Lec3 \ **Molecular mechanism of replication in prokaryotes and eukaryotes.**

Replication Process

In the process of DNA replication, the DNA makes multiple copies of itself. It is a biological polymerisation, which proceeds in the sequence of initiation, elongation, and termination. It is an enzyme-catalysed reaction. DNA Polymerase is the main enzyme in the replication process..

DNA Replication Steps

1--Initiation

For the replication to begin there is a particular region called the origin of replication. This is the point where the replication originates. Replication begins with the spotting of this origin followed by the unwinding of the two DNA strands.

Unzipping of DNA strands in their entire length is not feasible due to high energy input. Hence, first, a replication fork is created catalysed by the helicase enzyme, which unzips the DNA strand.

DNA Replication Steps

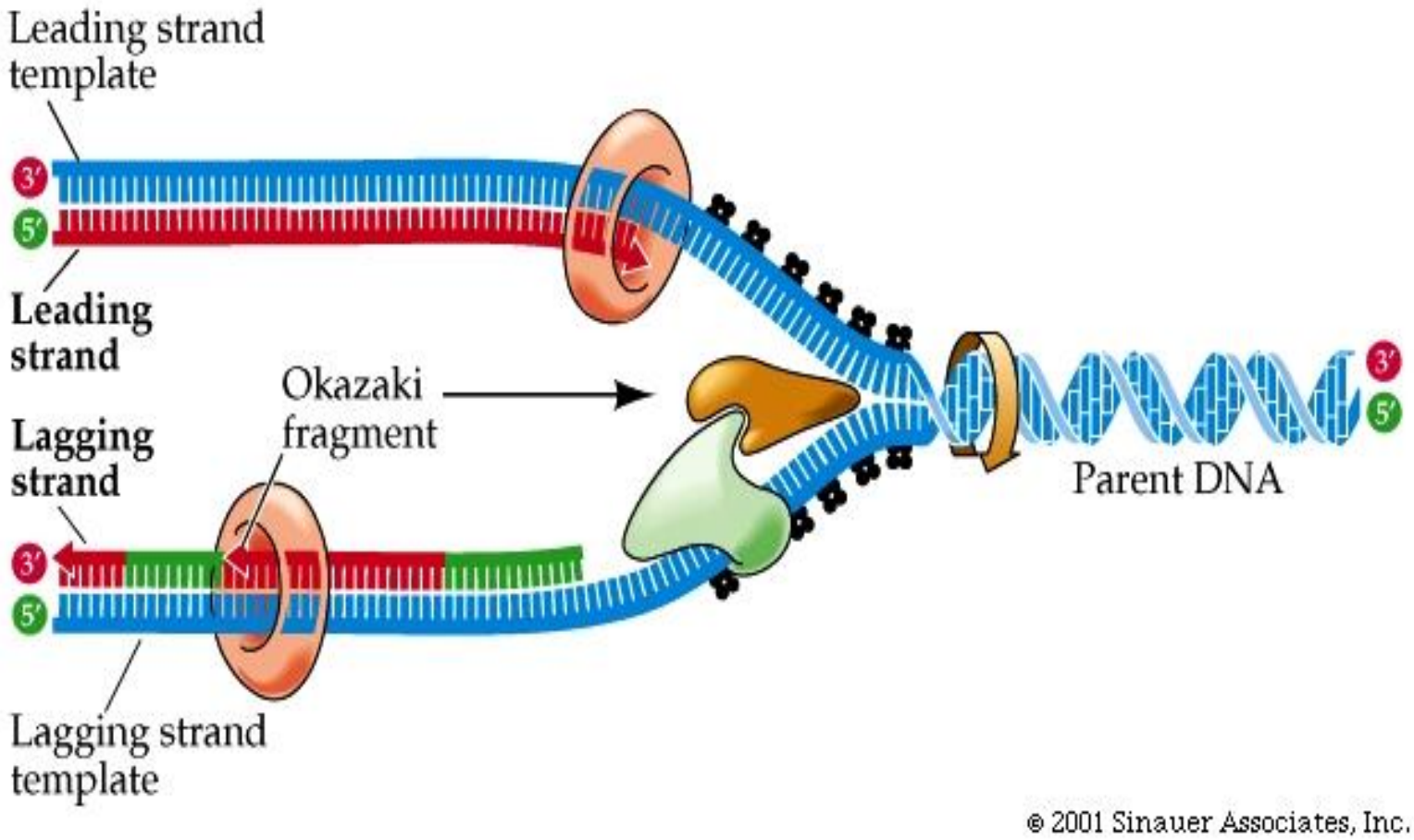
2 Elongation

As the strands are separated, the polymerase enzymes start synthesising the complementary sequence in each of the strands. The parental strands will act as a template for newly synthesising daughter strands that elongation is unidirectional i.e. DNA is always polymerised only in the 5′ to 3′ direction. Therefore, in one strand (the template 3‘→5‘) it is continuous, hence called continuous replication while on the other strand (the template 5‘→3‘) it is discontinuous replication. They occur as fragments called Okazaki fragments. The enzyme called DNA ligase joins them later.

DNA replication process

3-Termination

Termination of replication occurs in different ways in different organisms. In E.coli like organisms, chromosomes are circular. And this happens when the two replication forks between the two terminals meet each other.


Leading strand template
3′
5′
Leading strand
Lagging strand
Okazaki fragment
3′
5′
Parent DNA
3′
5′
Lagging strand template
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DNA Replication Process in Prokaryotes

1- The two strands of DNA unwind at the origin of replication.

2-Helicase opens the DNA and replication forks are formed.

3-The DNA is coated by the single-strand binding proteins around the replication fork to prevent rewinding of DNA.

4-Topoisomerase prevents the supercoiling of DNA.

5-RNA primers are synthesised by primase. These primers are complementary to the DNA strand.

6-DNA polymerase III starts adding nucleotides at the end of the primers.

7-The leading and lagging strands continue to elongate.

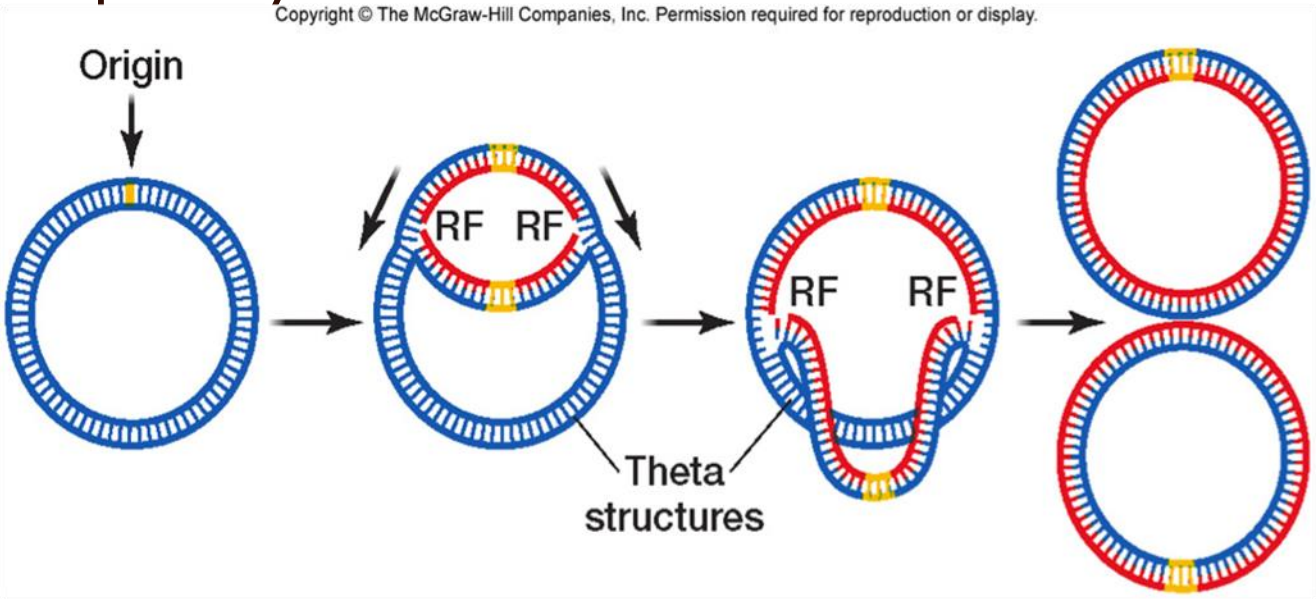
8- The primers are removed and the gaps are filled with DNA Polymerase I and sealed by ligase.

DNA replication process in Prokaryotic

It is similar to that in eukaryotes with some differences. There are two types of replication in prokaryotes:

1. Theta Shape replication

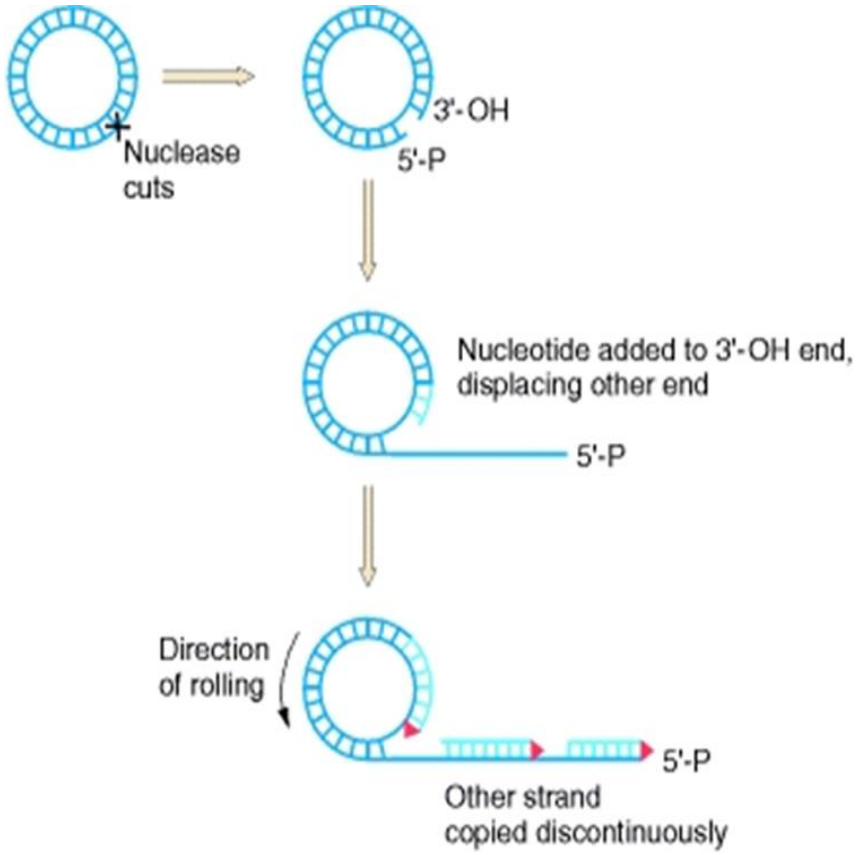
This happens in the circular chromosome of prokaryotes



DNA replication process in Prokaryotic

2. Rolling Circle Replication

This type of replication occurs in plasmids



DNA Replication in Eukaryotes

The DNA replication in eukaryotes is similar to the DNA replication in prokaryotes. However, the initiation process is more complex in eukaryotes than prokaryotes. In eukaryotes, there are multiple origins of replication present. A pre-replication complex is made with other initiator proteins. The process is entirely the same but the enzymes used are different. e.g. in eukaryotes, the polymerisation process is carried out by the enzyme Pol δ, whereas in prokaryotes it is done by DNA Pol III.

DNA POLYMERASE TYPE

In Euokaryotic

Pol α

Pol ε

Pol δ

In Prokaryotic

Pol I

Pol II

Pol III