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Commentary

# Various Functions and Types Involved in DNA Polymerases

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## DESCRIPTION

DNA Polymerases are a group of enzymes that catalyse the template directed synthesis of DNA during replication. The main function of DNA polymerases is to duplicate the DNA content of a cell during cell division. The discovery of DNA polymerase is one of the most important in the history of genetics. Studies have found that the enzyme plays a crucial role in DNA replication. Without it, cells would be unable to reproduce. DNA polymerases are divided into 7 families according to their sequence homology and 3D structure similarities. The families are:

1. Family A: DNA replication and condition of DNA Polymerase I, γ.
2. Family B: DNA replication and condition of DNA Polymerase II, α, δ, ε.
3. Family C: DNA replication in prokaryotes of DNA Polymerase III.
4. Family D: DNA replication in archaea.
5. Family X: DNA condition in eukaryotes.
6. Family Y: DNA replication of damaged DNA.
7. Family RT: Reversed transcriptase.

### Functions of DNA polymerases

The application of DNA polymerases is widely used in the area of research and diagnostics for the amplification of genetic materials. It was also applied in DNA cloning, Polymerase Chain Reaction (PCR), DNA sequencing, Single Nucleotide Polymorphism (SNP) detection, Whole Genome Amplification (WGA), synthetic biology and molecular diagnostics. There are certain factors about the polymerases like the stability, processivity, and more affecting the process and the final product. The main function of DNA polymerase is to replicate and form new DNA helixes and repair any mismatch or damage in the DNA. DNA polymerase duplicates the cellular DNA content every time a cell divides so that there is an equal distribution of DNA to the daughter cells. The three main functions of DNA polymerase are:

1. 5'→3'polymerization which is needed for replication and to add nucleotides at the 3 '-OH group of the growing DNA strand and filling the gaps.
2. 3'→5'exonuclease which is needed for proofreading and DNA polymerase removes any mistakenly added nucleotides while replication.
3. 5'→3'exonuclease which is responsible for removing RNA primers and condition.

### Types of DNA polymerases

Prokaryotic DNA polymerases and eukaryotic DNA polymerases are the two types of DNA polymerases.

- Prokaryotic DNA polymerases: Bacteria have 5 familiar DNA polymerases.

1. Pol I involved in DNA repair has both 5'->3' and 3'->5' exonuclease exertion.
2. Pol II involved in replication of damaged DNA; has 3'->5' exonuclease exertion.
3. Pol III is the main polymerase in bacteria (elongates in DNA replication); has 3'->5' exonuclease proofreading capability.
4. Pol IV a Y family DNA polymerase.
5. Pol V a Y family DNA polymerase participates in bypassing DNA damage.

- Eukaryotic DNA polymerases: Eukaryotes have at least 15 DNA polymerases.

1. Pol α (synonymes are DNA primase, RNA polymerase) acts as a primase (synthesizing a RNA primer), and further as a DNA Pol prolonging that primer with DNA nucleotides. After around 20 nucleotides extension is taken over by Pol δ (on the delaying strand) and ε( on the leading strand).
2. Pol β is involved in repairing DNA.
3. Pol γ is involved in replication of mitochondrial DNA.
4. Pol δ is the main polymerase on the dragging helix in eukaryotes, it's largely processive and has 3'->5' exonuclease exertion.

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5. Pol ε is the primary leading strand DNA polymerase in eukaryotes, and is also largely processive and has 3'->5' exonuclease exertion.
6. η, ι, κ, and Rev1 are Y-family DNA polymerases and Pol ζ is a B-family DNA polymerase. These polymerases are involved in the bypass of DNA damage.

There are also other eukaryotic polymerases known, which aren't as well characterized θ, λ, φ, σ, and μ. None of the eukariotic polymerases can remove primers (5'->3' exonuclease conditioning) that function is carried out by other enzymes. Only the polymerases that deal with the prolonging (γ, δ and ε) have proofreading capability (3'->5' exonuclease).