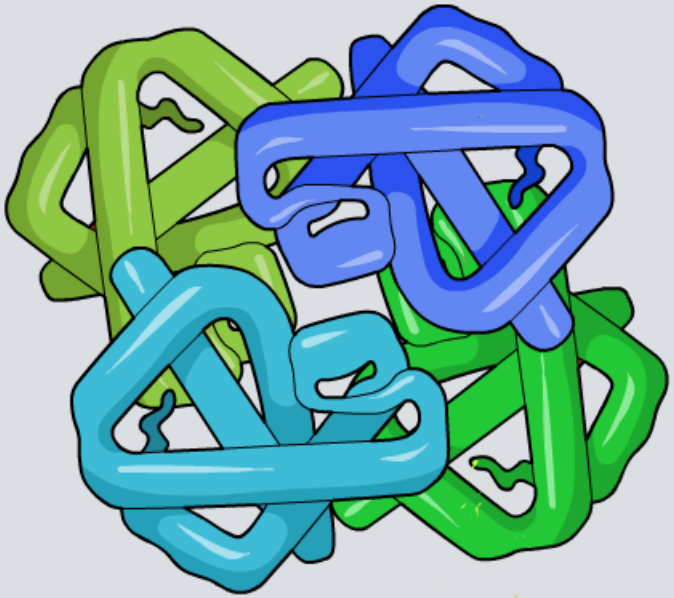
Proteins



Introducing proteins

Proteins are a diverse group of large and complex polymer molecules, made up of long chains of **amino acids**.

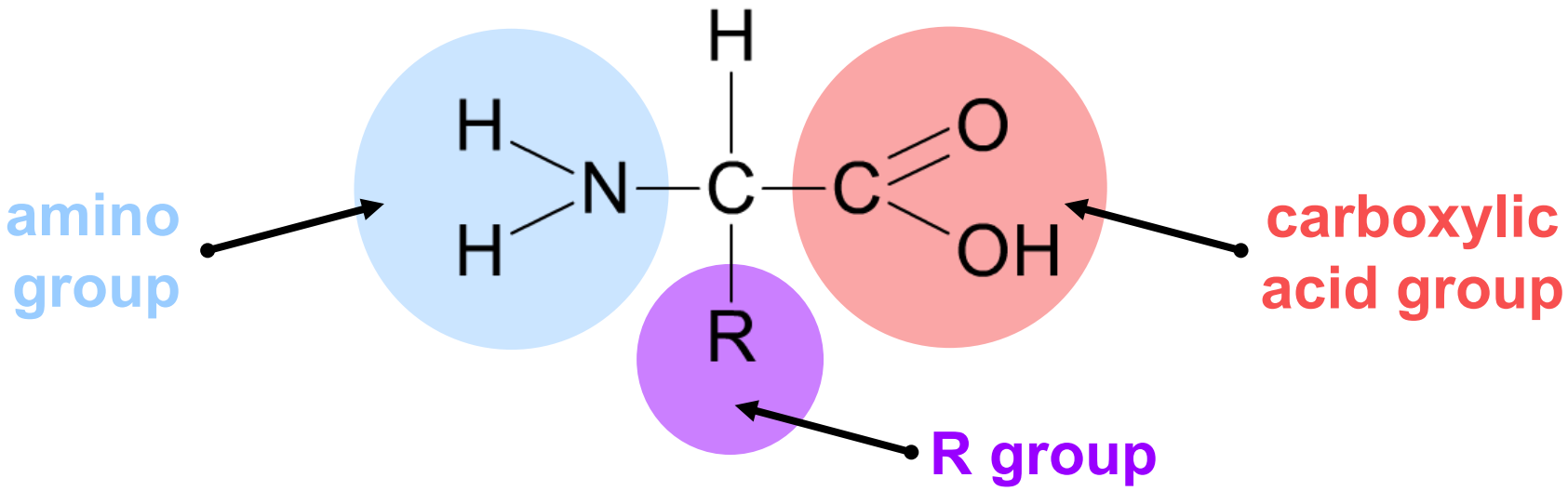
They have a wide range of biological roles, including:

- **structural:** proteins are the main component of body tissues, such as muscle, skin, ligaments and hair
- **catalytic:** all enzymes are proteins, catalyzing many biochemical reactions

- **signaling:** many hormones and receptors are proteins
- **immunological:** all antibodies are proteins.

The general structure of amino acids

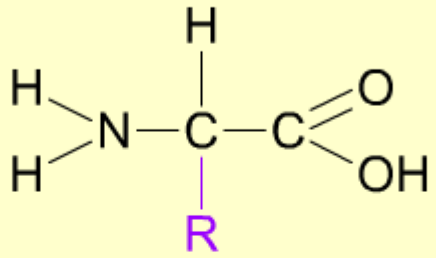
All amino acids have the same general structure: the only difference between each one is the nature of the **R group**. So the R group defines an amino acid.



The R group represents a side chain from the central “alpha” carbon atom, and can be anything from a simple hydrogen atom to a more complex ring structure.

The 20 naturally occurring amino acids

The 20 naturally-occurring amino acids



Click the name of an amino acid to find out more about its structure.

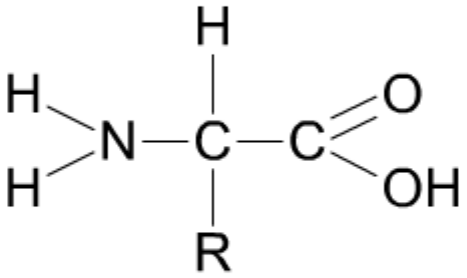
alanine	leucine
arginine	lysine
asparagine	methionine
aspartic acid	phenylalanine
cysteine	proline
glutamic acid	serine
glutamine	threonine
glycine	tryptophan
histidine	tyrosine
isoleucine	valine

Peptide bonds and dipeptides

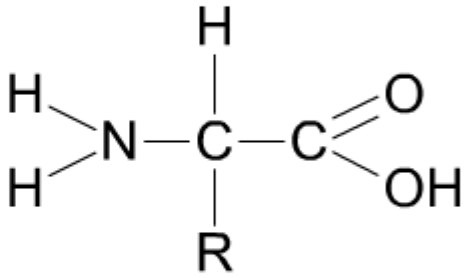
What is a peptide bond?

Two amino acids can join together to form a **dipeptide**, linked by a **peptide bond**.

Click "**play**" or either of the two amino acids to find out more.



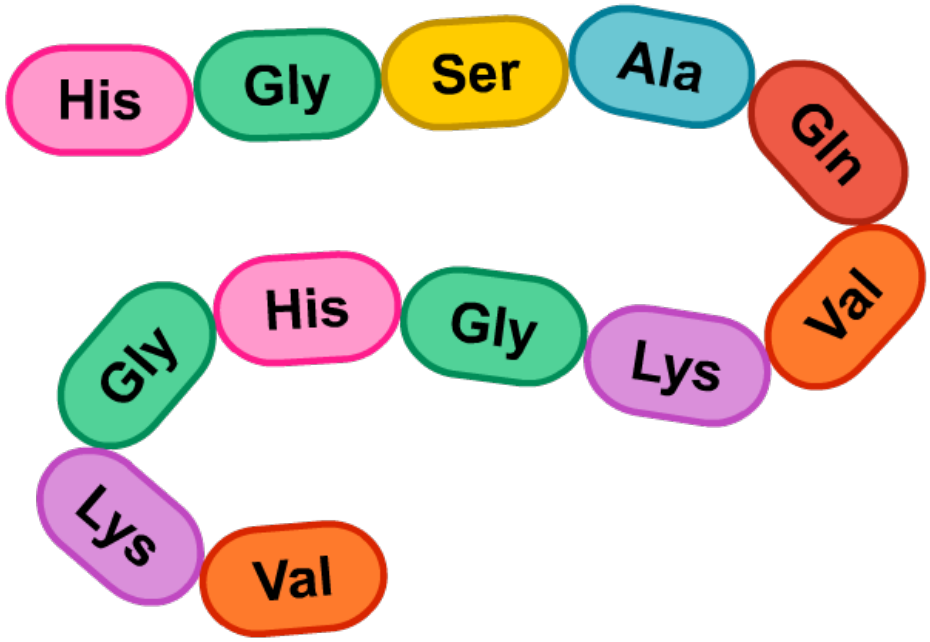
amino acid 1



amino acid 2

Polypeptides

When more amino acids are added to a dipeptide, a **polypeptide** chain is formed.



A protein consists of one or more polypeptide chains folded into a highly specific 3D shape.

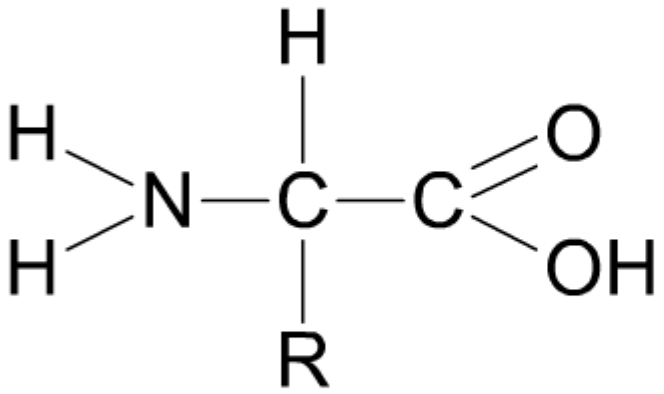
There are up to four levels of structure in a protein: **primary**, **secondary**, **tertiary** and **quaternary**. Each of these play an important role in the overall structure and function of the protein.

The structure of proteins

What is the structure of proteins?

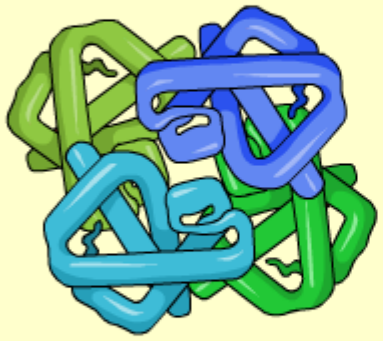
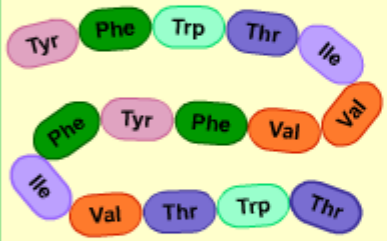
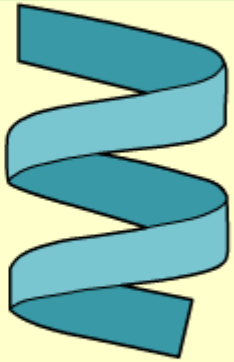
Proteins have a unique 3D structure that enable them to carry out specific functions.

Click "**play**" or the amino acid to find out about the different levels of structure.



Protein structure

What is the structural order of proteins?

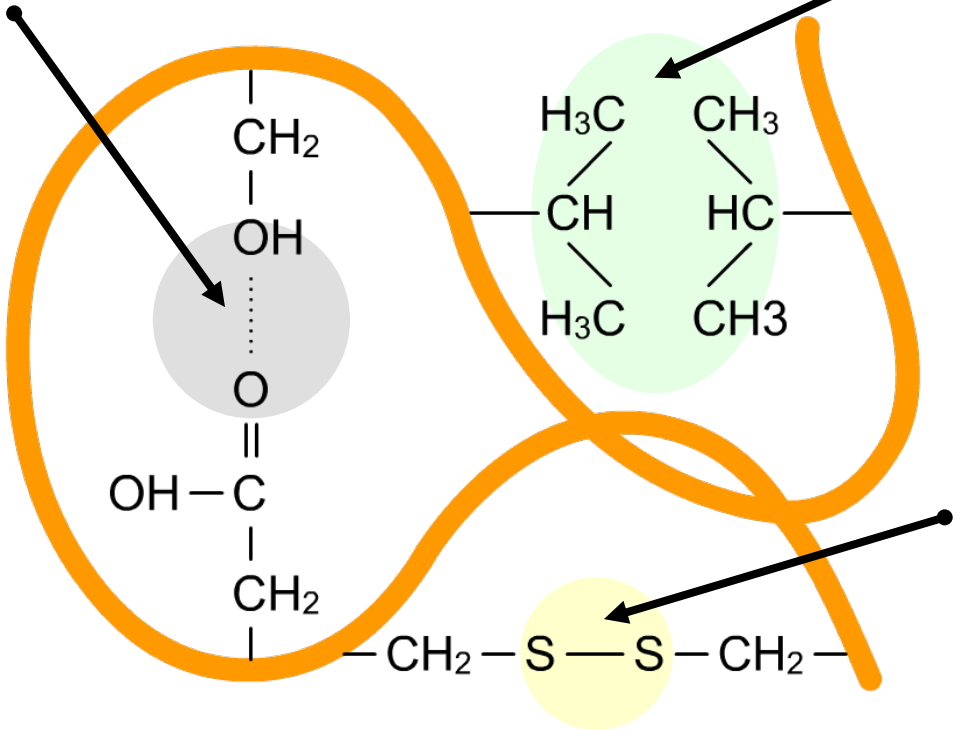
primary	secondary	tertiary	quaternary
			

Bonds in proteins

The 3D shape of a protein is maintained by several types of bond, including:

hydrogen bonds: involved in all levels of structure.

hydrophobic interactions: between non-polar sections of the protein.

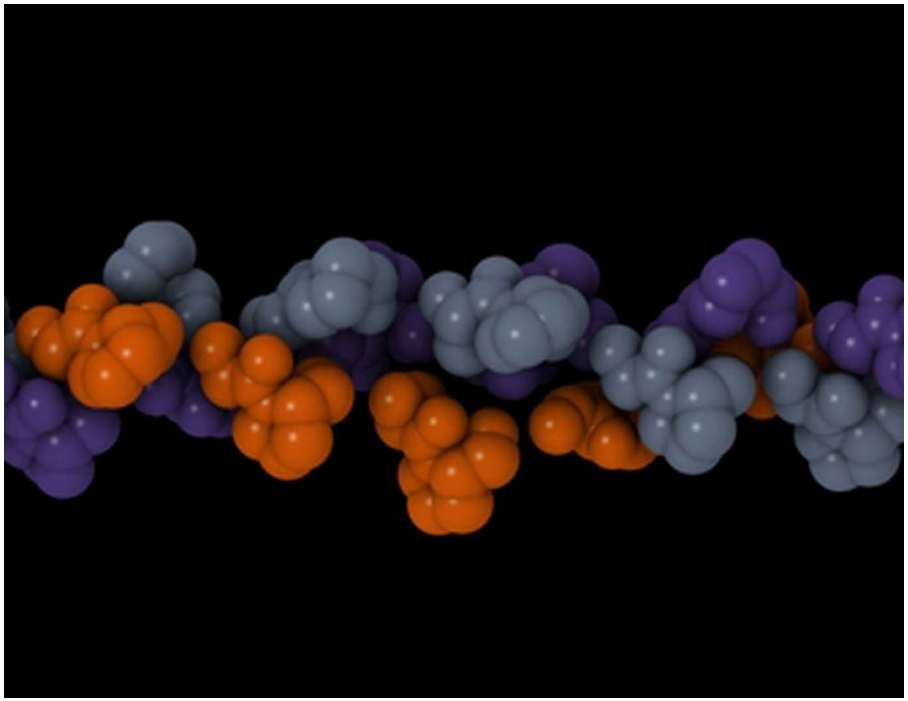


disulfide bonds: one of the strongest and most important type of bond in proteins. Occur between two cysteine amino acids.

Fibrous proteins

Fibrous proteins are formed from parallel polypeptide chains held together by cross-links. These form long, rope-like fibers, with high tensile strength and are generally insoluble in water.

- **collagen** – the main component of connective tissue such as ligaments, tendons and cartilage.
- **keratin** – the main component of hard structures such as hair, nails, claws and hooves.



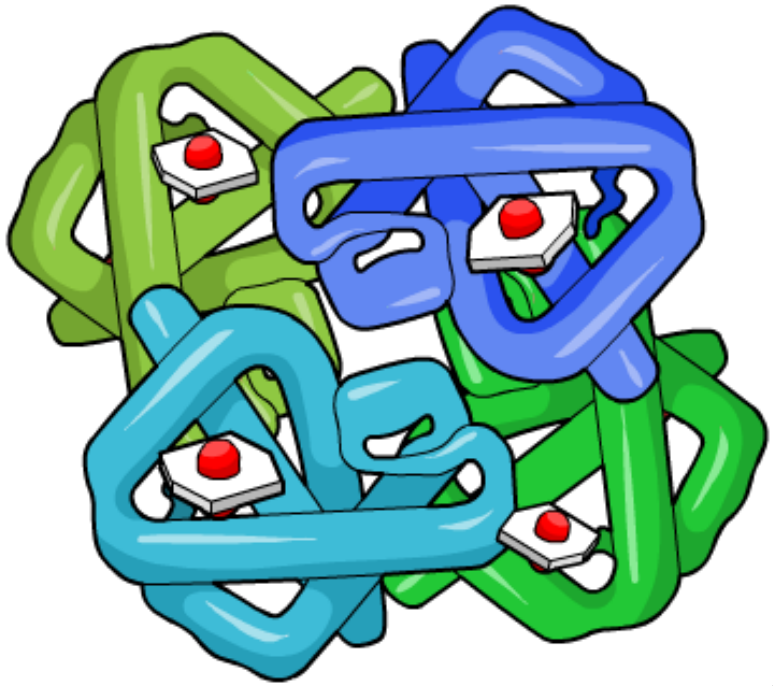
- **silk** – forms spiders' webs and silkworms' cocoons.

Globular proteins

Globular proteins usually have a spherical shape caused by tightly folded polypeptide chains.

The chains are usually folded so that hydrophobic groups are on the inside, while the hydrophilic groups are on the outside. This makes many globular proteins soluble in water.

- **transport proteins** – such as hemoglobin, myoglobin and those embedded in membranes.
- **enzymes** – such as lipase and DNA polymerase.
- **hormones** – such as estrogen and insulin.



Proteins: true or false?

Are these statements about proteins true or false?

1.	Collagen and keratin are globular proteins.	?
2.	Peptide bonds and hydrogen bonds are the only bonds that maintain a protein's shape.	?
3.	Polypeptides are made by condensation reactions between amino acids.	?
4.	Changing just a single amino acid in a polypeptide may stop the protein working properly.	?
5.	All proteins have a quaternary structure.	?

true false