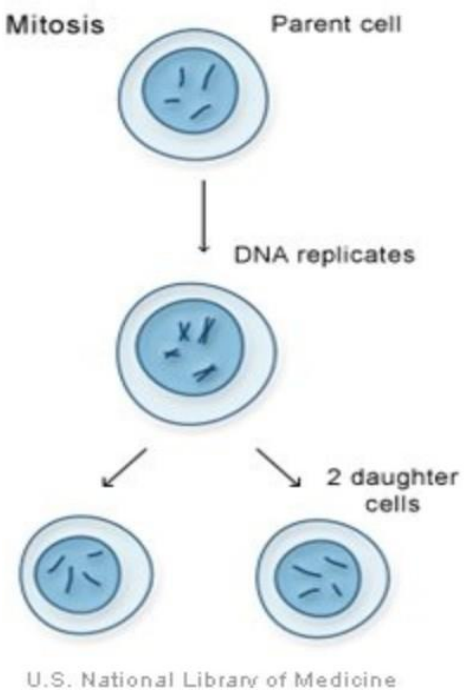
DNA replication (semi conservative model)

Cell Division (mitosis)

Cells must copy their chromosomes (DNA synthesis) before they divide so that each daughter cell will have a copy.

A region of the chromosome remains uncopied (centromere) in order to hold the sister chromatids together

Keeps chromatids organized to help make sure each daughter cell gets exactly one copy.



DNA Synthesis

The DNA bases on each strand act as a template to synthesize a complementary strand

Recall that Adenine (A) pairs with thymine (T) and guanine (G) pairs with cytosine (C)

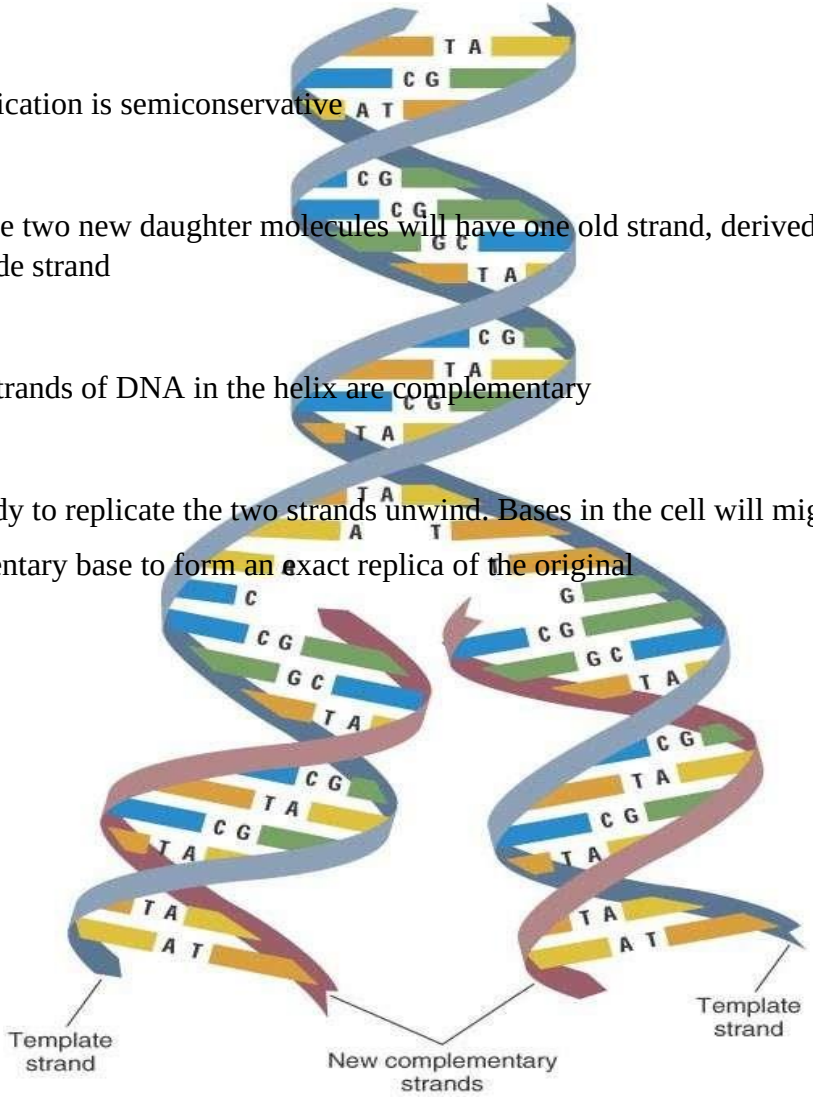
The process is semiconservative because each new double-stranded DNA contains one old strand (template) and one newly-synthesized complementary strand

DNA replication is semiconservative

Each of the two new daughter molecules will have one old strand, derived from the parent molecule, and one newly made strand

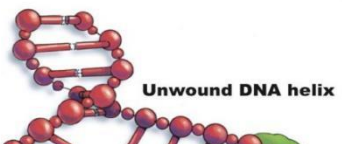
The two strands of DNA in the helix are complementary

When ready to replicate the two strands unwind. Bases in the cell will migrate and bind with their complementary base to form an exact replica of the original



DNA Polymerase

Enzyme that catalyzes the covalent bond between the phosphate of one nucleotide and the deoxyribose (sugar) of the next nucleotide



3’ end has a free deoxyribose and 5’ end has a free phosphate

DNA polymerase:

can only build the new strand in the 5’ to 3’ direction

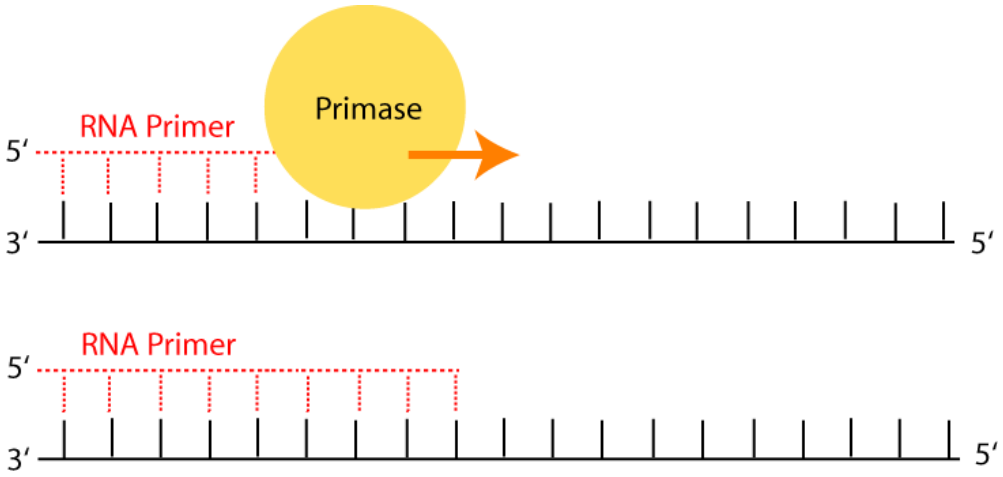
Thus scans the template strand in 3’ to 5’ direction

A)Initiation

Primase (a type of RNA polymerase) builds an RNA primer

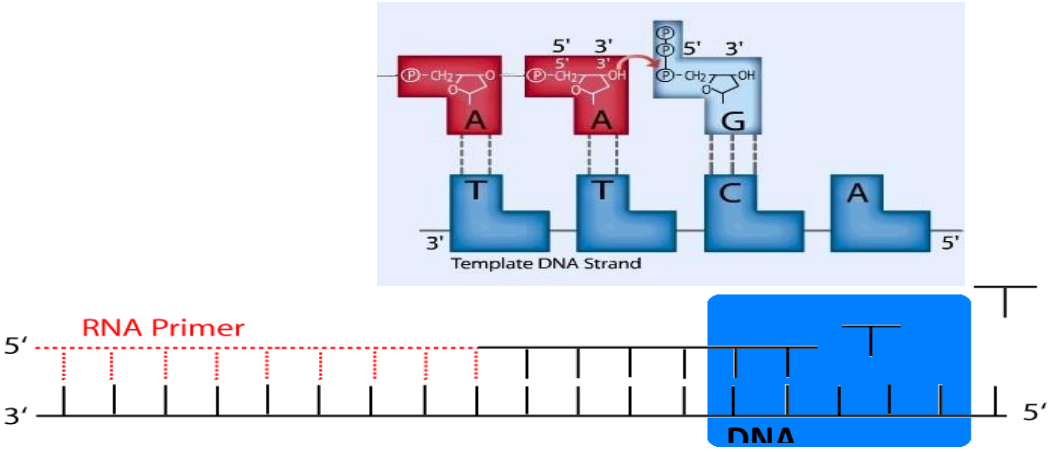
(5-10 ribonucleotides long)

DNA polymerase attaches onto the 3’ end of the RNA primer



B)Elongation

DNA polymerase uses each strand as a template in the 3’ to 5’ direction to build a complementary strand in the 5’ to 3’ direction



DNA polymerase uses each strand as a template in the 3’ to 5’ direction to build a complementary strand in the 5’ to 3’ direction. Its results in a leading strand and a lagging strand

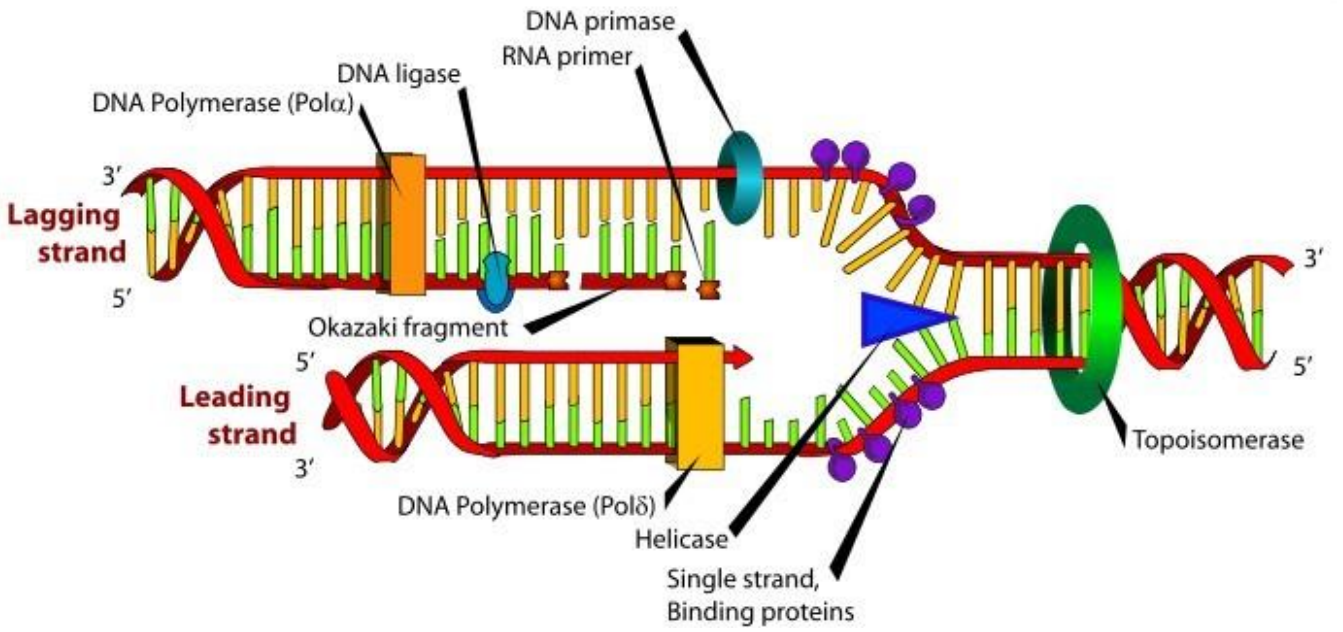
Leading Strand

Topisomerase unwinds DNA and then Helicase breaks H-bonds

DNA primase creates a single RNA primer to start the replication

DNA polymerase slides along the leading strand in the 3’ to 5’ direction synthesizing the matching strand in the 5’ to 3’ direction

The RNA primer is degraded by RNase H and replaced with DNA nucleotides by DNA polymerase, and then DNA ligase connects the fragment at the start of the new strand to the end of the new strand (in circular chromosomes)



Lagging Strand

Topisomerase unwinds DNA and then Helicase breaks H-bonds

DNA primase creates RNA primers in spaced intervals

DNA polymerase slides along the leading strand in the 3’ to 5’ direction synthesizing the matching Okazaki fragments in the 5’ to 3’ direction

The RNA primers are degraded by RNase H and replaced with DNA nucleotides by DNA polymerase

DNA ligase connects the Okazaki fragments to one another (covalently bonds the phosphate in one nucleotide to the deoxyribose of the adjacent nucleotide)

Enzymes involved:

Topoisomerase - unwinds DNA

Helicase – enzyme that breaks H-bonds

DNA Polymerase – enzyme that catalyzes connection of nucleotides to form complementary DNA strand in 5’ to 3’ direction (reads template in 3’ to 5’ direction)

Leading Strand – transcribed continuously in 3’ to 5’ direction

Lagging Strand – transcribed in segments in 5’ to 3’ direction (Okazaki fragments) DNA Primase – enzyme that catalyzes formation of RNA starting segment (RNA primer)

DNA Ligase – enzyme that catalyzes connection of two Okazaki fragments