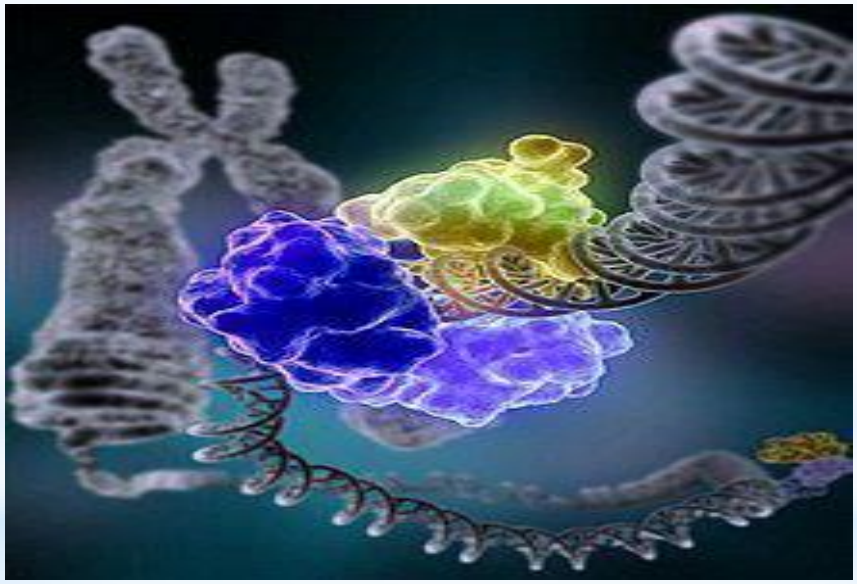
Lec2 \ DNA Replication: Models for DNA Replication



DNA Replication

Before each cell division, new copies must be made of each of the many molecules that form the cell, including the duplication of all DNA molecules. DNA replication is the name given to this duplication process, which enables an organism's genetic information — its genes — to be passed to the two daughter cells created when a cell divides.

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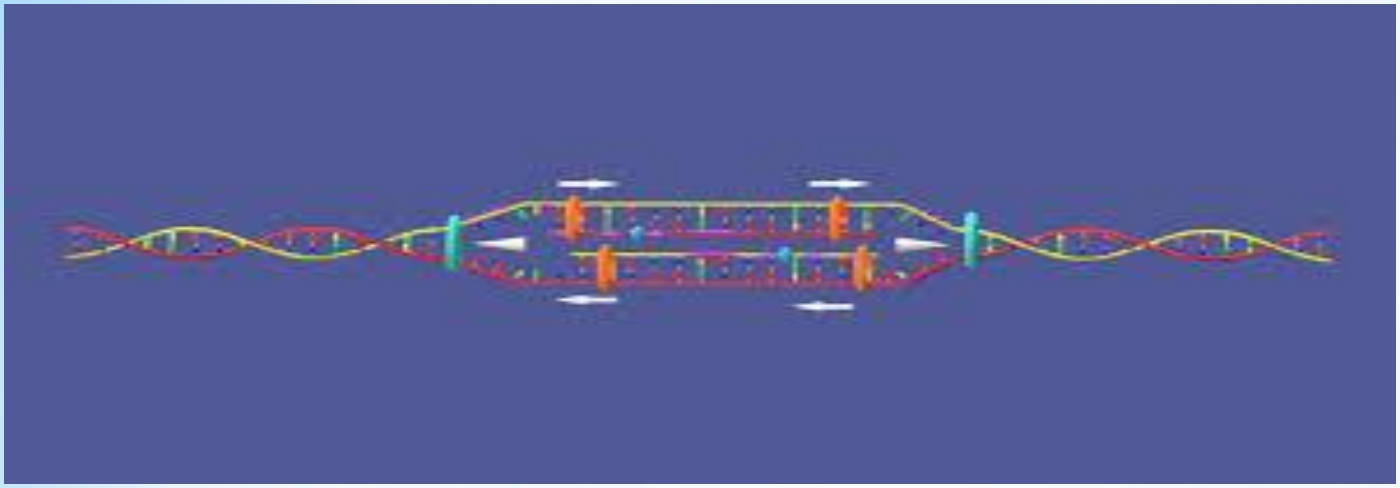

DNA replication is the process of producing two identical copies from one original DNA molecule. This biological process occurs in all living organisms . It is the basis for biological inheritance. DNA is composed of two strands and each strand of the original DNA molecule serves as template for the production of the complementary strand.

* semiconservative replication.

DNA replication process

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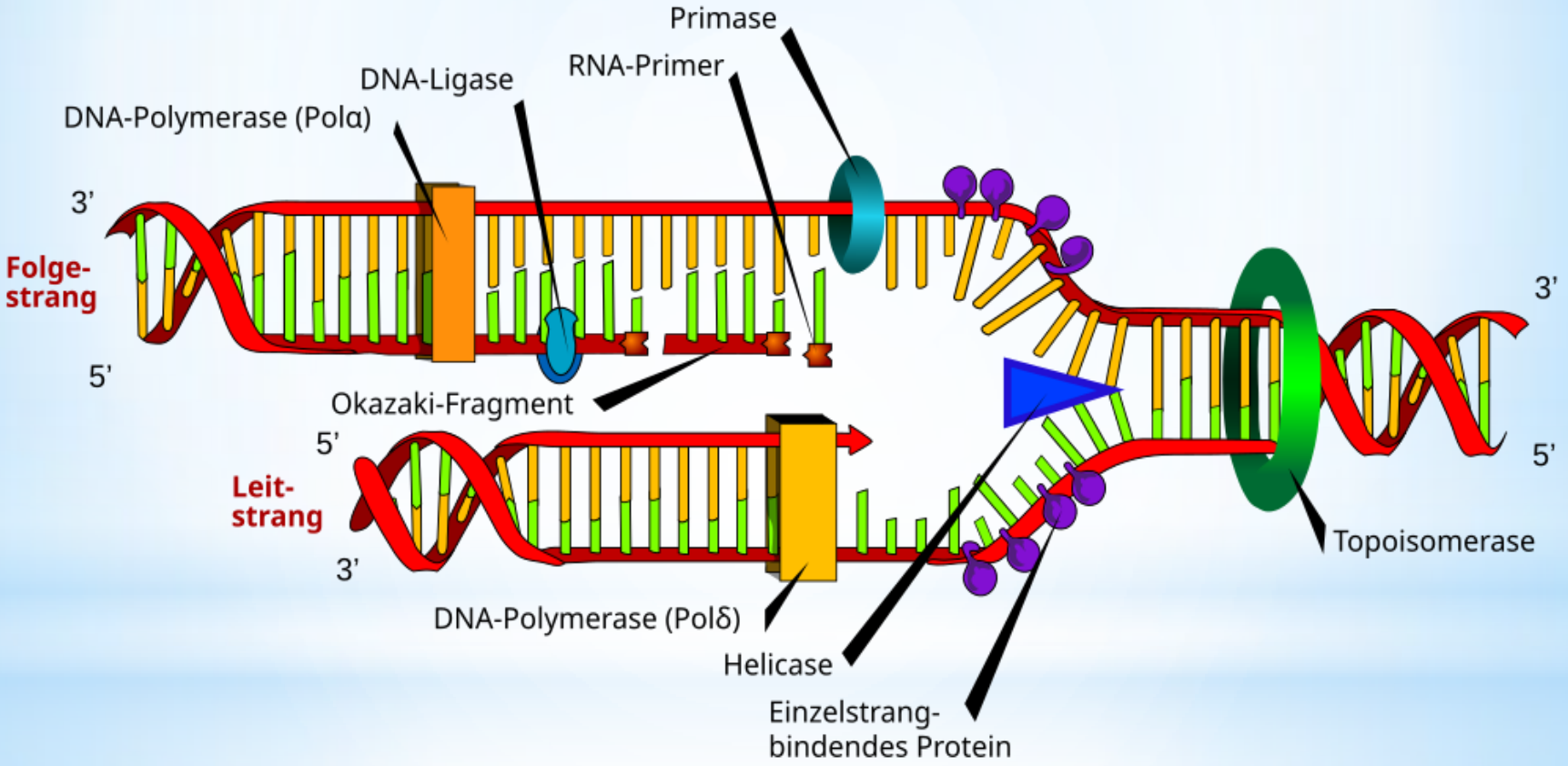
The process of DNA replication followed by proofreading or error checking mechanisms to ensure correct reading of the genetic code, like all biological polymerization processes (Transcription and Translation, will be discussed later), the process involve 3 stages :1-Initiation 2-Elongation and 3-Termination


Primase
RNA-Primer
DNA-Ligase
DNA-Polymerase (Polα)
3'
Folge-
strang
5'
Okazaki-Fragment
5'
Leit-
strang
3'
DNA-Polymerase (Polδ)
Helicase
Einzelstrang-
bindendes Protein
Topoisomerase
3'
5'

DNA replication process

* 1. An enzyme called helicase unwinds the DNA by breaking the hydrogen bonds between the nitrogenous base pairs. Topoisomerase : separate the two complete daughter chromosome in to two chromosome.

2. Single-strand binding proteins (SSBPs) bind to the single strands of DNA near the replication fork to prevent the ssDNA strands from winding back into a double helix, thus maintaining the strand separation.

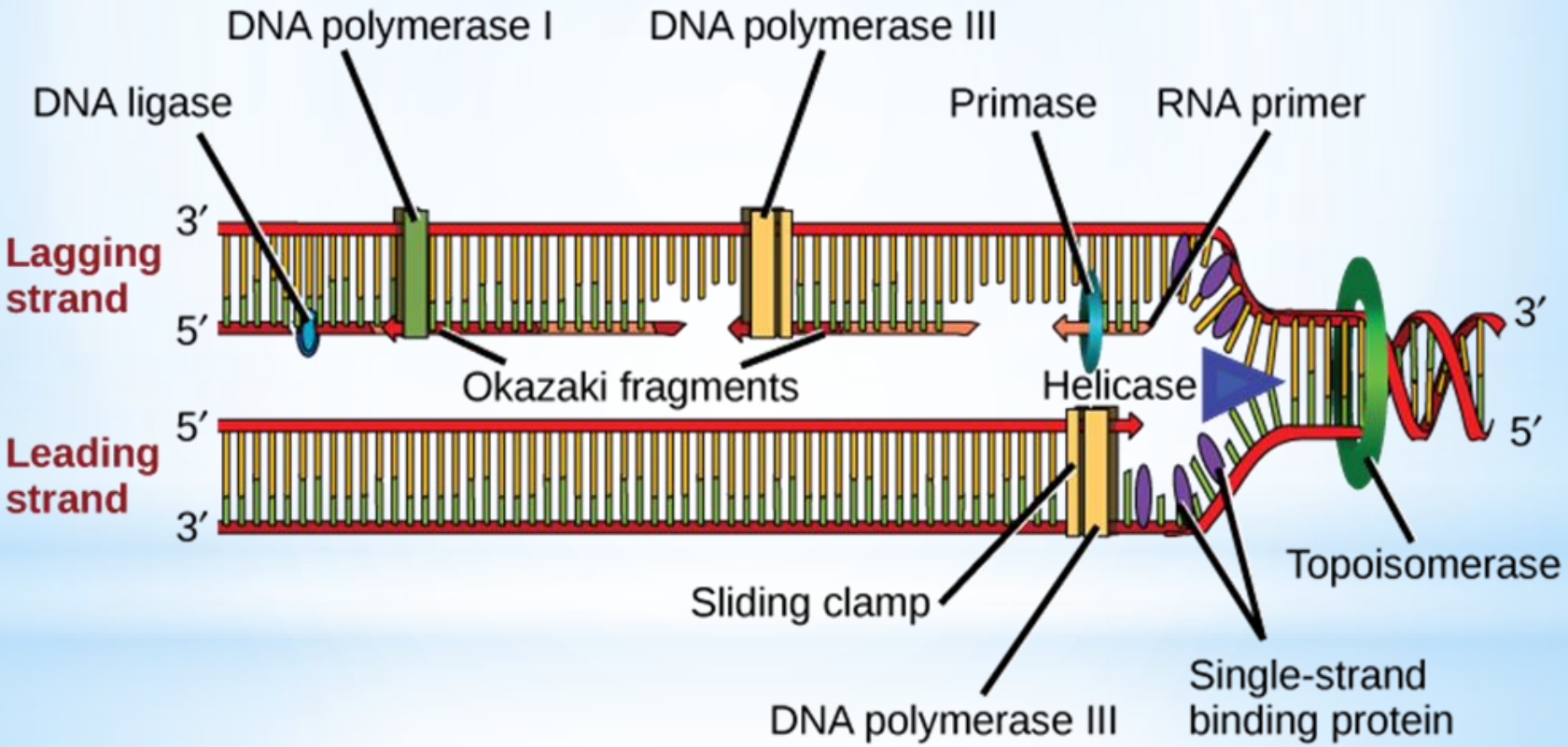
3. DNA polymerase is able to add nucleotides only in the 5' to 3' direction (anew DNA strand can be only extended in this direction)

DNA replication process *

4. The problem is solved with the help of an RNA sequence that provides the free 3′-OH end. RNA primase, synthesizes an RNA primer that is about five to ten nucleotides long and complementary to the DNA template .

5. The gaps that remain are sealed by DNA Ligase.

The primer is RNA rather than DNA because DNA polymerases cannot start chains de novo


DNA polymerase I
DNA polymerase III
DNA ligase
Primase
RNA primer
3′
Lagging strand
5′
Okazaki fragments
Helicase
3′
5′
5′
Leading strand
3′
Topoisomerase
Sliding clamp
Single-strand binding protein
DNA polymerase III

Modes of DNA Replication *

1- semi-conservative model

the two parental strands separate and each makes a copy of itself. After one round of replication, the two daughter molecules each comprises one old and one new strand. Note that after two rounds, two of the DNA molecules consist only of new material, while the other two contain one old and one new strand.

2-conservative *

In the conservative model,

the parental molecule directs synthesis of an entirely new double-stranded molecule, such that after one round of replication, one molecule is conserved as two old strands. This is repeated in the second round.

3- Dispersive model*

In the dispersive model, material in the two parental strands is distributed more or less randomly between two daughter molecules. In the model shown here, old material is distributed symmetrically between the two daughters molecules. Other distributions are possible.