

Protein synthesis and gene variants

Revision notes · Explain how the order of bases decides protein shape, describe transcription and translation, and how gene variants change phenotype.

For Edexcel GCSE Biology 1BI0 and Combined Science 1SC0. **Triple only** is not in Combined Science. **Higher tier** is only on the Higher paper.

Protein synthesis and gene variants **Spec 3.7B-3.10B** **Triple only** **Higher tier**

From base order to protein shape **Spec 3.7B**

A gene is a section of DNA that codes for a specific protein. Proteins are made of chains of **amino acids**. The **order of bases** in a section of DNA decides the **order of amino acids** in the protein.

1. The sequence of bases in the gene decides the order of amino acids.
2. The chain of amino acids folds up.
3. The way the chain folds depends on the order of the amino acids, so it produces a **specifically shaped protein**.

The shape of a protein matters because it decides what the protein can do. For example, an **enzyme** has an active site with a shape that fits its substrate. A different order of bases would give a different order of amino acids, a differently folded protein and so a different shape.

Exam tip: Show the full chain of ideas in your answer: order of bases, then order of amino acids, then folding, then specific shape, then function.

Protein synthesis: transcription and translation **Spec 3.8B**

Protein synthesis has two main stages. In **transcription**, a copy of the gene is made as a strand of mRNA. In **translation**, the mRNA is used to build a polypeptide at a ribosome.

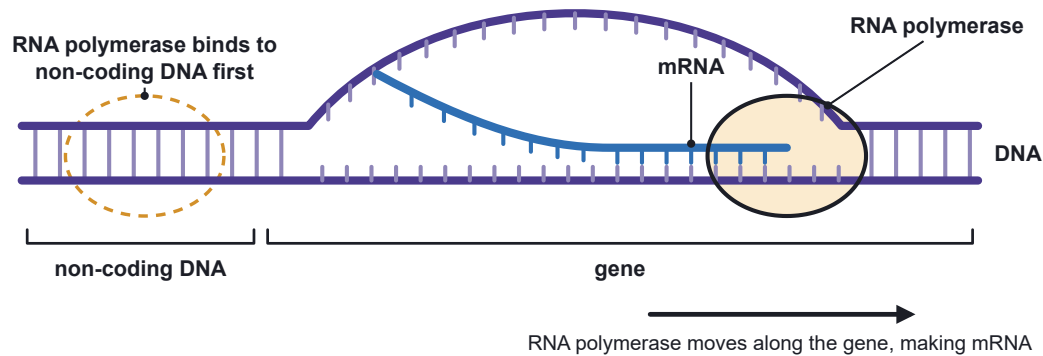
Transcription (in the nucleus)

1. **RNA polymerase** binds to the non-coding DNA located in front of a gene.
2. RNA polymerase produces a complementary mRNA strand from the coding DNA of the gene.
3. The mRNA moves out of the nucleus into the cytoplasm.

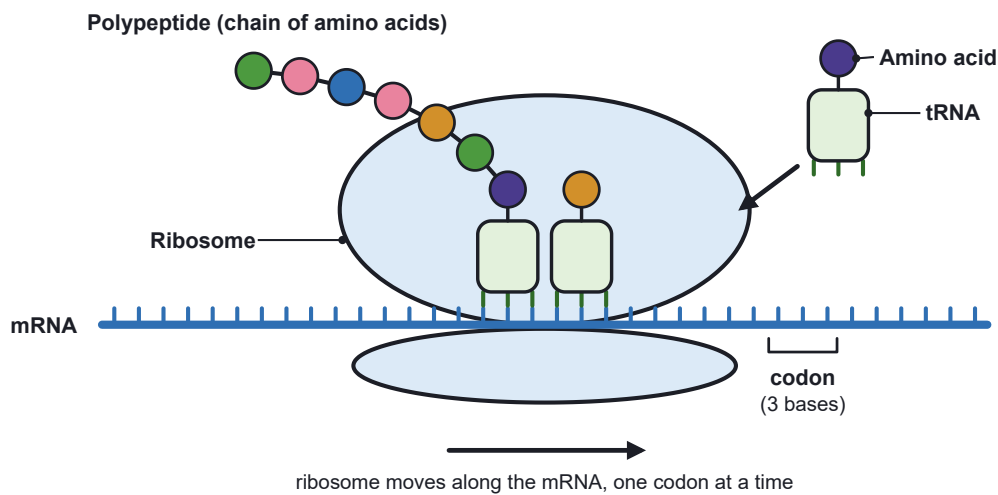
Translation (at a ribosome)

1. The mRNA attaches to a ribosome.
2. The mRNA is read in triplets of bases called **codons**. Each codon codes for a specific amino acid.
3. tRNA molecules transfer amino acids to the ribosome. Each tRNA carries the amino acid that matches a codon on the mRNA.
4. The amino acids are linked together to form a **polypeptide**, which folds into a protein.

1 Transcription (in the nucleus)



2 Translation (at a ribosome)



Transcription makes mRNA from DNA; **translation** makes a polypeptide from mRNA at a ribosome.

Common mistake: Do not mix up the two stages. Transcription makes mRNA from DNA. Translation makes a polypeptide from mRNA.

Genetic variants in non-coding DNA Spec 3.9B

A **genetic variant** is a difference in the DNA sequence. Variants in the **non-coding DNA** in front of a gene can affect the **phenotype** without changing the protein itself.

1. The variant is in the non-coding DNA, where RNA polymerase binds.
2. This can change how well RNA polymerase **binds**.
3. More or less mRNA is made, so the **quantity of protein** produced is altered.
4. The change in the amount of protein can change the phenotype.

Exam tip: A variant in non-coding DNA changes how much protein is made. It does not change the amino acid sequence of the protein.

Genetic variants in coding DNA Spec 3.10B

Variants in the **coding DNA** of a gene can change the base sequence that codes for the protein.

1. A variant in the coding DNA can alter the **sequence of amino acids**.
2. The polypeptide may then fold into a different shape.
3. A protein with a different shape may have different **activity**. For example, an enzyme's active site may no longer fit its substrate.
4. The change in the activity of the protein can affect the phenotype.

Where a variant is and what it changes

Where the variant is	What changes	Effect on phenotype
Non-coding DNA in front of the gene	Binding of RNA polymerase	Quantity of protein produced is altered
Coding DNA of the gene	Sequence of amino acids	Activity of the protein produced is altered

Quick check

1. What decides the order of amino acids in a protein?
2. What does RNA polymerase do?
3. What is a codon?
4. What carries amino acids to the ribosome?
5. How can a variant in non-coding DNA affect phenotype?

Quick check answers

Protein synthesis and gene variants

- 1 . The order of bases in a section of DNA (the gene).
- 2 . It binds to non-coding DNA in front of a gene and produces a complementary mRNA strand from the coding DNA.
- 3 . A triplet of bases in mRNA that codes for a specific amino acid.
- 4 . tRNA.
- 5 . It can change the binding of RNA polymerase and so alter the quantity of protein produced.