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# From DNA Replication to Protein Synthesis: Unraveling the Central Dogma of Biochemistry

**Fraser Stefano***

*Department of Biochemistry, Slovak University of Technology in Bratislava, Bratislava, Slovakia*

## Abstract

The field of biochemistry has been instrumental in unlocking the secrets of life, revealing the intricate processes that govern the functioning of living organisms. One of the fundamental concepts in biochemistry is the central dogma, which outlines the flow of genetic information from DNA to RNA to protein. Understanding this dogma is essential for comprehending the complex mechanisms behind life itself. The central dogma of biochemistry can be summarized in three key steps: DNA replication, transcription and translation. Each of these processes plays a crucial role in ensuring the accurate transmission and utilization of genetic information. The central dogma remains a cornerstone of biochemistry, guiding our exploration of life's most fundamental processes.

**Keywords:** Biochemistry • Protein synthesis • Central dogma

## Introduction

The Central Dogma of Biochemistry is a fundamental concept in molecular biology that describes the flow of genetic information within living organisms. Proposed by Francis Crick in 1958, it outlines the sequential transfer of information from DNA to RNA to protein. The term "central dogma" emphasizes the central role of DNA in storing genetic information and its transmission to functional proteins [1]. The journey begins with DNA replication, a fundamental process that occurs during cell division. DNA, the molecule that carries the genetic code, is composed of two complementary strands coiled into a double helix structure. Before a cell can divide, it must replicate its DNA to ensure that each daughter cell receives a complete set of genetic instructions [2].

## Literature Review

DNA replication is the process by which a cell duplicates its DNA before cell division. The double-stranded DNA molecule unwinds and each strand serves as a template for the synthesis of a complementary strand. Enzymes called DNA polymerases catalyze the addition of nucleotides to form new DNA strands, ensuring that the genetic information is faithfully copied. The result is two identical DNA molecules, each containing one original strand and one newly synthesized strand. Once DNA has been faithfully replicated, the next step in the central dogma is transcription [3]. Transcription is the process by which the genetic information encoded in DNA is copied into a single-stranded molecule called RNA. This RNA molecule, known as messenger RNA (mRNA), carries the instructions necessary for protein synthesis.

Transcription is the process by which genetic information in DNA is used to synthesize RNA molecules. It involves the synthesis of a single-stranded RNA molecule, known as messenger RNA (mRNA), using a DNA template. RNA polymerase, an enzyme that recognizes specific DNA sequences called promoters, initiates transcription by binding to the DNA strand. It then "reads" the DNA sequence and assembles a complementary RNA molecule. Unlike DNA, RNA contains the nucleotide Uracil (U) instead of Thymine (T) [4]. TranscriptFFion is essential because it allows the information stored in DNA to be carried from the nucleus (in eukaryotes) or from the nucleoid region (in prokaryotes) to the cytoplasm, where protein synthesis occurs. With the mRNA molecule in hand, the final step in the central dogma is translation. Translation is the process by which the genetic information contained in mRNA is used to synthesize proteins. Proteins are the workhorses of the cell, performing a wide array of functions necessary for life.

## Discussion

Translation is the process by which the information encoded in mRNA is used to synthesize proteins. It takes place on cellular structures called ribosomes. Ribosomes read the genetic code carried by mRNA in groups of three nucleotides called codons. Each codon specifies a particular amino acid. Transfer RNA (tRNA) molecules, with their characteristic cloverleaf shape, bring the corresponding amino acids to the ribosome [5]. The ribosome links the amino acids together in the correct sequence, forming a polypeptide chain. This process continues until a stop codon is encountered, signaling the end of protein synthesis. The newly synthesized polypeptide then undergoes further modifications, such as folding and post-translational modifications, to acquire its final functional shape. As the ribosome moves along the mRNA molecule, it catalyzes the formation of peptide bonds between adjacent amino acids, forming a growing polypeptide chain [6]. This process continues until the ribosome reaches a stop codon on the mRNA, signaling the end of protein synthesis. The newly synthesized protein is then folded into its functional shape, ready to carry out its designated tasks within the cell.

## Conclusion

The central dogma of biochemistry provides a framework for understanding how genetic information flows from DNA to RNA to protein. DNA replication ensures the faithful transmission of genetic material during cell division. Transcription converts DNA into mRNA, while translation uses mRNA as a template to synthesize proteins. These processes work in harmony to sustain life and underpin the remarkable complexity of biological systems. The unraveling of the central dogma has revolutionized our understanding of genetics, development, evolution and disease. By deciphering the mechanisms behind DNA replication, transcription and translation, scientists have gained invaluable insights into the workings of the cell and have paved the way for breakthroughs in fields such as medicine, biotechnology and genetic engineering.

***Address for Correspondence:** Fraser Stefano, Department of Biochemistry, Slovak University of Technology in Bratislava, Bratislava, Slovakia, E-mail: fraserstefano@gmail.com*



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## Conflict of Interest

None.

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