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Commentary

Protein Synthesis: Methods Involved in Transcripting the Genome

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DESCRIPTION

Proteins are macromolecules built up the of amino acid monomers which play a crucial role in living organisms. Each cell contains hundreds to thousands of proteins with specific structural and functional roles. Every component of an organism, including the production of proteins, is controlled by DNA in the chromosomes. Proteins are manufactured on ribosomes which are located in the cell cytoplasm.

Transcription and translation are the two stages involved in protein synthesis.

Transcription

Ribonucleic Acid (RNA) polymerase reads a Deoxyribose Nucleic Acid (DNA) sequence and produces a complementary, antiparallel RNA strand as part of transcription. Contrary to DNA replication, transcription finally results in a complement of RNA that contains uracil (U) in place of thymine (T) in a DNA complement. It is the first leading step to gene expression.

The stretch of DNA transcribed into an RNA molecule is called a transcription unit and encodes atleast one gene. If the gene transcribed encodes for a protein, the messenger RNA (mRNA) produced as a result of transcription process, which will then be used to create that protein *via* the process of translation. Only one of the 2 DNA strands called the template strand is used for transcription. As its sequence matches the newly formed RNA transcript, the other DNA strand is known as the coding strand. Transcription is divided into 3 stages such as initiation, elongation and termination.

Initiation: The initiation of translation in eukaryotes is complex, involving atleast 10 eukaryotic initiation factors and divided into 4 steps such as ribosomal dissociation, formation of 43s preinitiation complex, formation of 48s initiation complex and formation of 80s initiation complex.

Elongation: Ribosomes elongate the polypeptide chain by a sequential addition of amino acids. The amino acid sequence is determined by the order of the codons in the specific mRNA. Elongation may be divided into 3 steps such as binding of aminoacyl t-RNA to A-site, peptide bond formation and translocation.

Termination: The stop codon terminates the growing polypeptides. Rho-independent and Rho-dependent transcription termination mechanisms are the strategies employed by bacteria.

In Rho-independent transcription, when a newly synthesized RNA molecule produces a G-C rich hairpin loop followed by a run of U's, which makes it to separate from the DNA template, RNA transcription ceases.

In the Rho-dependent type of termination, Rho, a protein factor destabilizes the interaction between the template and the mRNA, thus releasing the newly synthesized mRNA from the elongation complex.

Translation

Translation is the production of proteins by decoding mRNA produced in transcription. It occurs in the cytoplasm where the ribosomes are located. Ribosomes are made of small and large subunits which surrounds the mRNA.

According to the genetic code, mRNA is decoded to produce a specific polypeptide in translation. This uses an mRNA sequence as a template to guide the synthesis of a chain of amino acid that form a protein. Many types of transcribed RNA, such as transfer RNA, ribosomal RNA and small nuclear RNA are not necessarily translated into an amino acid sequence. Translation proceeds in 4 phases such as activation, initiation, elongation and termination. Aminoacids are brought together to ribosomes and are assembled into proteins.

Properties of genetic code

- The code is universal. All prokaryotic and eukaryotic organisms use the same codon to specify each amino acid.
- The code is triplet. 3 nucleotides make 1 codon. 61of them code for amino acids and other 3 (UAA, UAG, UGA) are nonsense codons or chain termination codons.
- The code is non-overlapping. A base in mRNA is not used for 2 different codons.
- The code is commaless.
- The code is non ambiguous. A particular codon will always code for the same aminoacid, wherever it is found.

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