Molecular Biology

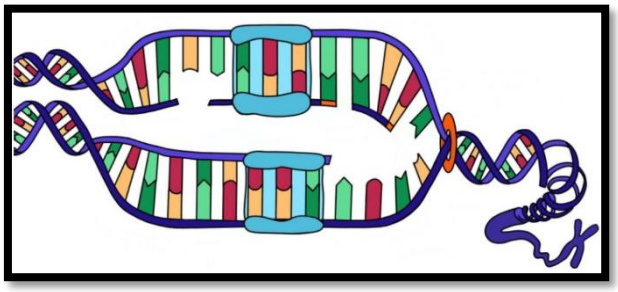
2nd stage

Lec.3

DNA

and

DNA replication



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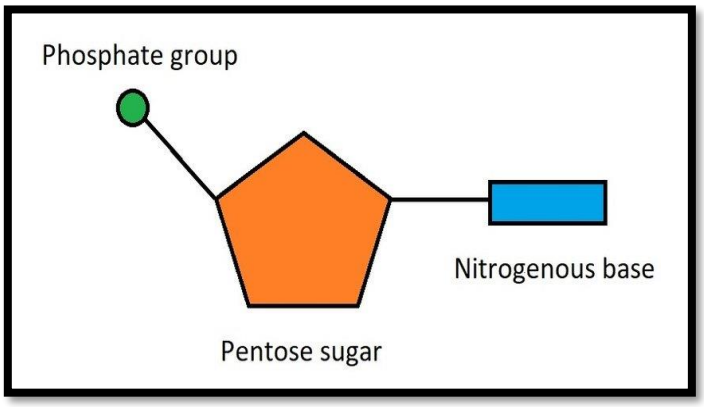
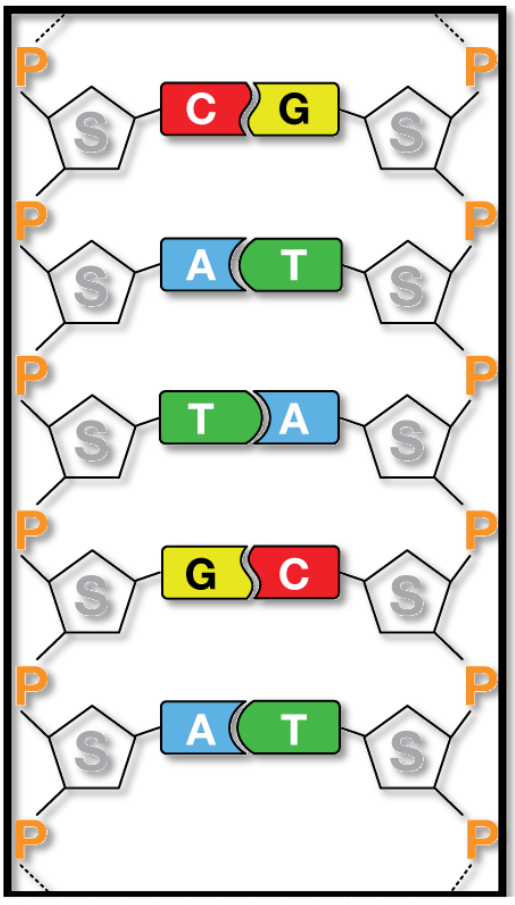
DNA:

- DNA stands for deoxyribonucleic acid. It is a molecule that contains the genetic code of organisms, such as animals, plants, bacteria, and viruses.
- DNA is made up of two strands that coil around each other to form a double helix.
- Each strand is composed of smaller units called nucleotides, which have a sugar, a phosphate, and a nitrogenous base.



nucleotides

- The bases are adenine (A), thymine (T), cytosine , and guanine (G).
- The order of these bases along the strand determines the genetic information.
- DNA can replicate itself by separating the strands and using them as templates for new strands.



DNA structure. Nitrogenous base. Thymine, Adenine, Cytosine and Guanine, Sugar and Phosphate group. DNA nucleotide.

DNA replication:

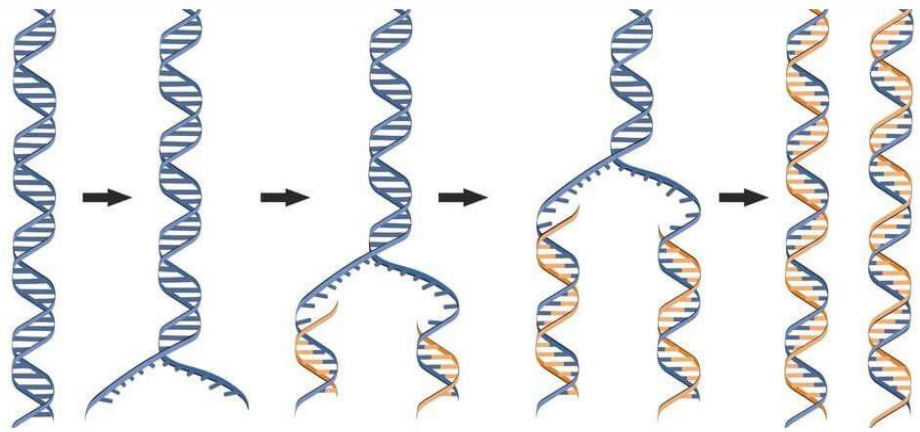
DNA replication is the biological process of producing two identical

replicas of DNA from one original DNA molecule DNA replication, also known as semi-conservative replication, is the process by which DNA is essentially doubled.

1. **In molecular biology DNA replication is the biological process of producing two identical replicas of DNA from one original DNA molecule .**
2. **DNA replication was postulated by Watson and Crick after they dicoverd the structure of DNA .**
3. **DNA replication is semiconservative . Each srand in the double helix acts as a template for synthesis of a new , complementary .**
4. **The process of DNA replication is vital for cell growth , repair , and reproduction in organisms**

What is replication of DNA?

1. **DNA replication is the process by which DNA makes a copy of itself during cell division .**
2. **This process takes us from one starting molecule to two daughter molecules , with each newly formed double helix containing one new and one old strand .**
3. **DNA found within the nucleus , must be replicated in order to ensure that each new cell receives he correct number of chromosomes. The process of duplication is called DNA replication .**
4. **Fundamental process occurring in all cells for copying DNA to transfer the genetic information to daughter cells .**



BASIC RULES OF DNA REPLICATION

1 . Replication is always semiconservative .

2 . Replication begins at the sequences called origins .

3 . DNA synthesis is initiated by short fragments of RNA call primers .

4 . The elongation of DNA strands is always in the 5' to 3' direction .

5. DNAreplicationcanbeuniorbidirectional.

6 . Replication is continuous on the leading strand and discontinuous on the lagging strand .

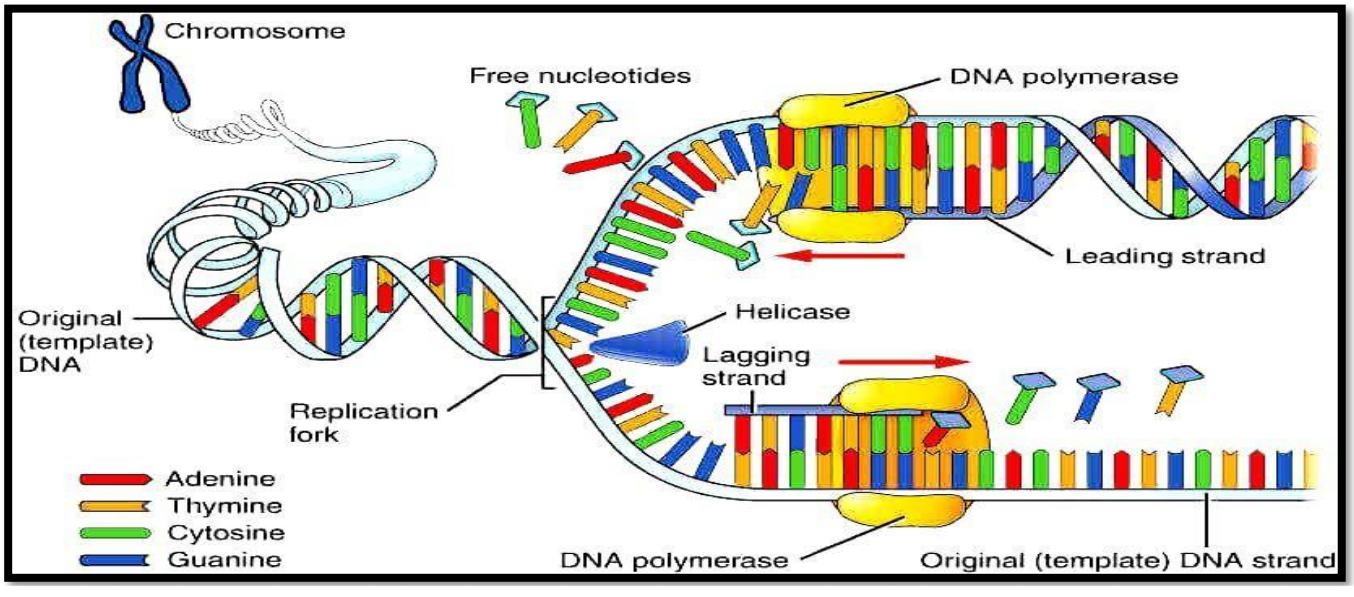
7 . New nucleotide strands are complementary and antiparallel to their template strands .

8 . Replication takes place at very high rates and is astonishingly accurate due to the processes of nucleotide selection , proof reading and repair mechanisms .

PROCESS OF DNA REPLICATION

step1:- Replication fork formation

- Before DNA can be replicated the double stranded molecule must be unzipped into two single strands.
- DNA has four base called adenine, thymine, cytosine and guanine that form pairs between the two strands.
- In order to unwind DNA these interaction between base pairs must be broken. These is performed by an enzyme known as DNA helicase.
- DNA helicase separate the strands into Y shape known as the replication fork



Step 2 :- Primer binding

- The leding strands is the simplest to replicated .
- once the DNA strands have been separated , a short piece of RNA called a primer binds to the 3' end of the strand .
- The primer always binds as the starting point for replication . Primers are generated by the enzyme DNA primase .
- DNA polymerase 3' can only nucleotides to existing strands of DNA .

Step 3 :- Elongation

Enzymes known as DNA polymerases are responsible creating the new

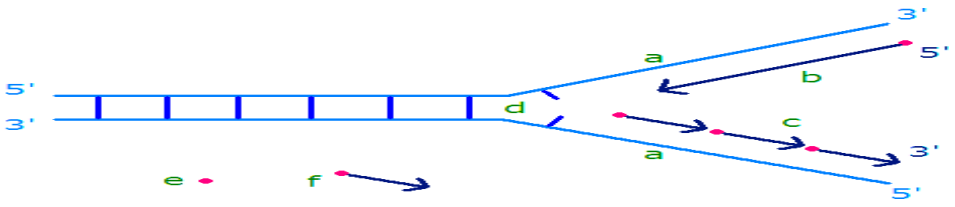
strands by a process called elongation .

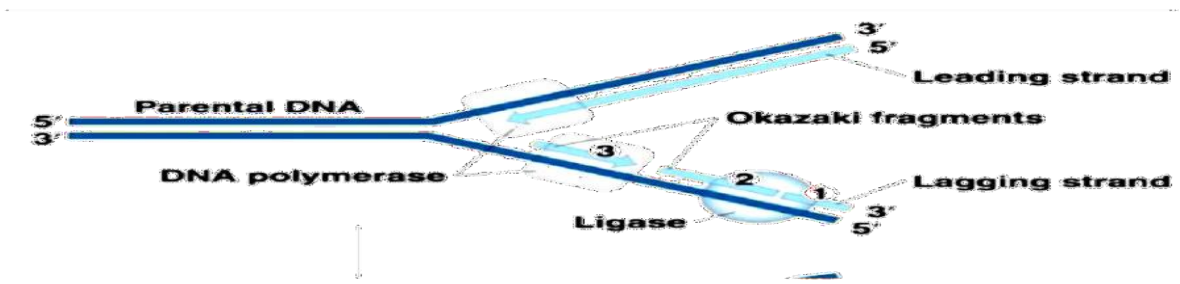
- In eukaryotic cells polymerases alpha , delta and epsilon are the primary polymerases involved in DNA replication . Because replication proceeds in the 5' to 3' direction on the leading strand , the newly formed strands is

continuous .

- The lagging strands begins replication by binding with multiple primer .
- Each primer is only several bases apart .
- DNA polymerase then adds pieces of DNA , called Okazaki fragments , to the strand between primers .

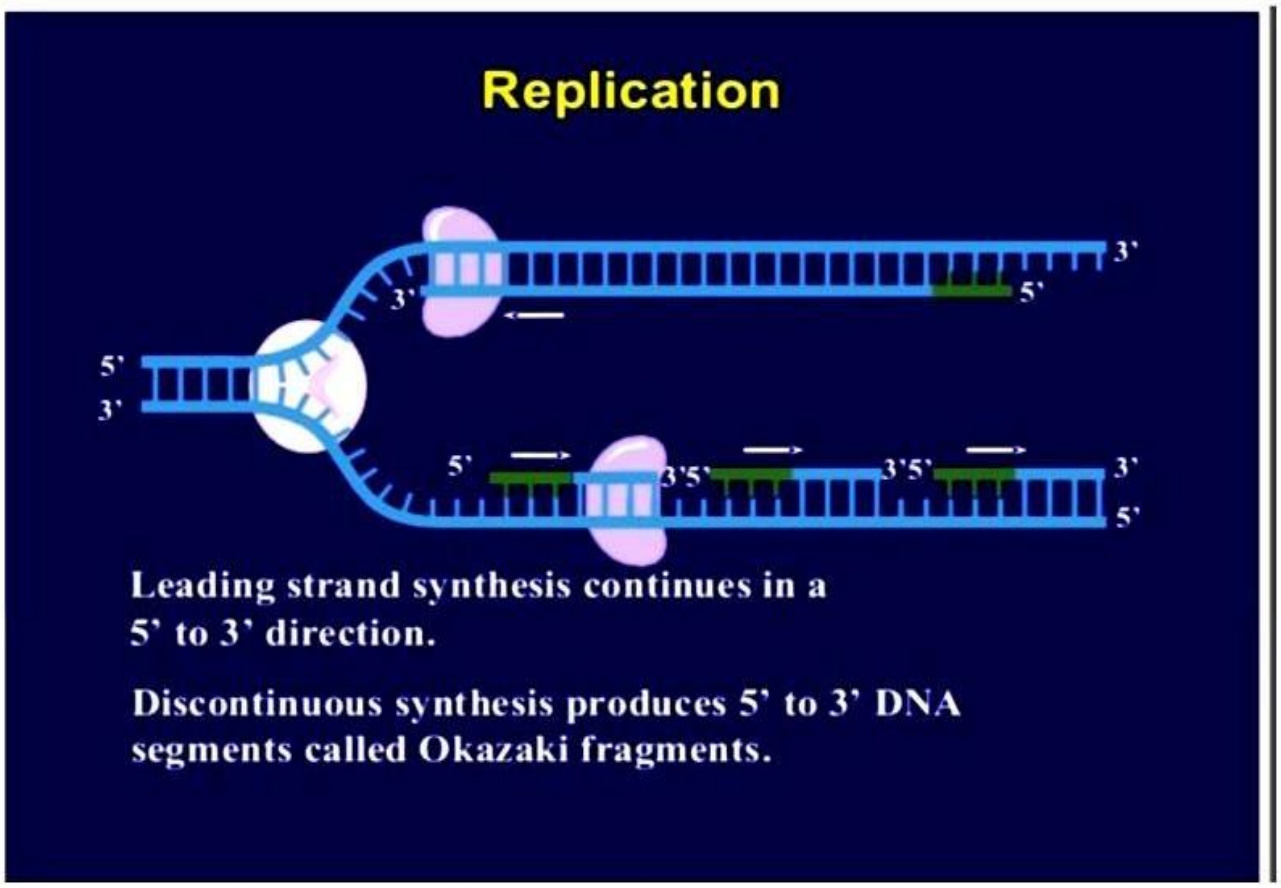
- This process of replication is discontinuous as the newly created fragments are disjointed .
- Involves the addition of new nucleotides based on complementarity of the templated strands .
- The daughter strands is elongated with the binding of more DNA nucleotides.





Step 4 :- 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 enzyme called DNA ligase joins Okazaki fragments together forming a single unified strands .
- The ends of the linear DNA presents a problem as DNA polymerase can only add nucleotides in the 5’ to 3’ direction .
- Once completed the parent strand and its complementary DNA strands 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 .



ENZYME INVOLVE IN DNA REPLICATION

DNA replication would not occur without enzymes that catalyse various steps in the process

1. **DNA helicase :-** unwind and separates double stranded as it moves along the DNA It forms the replication fork by breaking hydrogen bonds between nucleotide pairs in DNA.

2. **DNA primase :-** A type of RNA polymerase that generates RNA primers . RNA molecule acts as templates for the starting point of DNA replication.

3. **DNA polymerases :-** Synthesize new DNA molecules by adding nucleotides to leading and lagging DNA strands .

4. **DNA Gyrase or (Topoisomerase) :-** unwind and rewinds DNA strands to prevent the DNA from becoming tangled or supercoiled .

5. **DNA ligase :-** joins DNA fragments together by forming phosphodiester bonds between nucleotides .

6. **Single strand binding proteins :-** Keep the DNA single stranded after it has been melted by helicase .

7. **RNA primer :-** RNA primer composed of multiple bases that attached to the template strands to initiate the DNA replication .

8. **Telomerase :-** Finishes off the ends of DNA strands .

9. **Exonucleases :-** Group of enzymes that remove nucleotide bases from the end of a DNA chain.