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The Importance of DNA Replication

Franziska Bleichert*

Department of Biochemistry, Vanderbilt University, Nashville, USA

Introduction

DNA replication is the process by which DNA makes a copy of itself before cell division. It is an essential process for the survival of all living organisms. DNA replication is a complex process that involves several enzymes, proteins, and molecular machinery. In this article, we will discuss the steps involved in DNA replication and the importance of DNA replication in maintaining the genetic information of an organism.

Description

Steps of DNA replication

There are several steps involved in DNA replication. These steps can be broadly classified into three stages: Initiation, elongation, and termination.

Initiation

The first step in DNA replication is initiation. This stage involves the unwinding of the double helix structure of DNA. The enzyme helicase is responsible for unwinding the DNA. Helicase breaks the hydrogen bonds between the complementary base pairs of DNA, allowing the DNA strands to separate. Once the DNA strands are separated, the enzyme primase comes in and synthesizes a short RNA primer on each of the DNA strands. This RNA primer acts as a starting point for DNA polymerase to begin synthesis.

Elongation

The elongation stage is the most complex and time consuming step in DNA replication. This stage involves the actual synthesis of new DNA strands. The enzyme DNA polymerase is responsible for synthesizing new DNA strands. DNA polymerase adds nucleotides to the RNA primers, following the base pairing rules. This means that Adenine (A) always pairs with Thymine (T), and Cytosine (C) always pairs with Guanine (G). As DNA polymerase adds nucleotides, it forms a new complementary strand of DNA. The leading strand is synthesized continuously, whereas the lagging strand is synthesized in small fragments called okazaki fragments.

The lagging strand is synthesized in fragments because the DNA polymerase can only add nucleotides in the 5' to 3' direction, while the DNA strands run in the opposite direction (3' to 5'). Therefore, as the replication fork moves, the lagging strand must be synthesized in short fragments, which are later joined together by the enzyme DNA ligase. The process of elongation is repeated until the entire DNA molecule is replicated.

Termination

The final stage of DNA replication is termination. This stage involves the separation of the newly synthesized DNA molecules. The enzymes involved in DNA replication dissociate from the DNA molecule, and the two newly synthesized DNA molecules separate from each other. Once the DNA strands are separated, the process of cell division can begin.

Importance of DNA replication

DNA replication is an essential process in all living organisms. It ensures that the genetic information of an organism is accurately passed on to its offspring during cell division. DNA replication also plays a crucial role in DNA repair. Mutations can occur in DNA due to environmental factors or errors during DNA replication. These mutations can cause genetic disorders and diseases. DNA replication machinery has evolved to minimize errors during DNA replication, and several mechanisms exist to repair DNA damage. The DNA replication process also plays a critical role in genetic diversity. Mutations that occur during DNA replication can lead to the development of new traits and characteristics, which are essential for the survival and evolution of a species.

Conclusion

DNA replication is a complex process that involves several enzymes, proteins, and molecular machinery. It is essential for the survival of all living organisms and plays a critical role inmaintaining the genetic information of an organism. The process of DNA replication ensures that the genetic information of an organism is accurately passed on to its offspring during cell division. Mutations

***Address for Correspondence:** Franziska Bleichert, Department of Biochemistry, Vanderbilt University, Nashville, USA; E-mail: Bleichert.franziska@gmail.com*

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