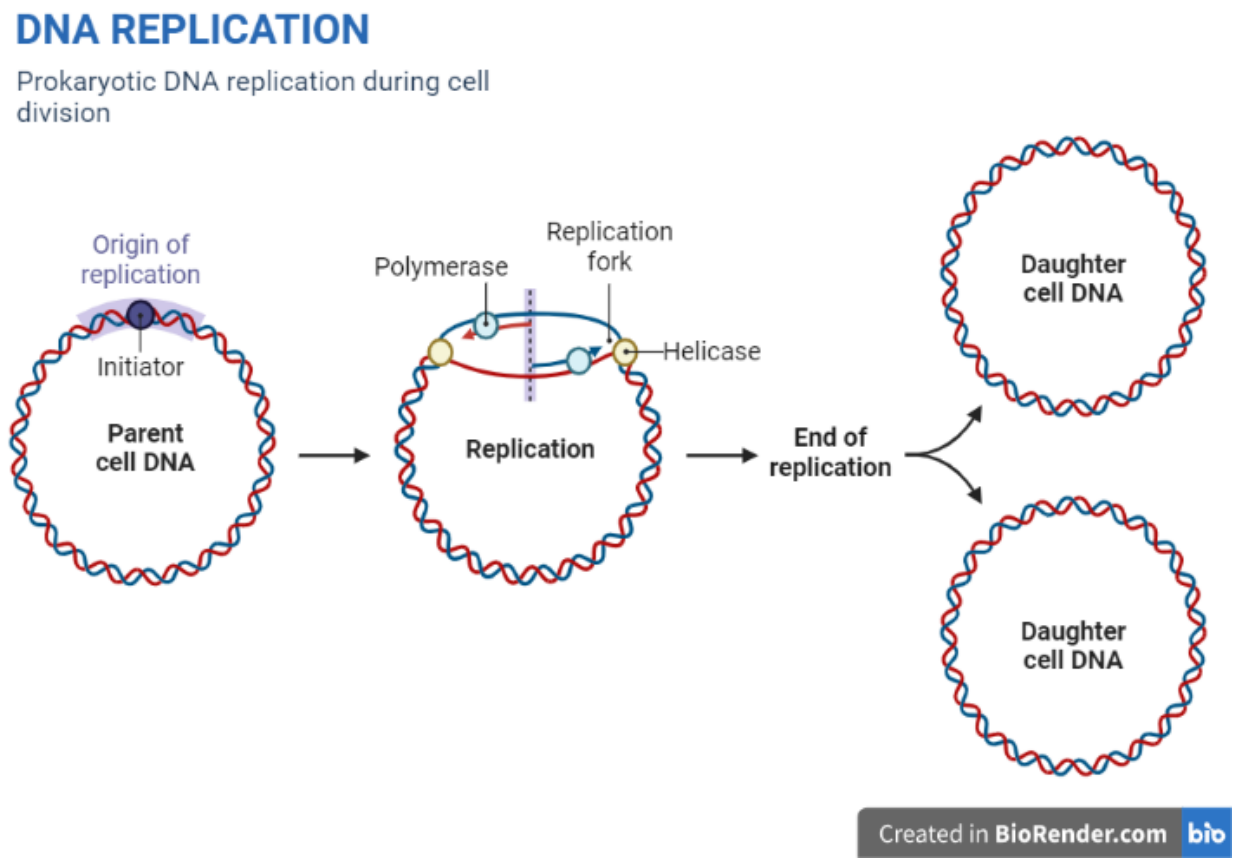
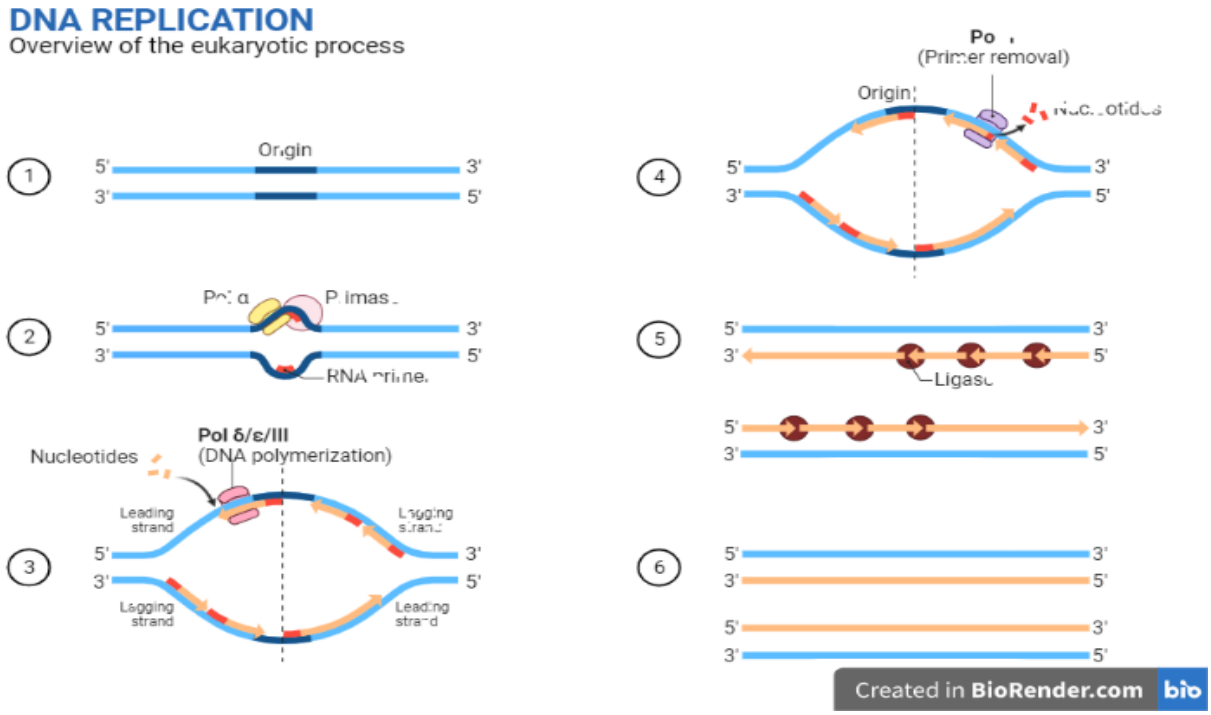
Replication in Prokaryotes and Eukaryotes – Explained

Replication is the process by which a cell duplicates its genetic material to pass on to its daughter cells during cell division. The replication process is different in eukaryotes and prokaryotes, which are two distinct types of cells.



In prokaryotes, such as bacteria, replication begins at a specific site on the circular DNA molecule called the origin of replication. The DNA is unwound, and the double helix is separated by the enzyme **helicase**. Single-stranded binding proteins stabilize the single-stranded DNA, and **primase** synthesizes RNA primers to initiate DNA synthesis. **DNA polymerase III** adds nucleotides to the 3' end of the RNA primer to form the new strand of DNA, while **DNA polymerase I** remove the RNA primer and replaces it with DNA. The leading strand is synthesized continuously, while the lagging strand is synthesized in short, Okazaki **fragments** that are later joined together by **DNA ligase**. The

result is two identical circular DNA molecules, each of which is passed on to a daughter cell during cell division.



In eukaryotes, replication is much more complex and occurs in a highly regulated manner. The DNA in eukaryotic cells is linear and is packaged into chromatin, which must be unwound and replicated in a coordinated fashion. Replication begins at multiple origins of replication throughout the genome, which are recognized by a complex of proteins called the **origin recognition complex (ORC)**. The **helicase** enzymes unwind the DNA at each origin, and replication proceeds bidirectionally from each origin, forming **replication bubbles**. DNA synthesis on the leading strand is continuous, while the lagging strand is synthesized in short Okazaki fragments. The RNA primers are removed, and the fragments are joined by DNA ligase. The result is two identical linear DNA molecules, each of which is packaged into a chromosome and passed on to daughter cells during cell division.

In summary, while the general principles of replication are the same in prokaryotes and eukaryotes, the process is much more complex in eukaryotes due to the linear nature of the DNA and the need to coordinate the replication of multiple origins throughout the genome.