"One Gene, One Polypeptide"

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Purpose of Protein Synthesis

Protein synthesis is the process of creating proteins, molecules that are made up of amino acids, and are essential for doing tasks within cells. This process is divided up into two major parts, transcription and translation, as well as processing in eukaryotic cells.

Steps

Overview

1. RNA polymerase attaches to promoter region
2. RNA polymerase unwinds DNA strands
3. RNA polymerase attaches nucleotides to non-coding DNA strand
4. RNA polymerase forms phosphodiester bonds
5. RNA polymerase rewinds DNA behind it
6. Upon reaching a terminator, RNA polymerase detaches from the DNA
7. 5' cap is added on to the mRNA
8. Poly tail is added on to the mRNA
9. Spliceosomes splice introns
10. mRNA leaves the nucleus through a nucleur pore
11. mRNA seeks out a ribosome
12. Ribosome attaches to the 5' cap
13. Ribosome moves along the mRNA in a 5' to 3' direction
14. When ribosome reads a start codon, ribosome binds tRNA to the mRNA
15. Ribosome catalyses formation of peptide bonds
16. Continues until ribosome reads a stop codon
17. Polypeptide chain is released and folds into a protein

Transcription

> Transcription: The process of producing a mRNA sequence from a DNA template.

In eukaryotes, transcription happens in the nucleus, where DNA, the genetic information for life, is contained. It begins when an enzyme known as RNA polymerase attaches to the promoter region of a DNA, and then unwinds and seperates the DNA strands by breaking the weak hydrogen bonds between the nucleotides. RNA polymerase then attaches free RNA nucleotides to the, now free, nitrogenous bases of the template strand, the DNA stand that runs in a 3' to 5' direction. Whilst doing so, RNA polymerase catalyses the formation of phosphodiester bonds between adjacent nucleotides. As RNA polymerase moves along the DNA strand, it detaches the RNA behind it and rewinds the DNA. This goes on until it reaches a termination point, at which the RNA polymerase will detach from the DNA. Then it will move on into processing.

Processing

> RNA Processing: The process of manipulating the mRNA sequence to make it suitable for protein synthesis.

In eukaryotes, the newly made RNA sequence is not yet ready be processed by ribosomes. This pre-mRNA, still needs to undergo some alteration to become mature mRNA. On the 5' end of the pre-mRNA, a 5' cap is added on, which prevents enzymes from hydrolising the mRNA sequence, and helps the ribosome to identify the start of the mRNA. This cap is made up of modified guanosne triphosphates. On the 3' end of the pre-mRNA, a poly(A) tail is added on, a

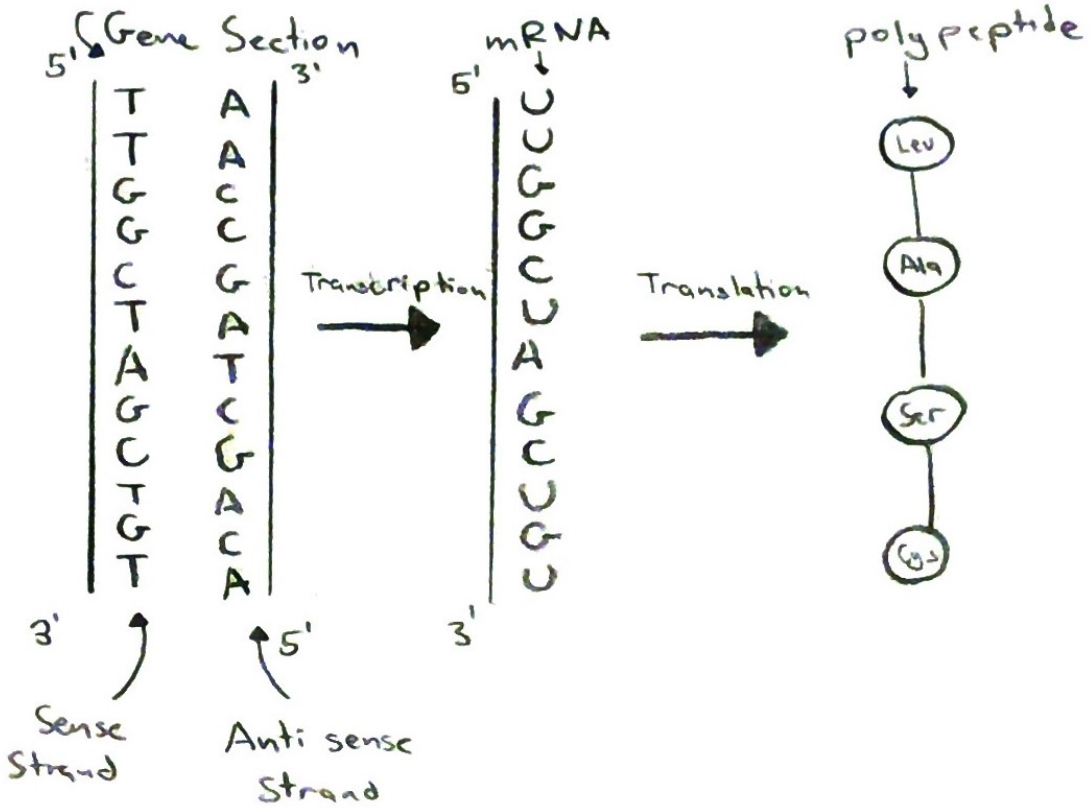
string of between 30 to 200 adenine molecules. This too stops enzymes from hydrolising the mRNA string. After that, RNA splicing begins, a process that removes introns, which are segments of RNA that do not code for an amino acid. There are two ways that splicing may occur. There is self-splicing, an uncommon occurance where RNA attaches to itself, and removes itself from the RNA sequence. There is also splicesome regulated splicing, where a spliceosome, a molecule made to remove introns, splices intron.

Translation

> Translation: The process of fabricating a polypeptide chain using mRNA information

The mRNA leaves the nucleus through the nuclear pore, and is now in the cytoplasm of a cell, where it will seek out a ribosome, a macromolecular machine that will create a polypeptide chain, a sequence of amino acids, using the information stored in the mRNA. A ribosome will attach to the 5' cap attached to the mRNA sequence, and will begin to move along the mRNA in a 5' to 3' direction, reading each codon. When it identifies a start codon (AUG), the ribosome will begin to bind tRNA anticodons to mRNA codons, and will catalyses the formation of peptide bonds between adjacent amino acids as a condensation reaction. This will continue until the ribosome reads a stop codon (UAA, UAG, or UGA), when the ribosome will cease to attach more tRNA anticodons to the mRNA sequence. The string of amino acids, also known as a polypeptide chain, will now be released, and fold itself into a protein.

One Gene, One Polypeptide



A gene is a section of DNA that codes for polypeptides. In the process, we can see that a gene in our DNA becomes an mRNA sequece and then is translated into an polypeptide chain. "One Gene, One Polypeptide" refers to the concept that each one gene is transformed into one polypeptide sequence only. However, there are exceptions to this. During RNA splicing that occurs during the processing of RNA sequences, an event called alternate splicing may occur. This is the splicing of specific extrons, pieces of the genetic code that do code for amino acids, which can lead to different polypeptides being translated with the same DNA template.

Bibliography

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