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A. DNA is the genetic material that defines every cell. Before a cell duplicates and is divided into new daughter cells through either mitosis or meiosis, DNA found within the nucleus must be replicated in order to ensure that each new cell receives the correct number of chromosomes. The process of DNA duplication is called DNA replication.

DNA replication is thought to be in three stages. They are; initiation, elongation and termination.

1. Initiation: DNA synthesis is initiated at particular points within the DNA strand known as origins, which are specific coding regions. These origins are targeted by initiator proteins, which also activate other proteins that aid the replication process forming replication complex around the DNA origin. There are multiple origin sites and when replication of DNA begins, these sites are referred to as replication forks.

   Within the replication complex is the enzyme DNA Helicase, which unwinds the double helix and exposes each of the two strands that they can be used as a template for replication. DNA can only be extended by the addition of a free nucleotide triphosphate to the 3' end of the chain.

   DNA Primase is another enzyme that synthesizes a small RNA primer which acts as a 'kick-starter' for DNA polymerase (which functions in the creation and expansion of the new strands of DNA).

2. Elongation: Once the DNA polymerase has attached to the original template of two strands of DNA, it is able to start synthesizing the new DNA to match the templates. One of the templates is read in a 3' to 5' direction which means that new strands will be formed in a 5' to 3' direction (as the two strands are antiparallel to each other). The newly formed strand is referred to as the leading strand, which is continuous. The other replication fork oriented in 5' to 3' direction, means the new strands will be formed in a 3' to 5' direction. The newly formed strand is referred to as lagging strands. It begins replication by binding with multiple primers. DNA polymerase then adds pieces of DNA called Okazaki fragments, to the strand between primers. This process of replication is discontinuous as the newly created fragments are disjointed.

   DNA polymerase initiated by DNA primase continues extending the new DNA strand.

3. Termination: Once both the continuous and discontinuous strands are formed,

an enzyme called exonuclease removes all RNA primers from the original strands. These primers are then replaced with appropriate bases. Another exonuclease cross check the newly formed DNA to remove and correct any errors. The ends of the parent strands consist of repeated DNA sequences called telomeres. Telomeres act as protective caps at the end of chromosomes to prevent caps at the end of chromosomes to prevent nearby chromosomes from fusing. DNA telomerase catalyzes the synthesis of telomere sequences at the ends of the DNA.

Once completed, the parent strand and its complementary DNA strand coils into the familiar double helix shape. In the end, replication produces two DNA molecules, each with one strand from the parent molecule and one new strand.

B. Functions of DNA Replication Enzymes

DNA replication would not occur without enzymes that catalyse various steps in the process. These enzymes and their functions include;

1. DNA helicase

a. It unwinds and separates double stranded DNA.

b. It also breaks hydrogen bonds between nucleotide pairs in DNA.

2. DNA primase: it generates RNA primers which act as starting templates for the starting point of DNA replication.

3. DNA polymerases: It synthesizes new DNA molecules by adding nucleotides to leading and lagging strands

4. DNA Gyrase: It unwinds and rewinds DNA strands to prevent the DNA from becoming tangled or supercoiled

5. Exonucleases: they remove nucleotide bases from the end of a DNA chain

6. DNA ligases: it joins DNA fragments together by forming phosphodiester bonds between nucleotides.

REFERENCES

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