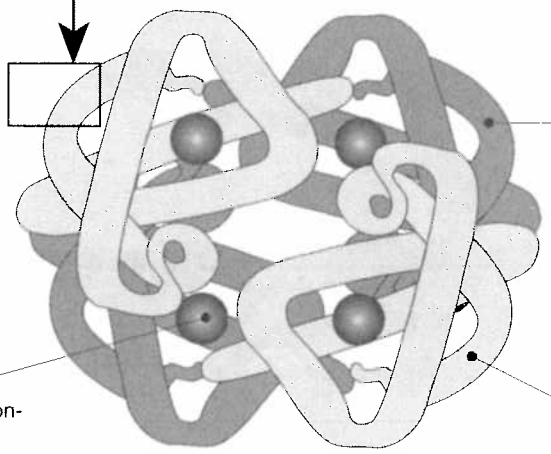
Amino Acids

Between hundreds and thousands of amino acids are linked together to form a long polypeptide chain. These chains fold up into a precise shape that give it a biological function.

Haemoglobin's chemical formula comprises:

3032	Carbon (**C**) atoms
4816	Hydrogen (**H**) atoms
872	Oxygen (**O**) atoms
780	Nitrogen (**N**) atoms
8	Sulphur (**S**) atoms
4	Iron (**Fe**) atoms

$C_{3032}H_{4816}O_{872}N_{780}S_8Fe_4$



Beta chain

Four polypeptide chains – two identical alpha chains and two identical beta chains – combine to form the complete protein

In haemoglobin, each polypeptide encloses an iron-containing **haem** structure

Alpha chain

Haemoglobin Molecule

The haemoglobin molecule above is a globule-shaped protein containing four polypeptide subunits. This protein is found in red blood cells and is responsible for transporting oxygen. About 80 million of these protein molecules are found in each red blood cell. Haemoglobin consists of 574 amino acids arranged in four polypeptide chains.

Protein Function	Description	Examples
Structural	Proteins can make up structural components of tissues and organs.	
Regulatory	Proteins can function as chemical messengers, called hormones, in the blood stream.	
Contractile	Some proteins form contractile elements in muscles and can cause movement.	
Immunological	Some proteins form antibodies that combat invading microbes.	
Transport	Proteins can act as carrier molecules, to transport molecules from one place to another.	
Catalytic	Some proteins can function as enzymes, thereby controlling cell metabolism.	

1. Using the following list, complete the table, placing the correct proteins for each function: *amylase, gamma globulin, insulin, collagen, actin, haemoglobin, lipase, lactase, keratin, myosin, myoglobin, trypsin, glucagon, growth hormone*

2. Name the basic building blocks of proteins: _____