



UBL201-T Introductory Biology III - Molecular Biology

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Telomeres and Telomerase

Introduction

The ends of linear chromosomes are capped by specialized structures called telomeres. Telomeres are composed of repetitive DNA sequences and associated proteins that protect the ends of chromosomes from degradation and fusion. Telomeres also play a key role in regulating the cellular lifespan and preventing the onset of cancer. Telomerase is an enzyme that maintains telomere length by adding repetitive nucleotide sequences to the ends of chromosomes. Telomerase is highly expressed in embryonic stem cells and cancer cells, but is absent in most somatic cells. Telomerase activation is a key step in the development of cancer. Telomerase is also a potential target for anti-aging therapies and regenerative medicine. In this report, we will discuss the structure and function of telomeres and telomerase, and their implications in aging and cancer. We will also explore the potential applications of telomerase in regenerative medicine and anti-aging therapies.

Understanding Telomeres and Telomerase

the telomere is a region of repetitive nucleotide sequences at each end of a chromosome, which protects the end of the chromosome from deterioration or from fusion with neighboring chromosomes. Its name is derived from the Greek nouns telos "end" and meros "part". For vertebrates, the sequence of nucleotides in telomeres is TTAGGG, with the complementary DNA strand being AATCCC, with a single-stranded TTAGGG overhang. This sequence of TTAGGG is repeated approximately 2,500 times in humans. In humans, average telomere length declines from about 11 kilobases at birth to less than 4 kilobases in old age, telomeres are also present in prokaryotes, but are less well-studied.

The End Replication Problem: causes and implications.

the end replication problem is a problem that is faced during the replication of linear chromosomes. The problem is that DNA replication occurs in a 5' to 3' direction, and the DNA helicase that unwinds the DNA double helix at the replication fork moves along the template strand in the 3' to 5' direction. The antiparallel nature of DNA means that the DNA polymerase responsible for synthesizing new strands, can only add nucleotides in the 5' to 3' direction. As a result, the DNA polymerase synthesizes a new strand of DNA in a 5' to 3' direction, but it can only do so continuously along one of the two strands. Along the other strand, the DNA polymerase must work in the direction away from the replication fork, and it must therefore synthesize DNA in short fragments, known as Okazaki fragments, which are subsequently joined together by DNA ligase. This mechanism of DNA replication is known as semi-conservative replication. The problem is that the last Okazaki fragment cannot be fully replicated, because there is no upstream primer for the DNA polymerase to bind to and synthesize the final Okazaki fragment. This results in the loss of a small portion of DNA at the end of each chromosome with each round of DNA replication. This is known as the end replication problem. The end replication problem is a major cause of aging and cancer, as it leads to the gradual shortening of telomeres with each round of DNA replication. Telomeres are repetitive nucleotide sequences at the ends of chromosomes that protect the ends of chromosomes from degradation and fusion. Telomeres also play a key role in regulating the cellular lifespan and preventing the onset of cancer. Telomerase is an enzyme that maintains telomere length by adding repetitive nucleotide sequences to the ends of chromosomes.

Resolving the End Replication Problem: telomerase a key solution

telomerase is a ribonucleoprotein that adds a species-dependent telomere repeat sequence to the 3' end of telomeres. A telomere is a region of repetitive sequences at each end of eukaryotic chromosomes in most eukaryotes. Telomeres protect the end of the chromosome from DNA damage or from fusion with neighbouring chromosomes. Its name is derived from the Greek nouns telos "end" and meros "part". For vertebrates, the sequence of nucleotides in telomeres is TTAGGG, with the complementary DNA strand being AATCCC, with a single-stranded TTAGGG overhang.

References

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