

QQuestion #61111, Biology, Other

Describe the process of DNA replication and illustrate your answer.

Answer:

DNA replication is the process by which DNA makes a copy of itself during cell division.

1. The first step in DNA replication is to 'unzip' the double helix structure of the DNA molecule.
2. This is carried out by an enzyme called helicase which breaks the hydrogen bonds holding the complementary bases of DNA together (A with T, C with G).
3. The separation of the two single strands of DNA creates a 'Y' shape called a replication 'fork'. The two separated strands will act as templates for making the new strands of DNA.
4. One of the strands is oriented in the 3' to 5' direction (towards the replication fork), this is the leading strand. The other strand is oriented in the 5' to 3' direction (away from the replication fork), this is the lagging strand. As a result of their different orientations, the two strands are replicated differently (Figure 1):

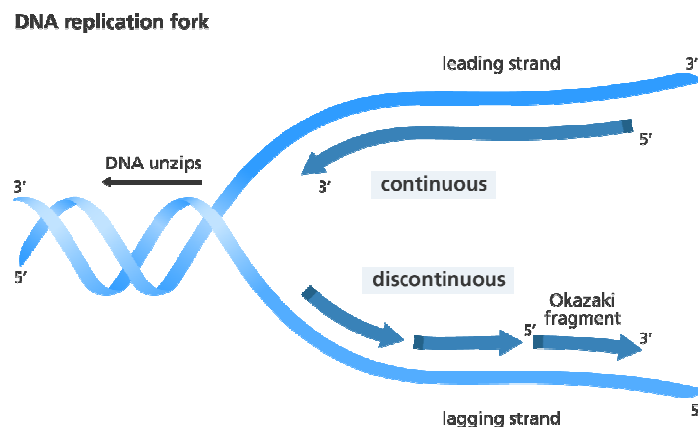


Figure 1 – DNA replication schematic

Leading Strand:

4. A short piece of RNA called a primer (produced by an enzyme called primase) comes along and binds to the end of the leading strand. The primer acts as the starting point for DNA synthesis.
5. DNA polymerase binds to the leading strand and then 'walks' along it, adding new complementary nucleotide bases (A, C, G and T) to the strand of DNA in the 5' to 3' direction.
6. This sort of replication is called continuous.

Lagging strand:

4. Numerous RNA primers are made by the primase enzyme and bind at various points along the lagging strand.
5. Chunks of DNA, called Okazaki fragments, are then added to the lagging strand also in the 5' to 3' direction.
6. This type of replication is called discontinuous as the Okazaki fragments will need to be joined up later.

8. Once all of the bases are matched up (A with T, C with G), an enzyme called exonuclease strips away the primer(s). The gaps where the primer(s) were are then filled by yet more complementary nucleotides.
9. The new strand is proofread to make sure there are no mistakes in the new DNA sequence.
10. Finally, an enzyme called DNA ligase seals up the sequence of DNA into two continuous double strands.
11. The result of DNA replication is two DNA molecules consisting of one new and one old chain of nucleotides. This is why DNA replication is described as semi-conservative, half of the chain is part of the original DNA molecule, half is brand new.
12. Following replication the new DNA automatically winds up into a double helix.