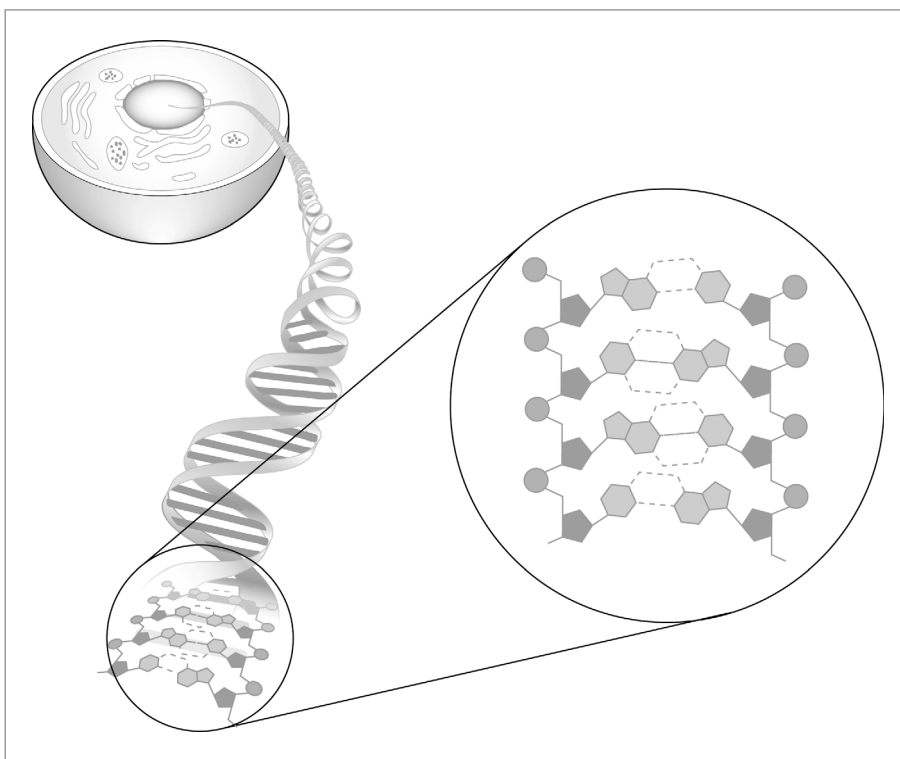


# Nucleic acids and protein synthesis

## DNA structure

The basic unit of DNA is a nucleotide.

- 1** Circle and label one nucleotide on the diagram of a DNA molecule, and label the sugar, phosphate group and base which make up this nucleotide.
- 2** Label the hydrogen bonds between the DNA strands.



▲ Diagram of a DNA molecule.

## Complementary base pairing in DNA

The bases on the two DNA strands pair with each other in a specific way. Adenine always pairs with Thymine, and Cytosine and Guanine go together. The bases pair in this way because together they need to be exactly the correct size and shape to form one of the 'rungs' of the DNA double helix.

### A Molecule of DNA:

|          |   |   |   |   |   |   |   |   |   |   |   |   |
|----------|---|---|---|---|---|---|---|---|---|---|---|---|
| Strand 1 | C | C | T | G | A | A | T | C | C | G | A | T |
| Strand 2 |   |   |   |   |   |   |   |   |   |   |   |   |

- 3 Fill in the letters representing the bases of strand 2, making sure that you enter the correct complementary base each time.

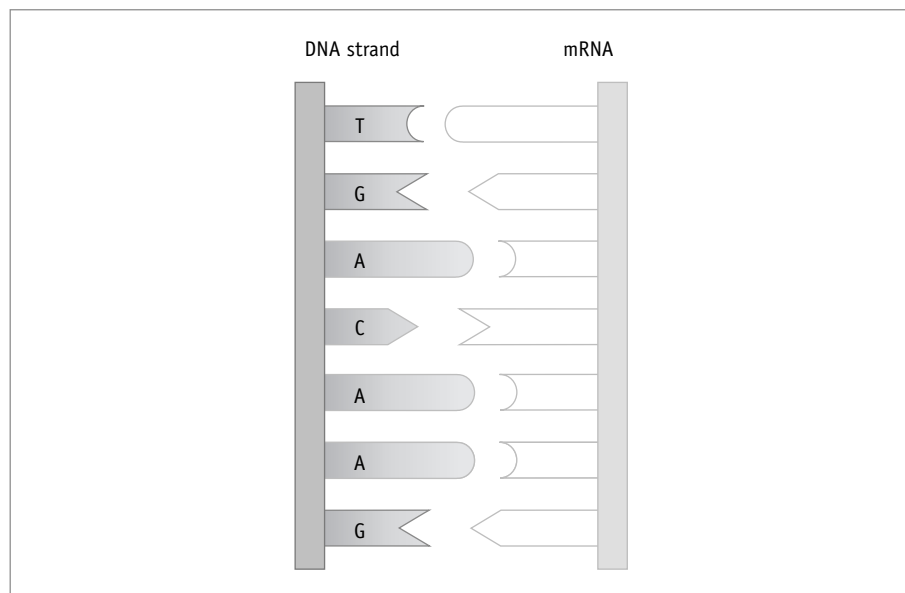
## Messenger RNA (mRNA)

- 4 During protein synthesis, the sequence of bases on the DNA is copied by complementary base-pairing of mRNA nucleotides in a process called .....
- 5 mRNA is another nucleic acid, differing from DNA in the following ways: (fill in the table to show the features of mRNA)

|                               | DNA         | mRNA |
|-------------------------------|-------------|------|
| Sugar present in nucleotides  | deoxyribose |      |
| Number of strands in molecule | 2           |      |
| Bases present in nucleotides  | A G C T     |      |

## Complementary base-pairing in transcription

- 6 Fill in the correct letters on the mRNA strand below.



## The Genetic Code

The table of the genetic code gives:

- the three-letter base code for all mRNA codons
- the corresponding three-letter abbreviation for the amino acid coded by the codon.

## Table of the Genetic Code

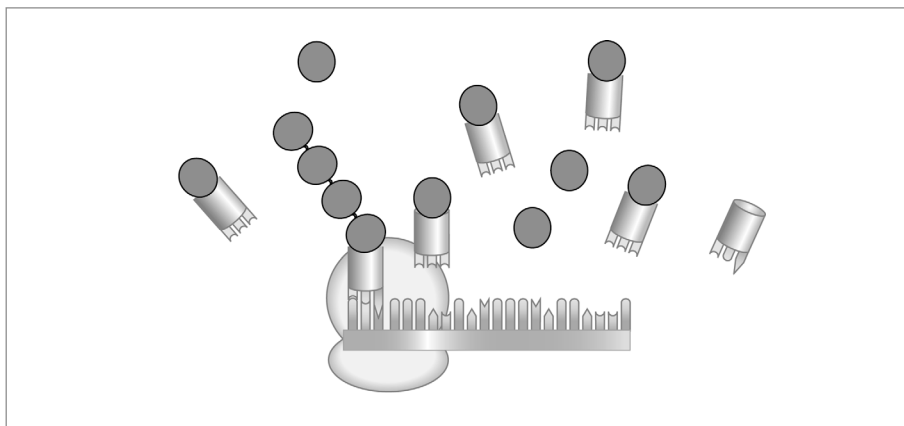
|                   |          |                          |                          |                            |                           |                  |                   |
|-------------------|----------|--------------------------|--------------------------|----------------------------|---------------------------|------------------|-------------------|
|                   |          | 2nd base in codon        |                          |                            |                           |                  |                   |
|                   |          | <b>U</b>                 | <b>C</b>                 | <b>A</b>                   | <b>G</b>                  |                  |                   |
| 1st base in codon | <b>U</b> | Phe<br>Phe<br>Leu<br>Leu | Ser<br>Ser<br>Ser<br>Ser | Tyr<br>Tyr<br>STOP<br>STOP | Cys<br>Cys<br>STOP<br>Trp | U<br>C<br>A<br>G | 3rd base in codon |
|                   | <b>C</b> | Leu<br>Leu<br>Leu<br>Leu | Pro<br>Pro<br>Pro<br>Pro | His<br>His<br>Gln<br>Gln   | Arg<br>Arg<br>Arg<br>Arg  | U<br>C<br>A<br>G |                   |
|                   | <b>A</b> | Ile<br>Ile<br>Ile<br>Met | Thr<br>Thr<br>Thr<br>Thr | Asn<br>Asn<br>Lys<br>Lys   | Ser<br>Ser<br>Arg<br>Arg  | U<br>C<br>A<br>G |                   |
|                   | <b>G</b> | Val<br>Val<br>Val<br>Val | Ala<br>Ala<br>Ala<br>Ala | Asp<br>Asp<br>Glu<br>Glu   | Gly<br>Gly<br>Gly<br>Gly  | U<br>C<br>A<br>G |                   |

- 7** Write in the codons which will produce the following sequence of amino acids.

| Amino acid | Val |  |  | His |  |  | Leu |  |  | Thr |  |  | Pro |  |  | Glu |  |  |
|------------|-----|--|--|-----|--|--|-----|--|--|-----|--|--|-----|--|--|-----|--|--|
| Codons     |     |  |  |     |  |  |     |  |  |     |  |  |     |  |  |     |  |  |

## Translation

- 8** In the first diagram of translation below, label the following: tRNA, tRNA bound to amino acid, mRNA, amino acid, polypeptide chain, ribosome.
- i** Describe the process of translation in your own words referring to the sequence of diagrams





- 9** The base sequence in the section of mRNA that codes for one of the amino acids in haemoglobin has the codon GAA.
- i** What is the DNA triplet which will have coded for this RNA codon?
- 10** In individuals who have sickle cell anaemia, this codon is changed from GAA to GUA.
- i** Using the table of the genetic code above, how will this alter the primary structure of amino acids in the polypeptide chain?
- ii** Suggest why individuals with this mutation have haemoglobin that has a different 3-D structure to 'normal' haemoglobin.
- iii** If this disease is passed on by inheritance, suggest which of the following is more likely to be true, and explain your answer:
- a** there has been a mistake during transcription, where the DNA code is copied to form mRNA.
- b** the mistake was made during DNA replication where DNA is copied to form new DNA molecules before cell division.