

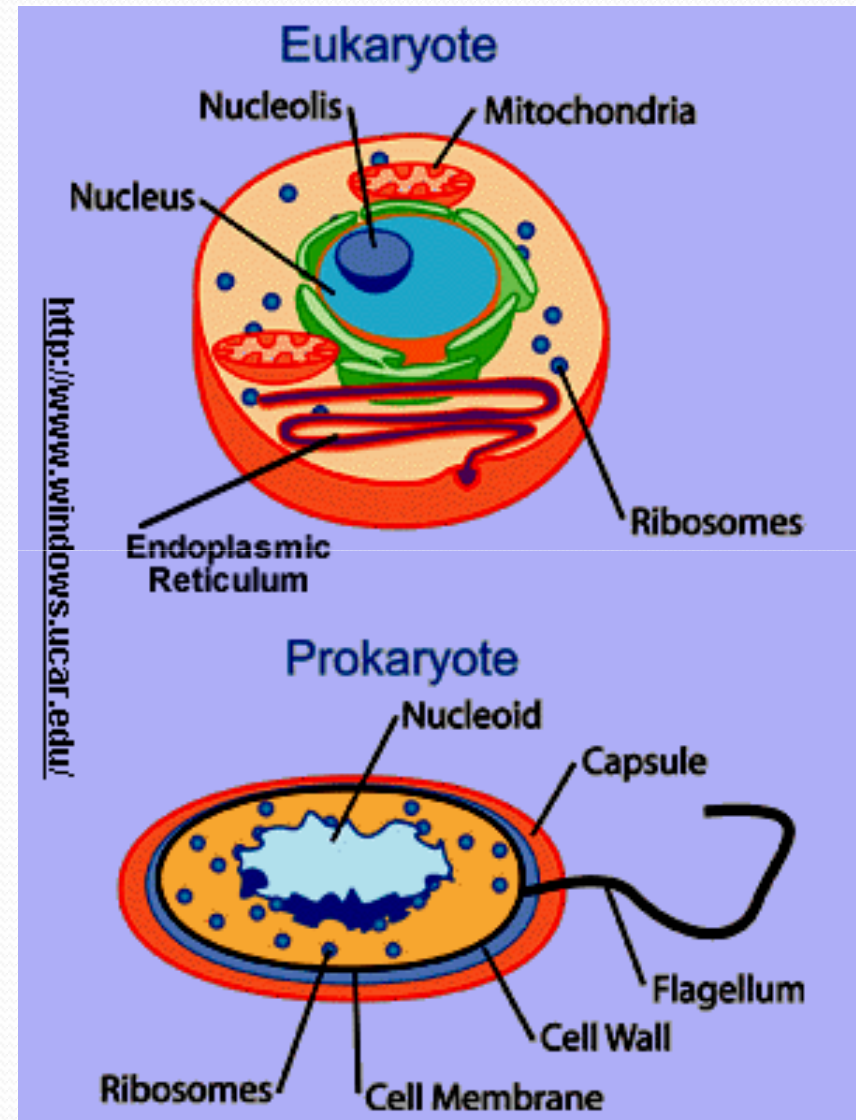
DNA REPLICATION

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DNA replication

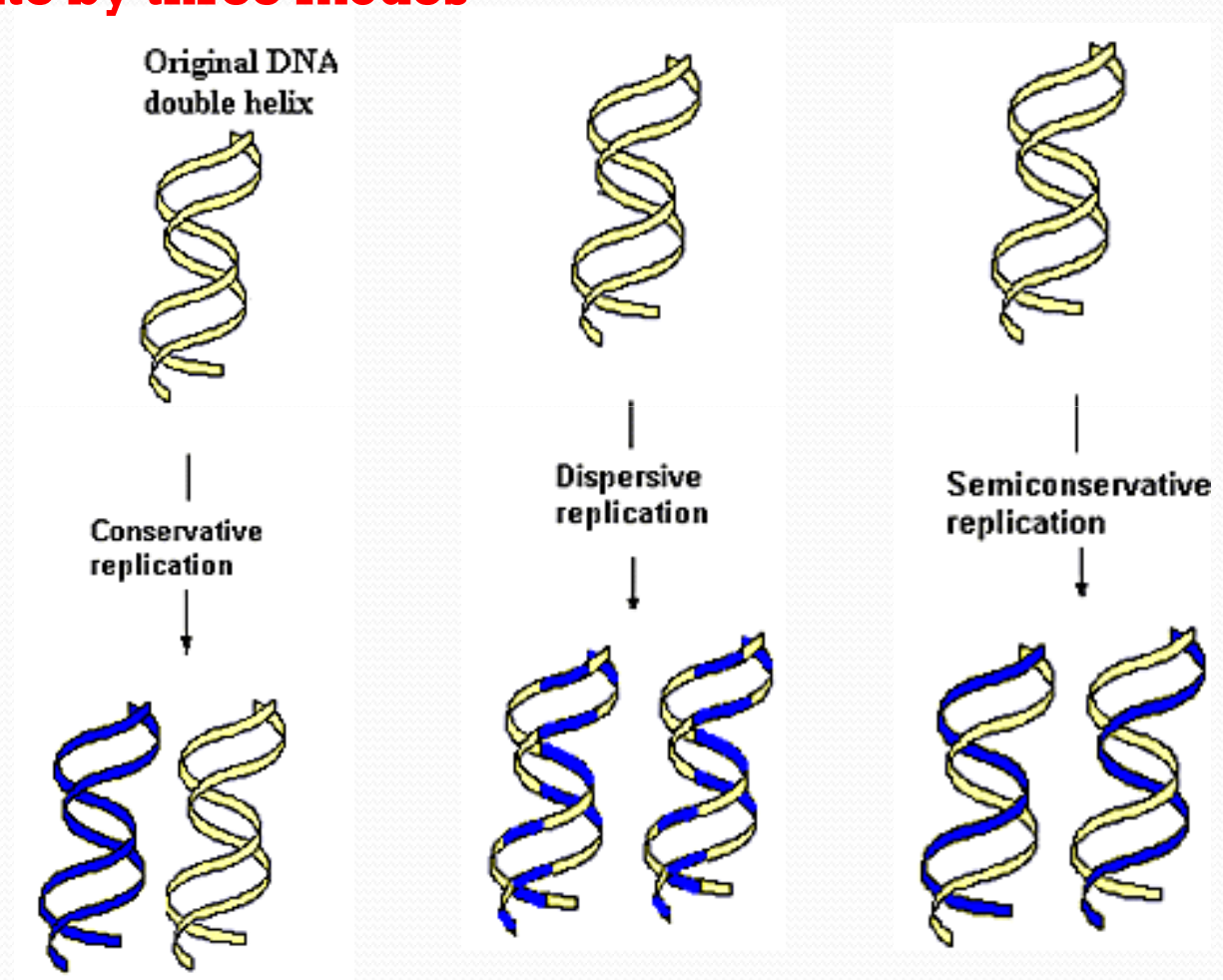
The process of making an identical copy of a section of duplex (double-stranded) DNA, using existing DNA as a template for the synthesis of new DNA strands.

In humans and other eukaryotes, replication occurs in the cell nucleus.

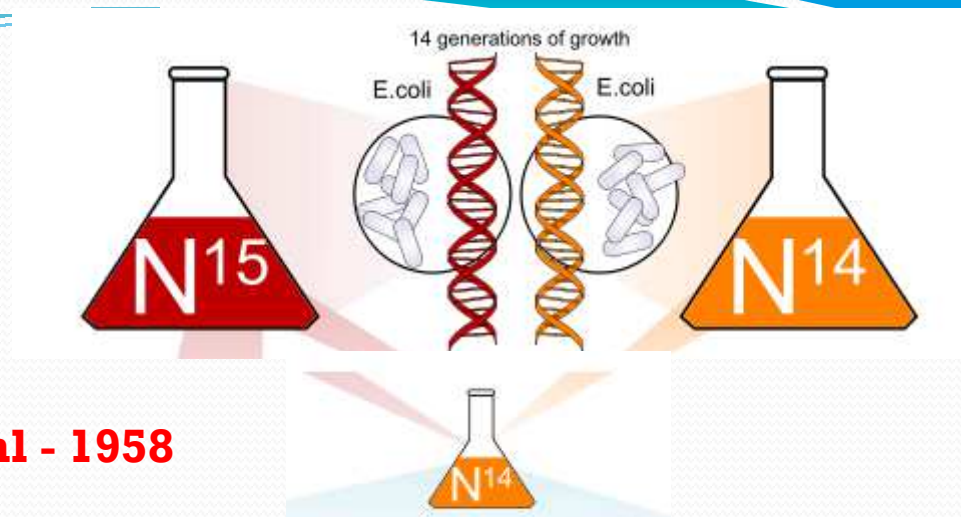


Possible models of DNA replication

Delbruck suggested that the Watson and Crick model of DNA could theoretically replicate by three modes

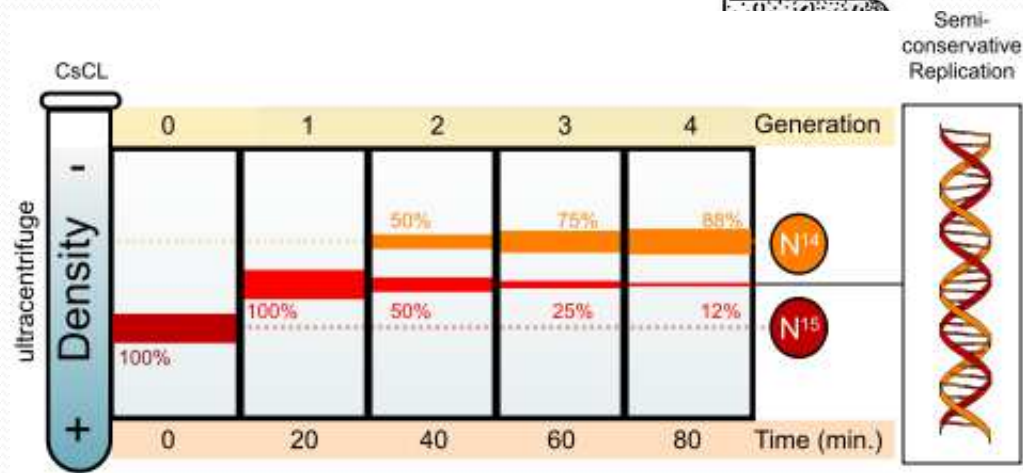
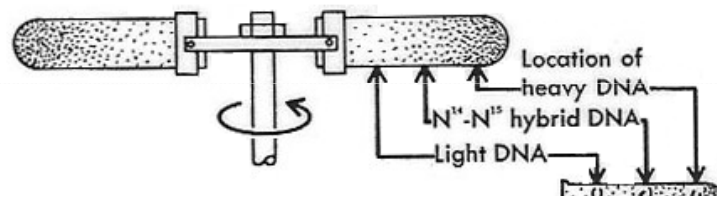


E. Coli culture



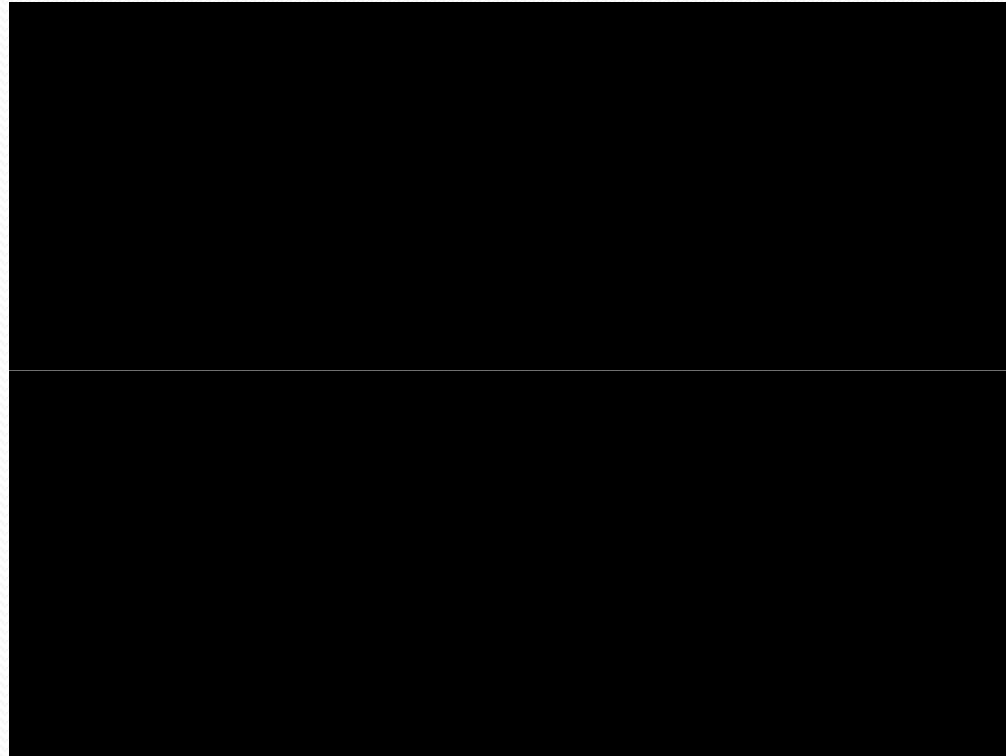
Meselson and Stahl - 1958

Ultra centrifugation



Result

Animation on Messelson and Stahl's Experiment



https://www.youtube.com/watch?v=0e_Zb5e9Bfk

Major enzymes & Proteins involved in DNA replication

Polymerase I:

Discovered by Arthur Kornberg. 400 molecules/cell; mol. wt. 1,09,000.

- 1. 5' → 3' Polymerization: Synthesis of polymer from monomers
1000 nucleotides / min at 37° C**
- 2. 3' → 5' Exonuclease activity: Hydrolysis of single nucleotides from the end of a DNA or RNA chain. Functions as proof reader, thus acts in repair synthesis.**
- 3. 5' → 3' Exonuclease activity: Removes thymine dimers. As moves ahead it cuts off Ribonucleotides (Primer) in front and adds deoxyribonucleotides behind.**

Polymerase II:

Single polypeptide chain with Mol. Wt 90,000.

40 mol / cell.

50 nucleotides/ min.

- 1. 5' → 3' Polymerization: 50 nucleotides / min at 37° C**
- 2. 3' → 5' Exonuclease: involves in editing in repair replication of UV damage. Also, it can elongate OKAZAKI fragments in absence of Pol I.**

Polymerase III:

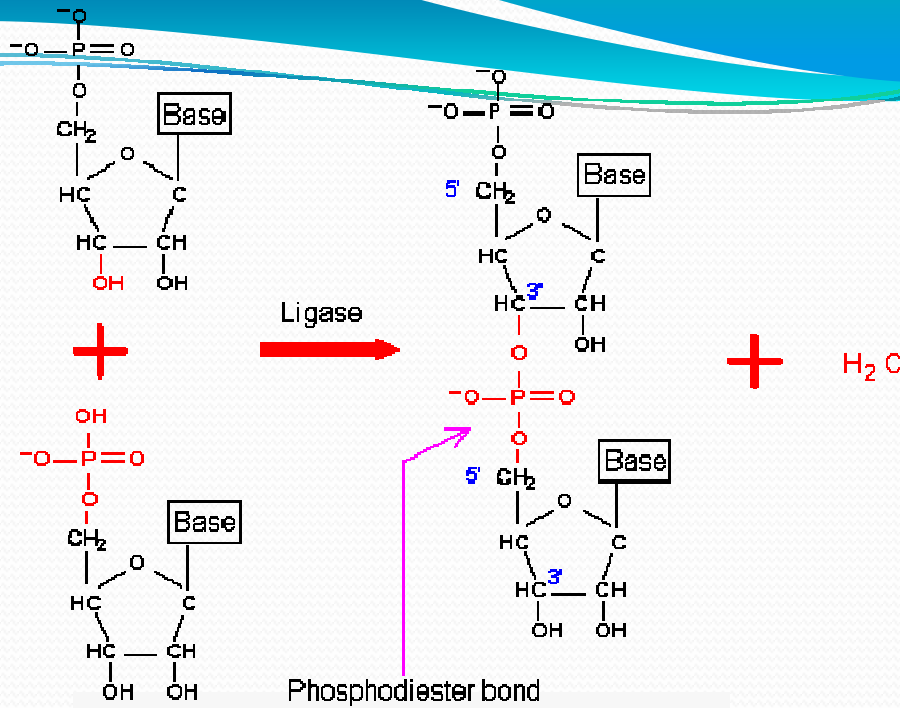
Very complex enzyme. It associated with 9 other protein in its active form.

Core enzyme: The smallest aggregate having function of polymerase.

5' → 3' Polymerization: 15,000-60,000 nucleotides / min at 37° C

3' → 5' Exonuclease: : Hydrolysis of single nucleotides from one end

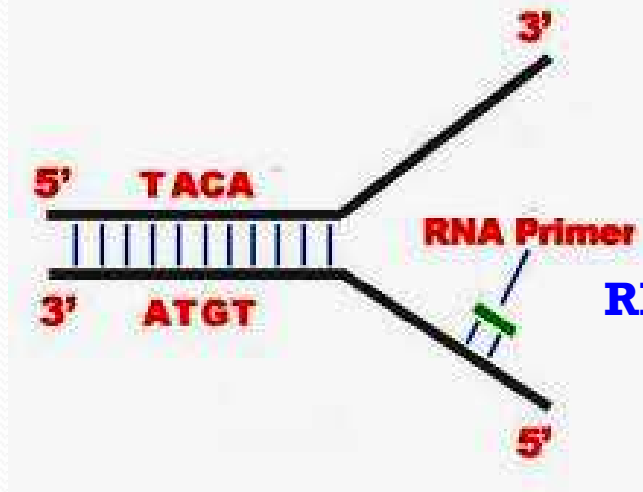
DNA ligase:



Seals OKAZAKI fragments.

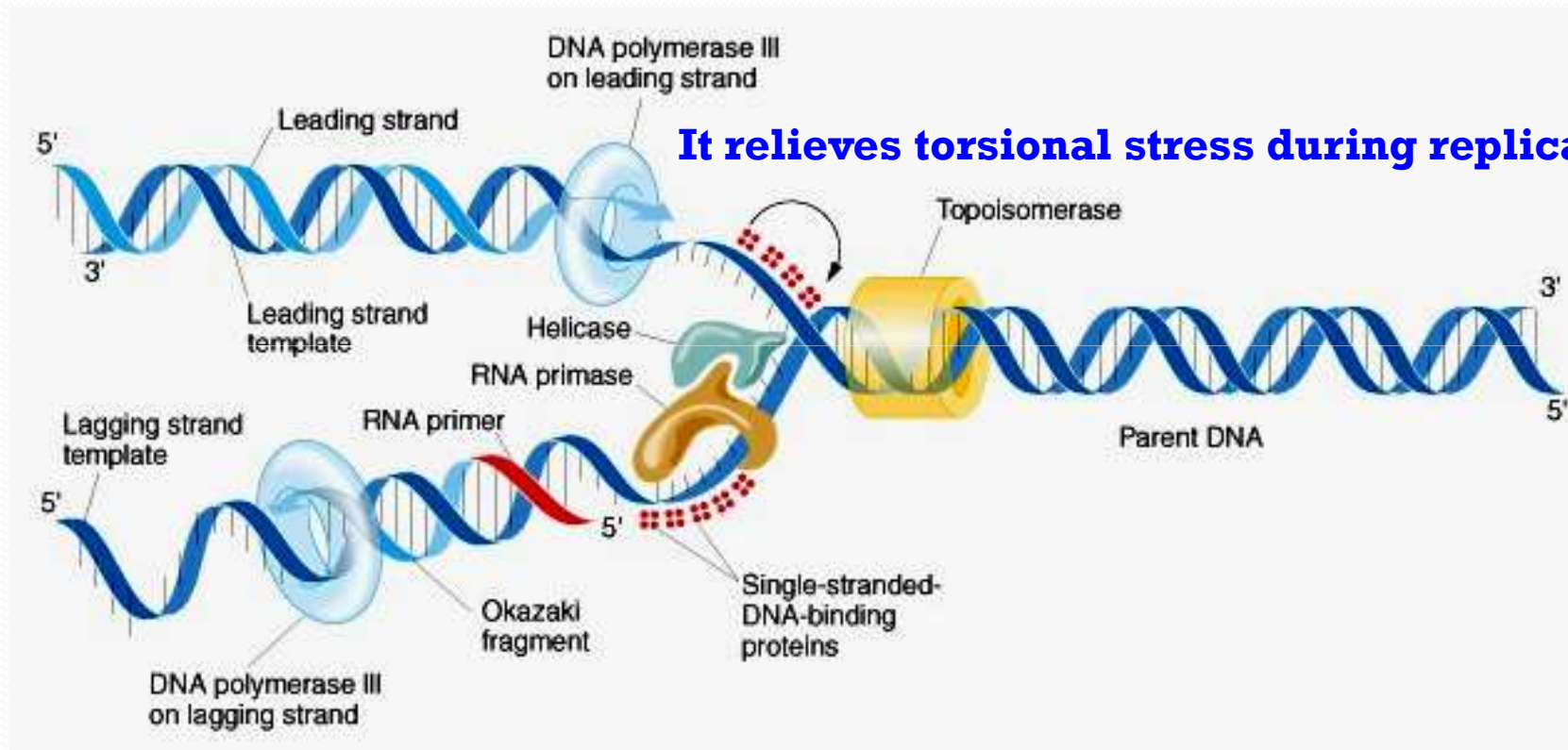
DNA ligase seals a 3'OH to a 5' P.

Primase:

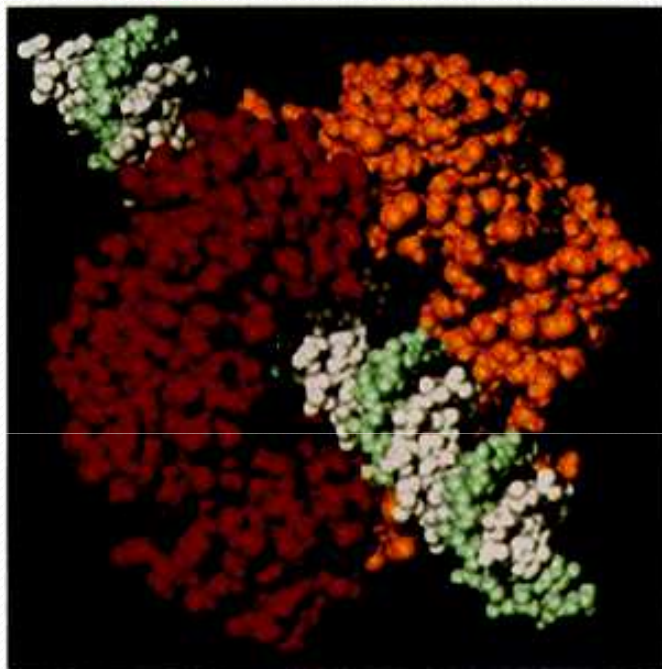


RNA primer is synthesized

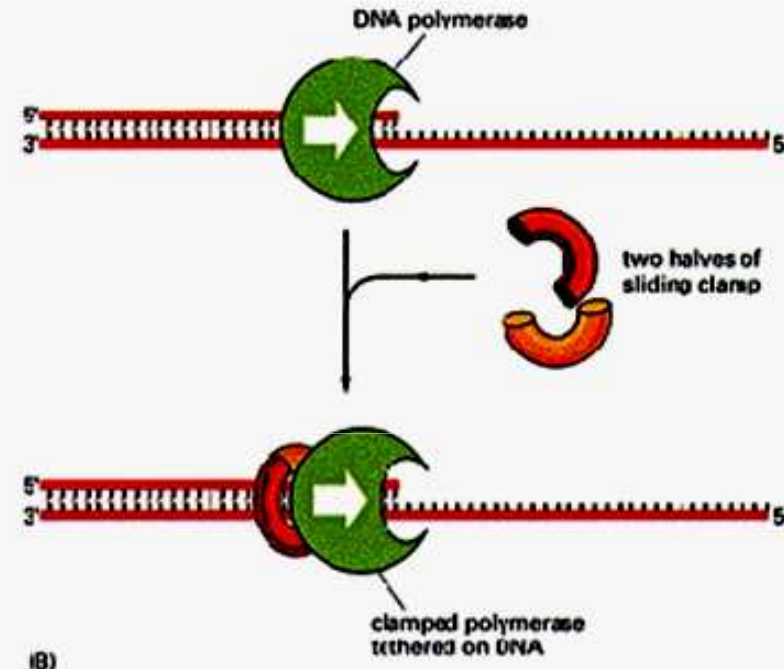
DNA Gyrase (Topoisomerase II):



Sliding Clamps:



(A)

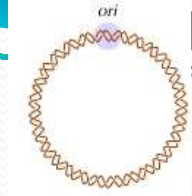


(B)

Sliding Clamps allows DNA polymerase to remain attached to their DNA stretches of DNA efficiently without falling off the template DNA

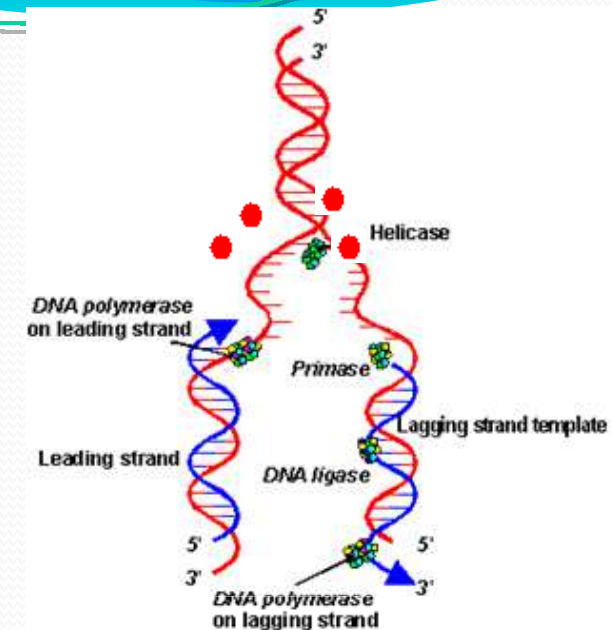
Dna A (Origin Binding Protein):

**binds to origin of replication
just before initiation**



Dna B (Helicase):

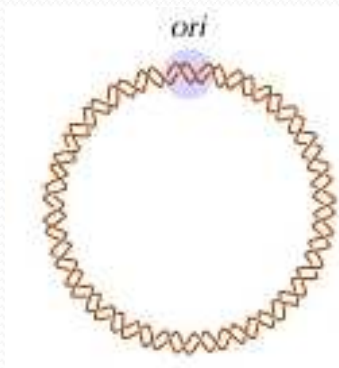
**Helicase unwinds DNA strands
using ATP energy**



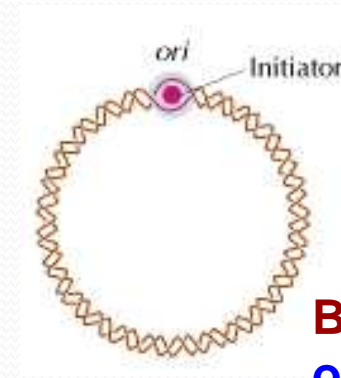
**Single strand Binding Protein: Binds to & stabilizes unwound
single stranded DNA**

**Dna C: Forms a complex with helicase to load & function on DNA
template.**

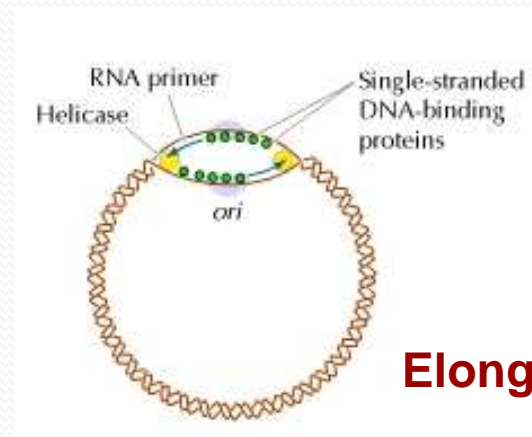
Mechanism of Replication in Prokaryotes



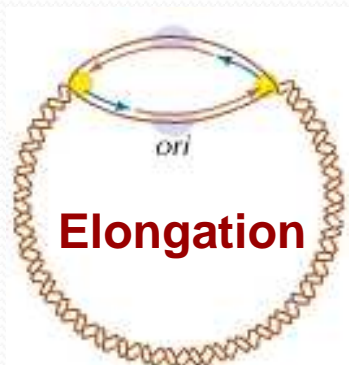
Initiation by binding of Origin Binding Protein

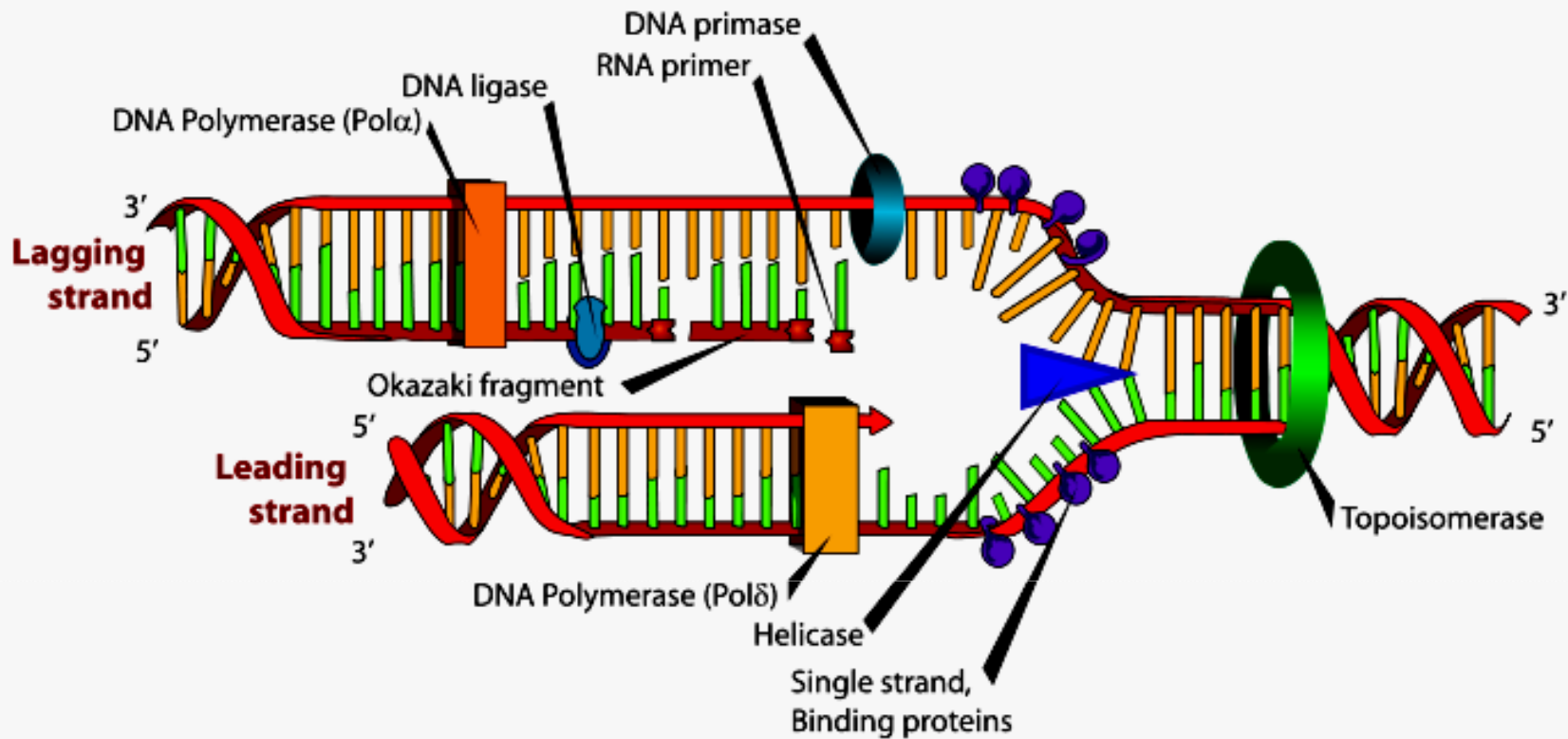


Binding of Helicase, other proteins and enzymes

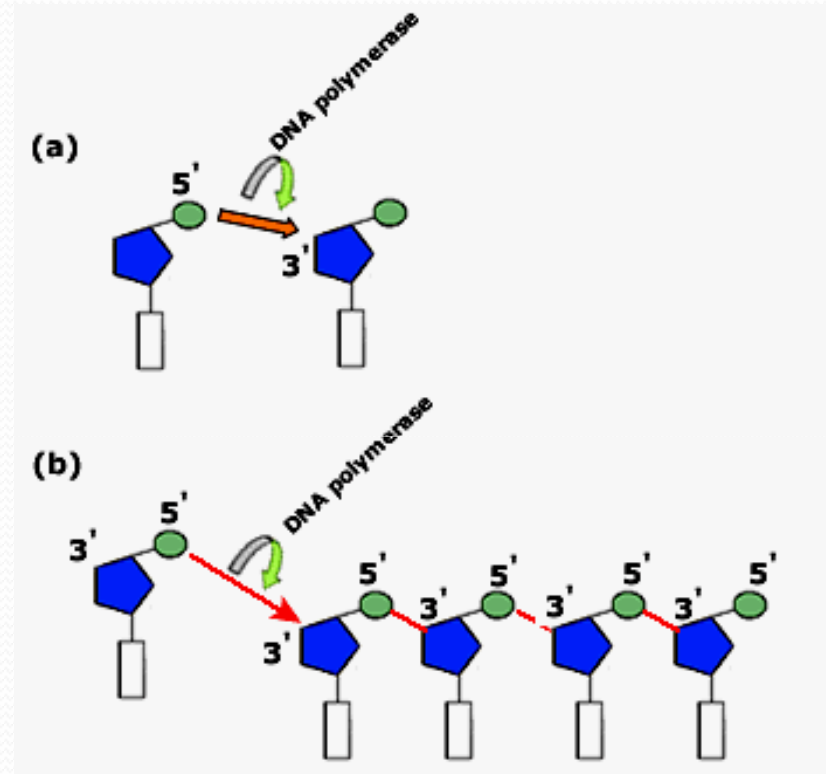
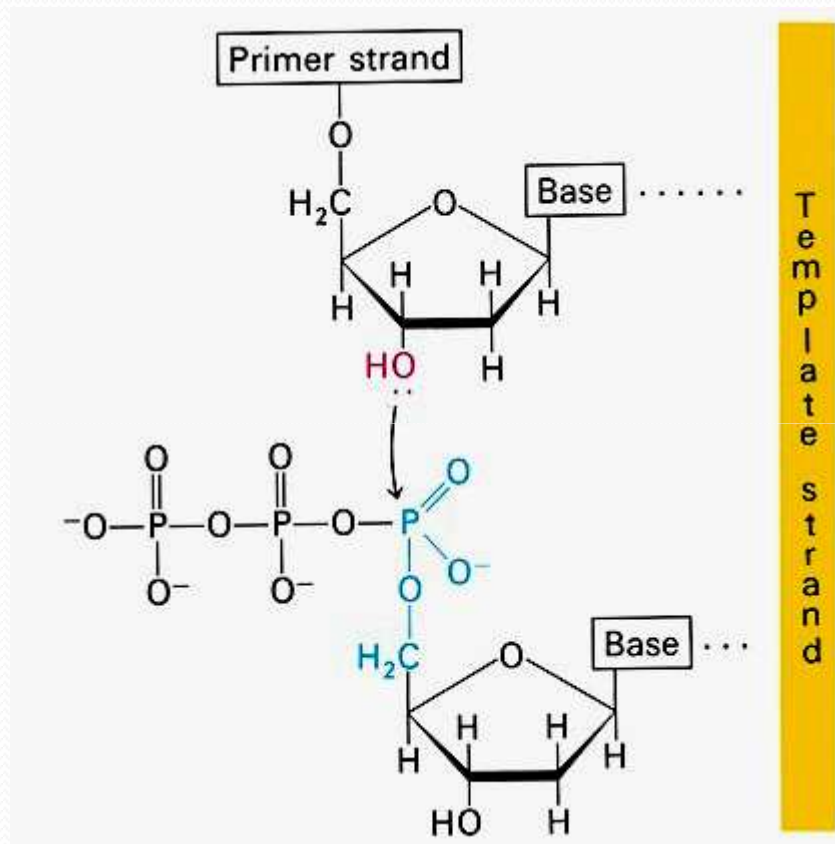


Elongation



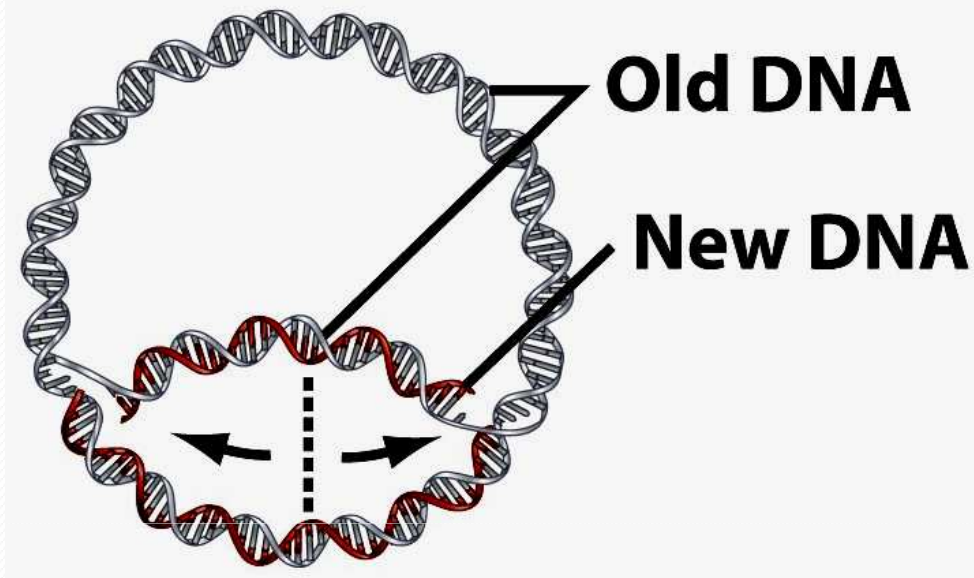


REPLICOSOME: The unit consisting of enzymes, template strand and newly synthesized daughter strand at the replication fork is called replicosome



3' ← ← ← ← ← ← ← ← ← ← 5'
Chain Growth from 5' to 3'

Termination:



In a unidirectional replicating molecule, replication terminates at the origin.

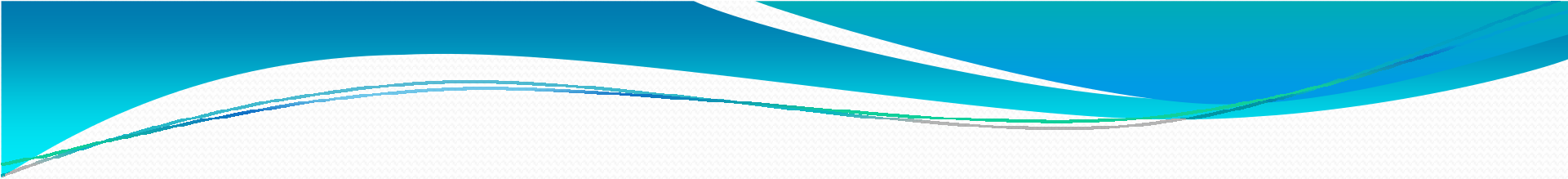
In a bidirectionally replicating molecule, there are two possible modes of termination.

1. There is a defined termination sequence
2. Two growing points collide and termination occurs

Animation on Mechanism of DNA Replication



<https://www.youtube.com/watch?v=TNKWgcFPHqw>



**Acknowledgements
to
INTERNET
FOR
PICTURES AND PHOTOGRAPHS**