

Protein synthesis

Transcription

Protein synthesis

Base pairing in transcription

Protein synthesis

Why must DNA templates be stable?

Protein synthesis

Why is transcription a key stage of gene expression?

Protein synthesis

Translation

Protein synthesis

Where do mRNA and tRNA bind on the ribosome?

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Codon vs anticodon

Protein synthesis

How does the polypeptide grow during elongation?

Template A pairs with RNA U; T with A; C with G; G with C. Held by hydrogen bonds.

The synthesis of RNA using a DNA template, carried out by RNA polymerase.

It is the first stage, so genes can be switched on or off by controlling transcription.

In non-dividing somatic cells the same sequences are transcribed for the life of the cell, so transcription must not change them.

mRNA binds to the small subunit; two tRNAs can bind simultaneously to the large subunit.

The synthesis of a polypeptide from mRNA: the mRNA base sequence is translated into an amino acid sequence.

A peptide bond links the next amino acid to the chain, then the ribosome moves one codon along the mRNA.

Codon: three bases on mRNA coding for one amino acid. Anticodon: complementary three bases on tRNA.

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Why is the genetic code a triplet code?

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Degeneracy and universality

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Start codon and stop codons

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Sickle-cell mutation

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Effect of haemoglobin S

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Direction of transcription and translation

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The promoter

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Examples of non-coding DNA

Degeneracy: more than one codon per amino acid. Universality: the same codons code for the same amino acids in almost all organisms.

4 bases and 20 amino acids: pairs give 16 combinations (too few); triplets give 64.

Base substitution in the haemoglobin beta-chain gene: codon GAG → GUG, glutamic acid → valine at the sixth amino acid.

Start: AUG (methionine). Stop: UAA, UAG, UGA.

Both 5' to 3': RNA grows at its 3' end; ribosomes move from the 5' end to the 3' end of mRNA.

At low oxygen it forms long fibres that distort red blood cells into rigid sickle shapes.

Regulators of gene expression, introns, telomeres, and genes for rRNA and tRNA.

A DNA sequence before a gene where transcription factors bind, allowing RNA polymerase to bind and start transcription.

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Post-transcriptional modification

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Alternative splicing

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Steps of initiation of translation

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A, P and E sites

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Pre-proinsulin to insulin

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Role of proteasomes

Splicing different combinations of exons so one gene codes for different polypeptides.

Introns removed and exons spliced together; 5' cap and 3' polyA tail added to stabilise the mRNA.

A: incoming tRNA with amino acid. P: tRNA holding the growing polypeptide. E: exit of tRNA without amino acid.

Small subunit binds 5' end of mRNA, moves to AUG; initiator tRNA (Met) pairs; large subunit attaches; next tRNA binds.

Break down unwanted or faulty proteins so amino acids are recycled; a functional proteome needs constant breakdown and synthesis.

Signal sequence removed → proinsulin (folds, disulfide bonds form); C-peptide removed → insulin of A and B chains.