CONCEPT: DNA REPLICATION

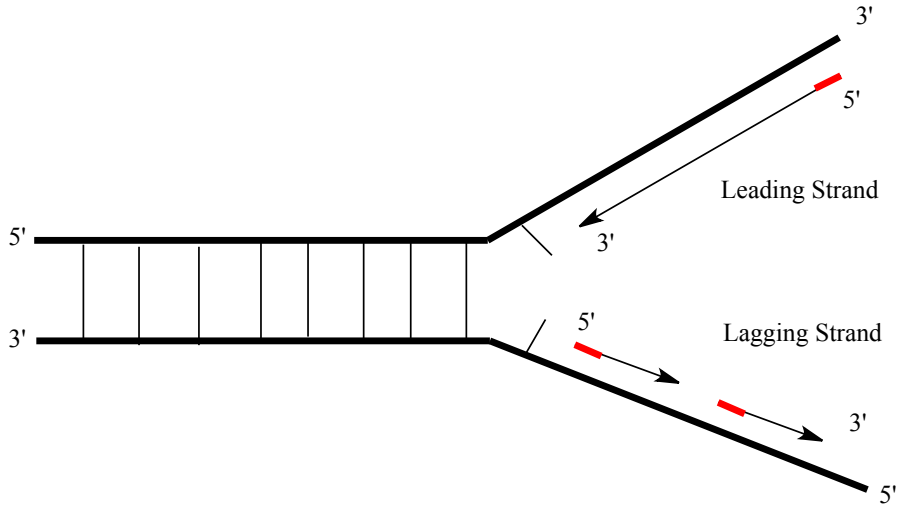
● DNA replication occurs _____ on each strand of DNA

□ On the **leading strand** DNA replication proceeds continuously adding nucleotides from 5' to 3'

□ On the **lagging strand** DNA replication proceeds continuously adding nucleotides from 5' to 3'

□ DNA can only be synthesized from 5' to 3', meaning that the template strand is read from 3' to 5'

EXAMPLE:



Steps of Replication

● The first step of replication involves _____ the double helix

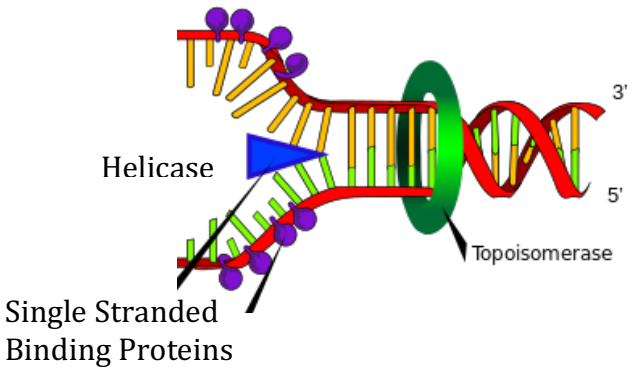
□ **DNA Helicase** attaches to the DNA and unwinds the double helix

- Breaks hydrogen bonds

□ **Single-strand binding proteins** bind to the unwound DNA strands and prevent them from reforming

□ **Topoisomerases** relax the supercoiling caused from DNA unwinding

EXAMPLE:



● The second step of replication involves the use of important _____

□ The **Pol III Holoenzyme** consists of **DNA polymerase III** and accessory replication proteins

- **DNA pol III** replicates the DNA

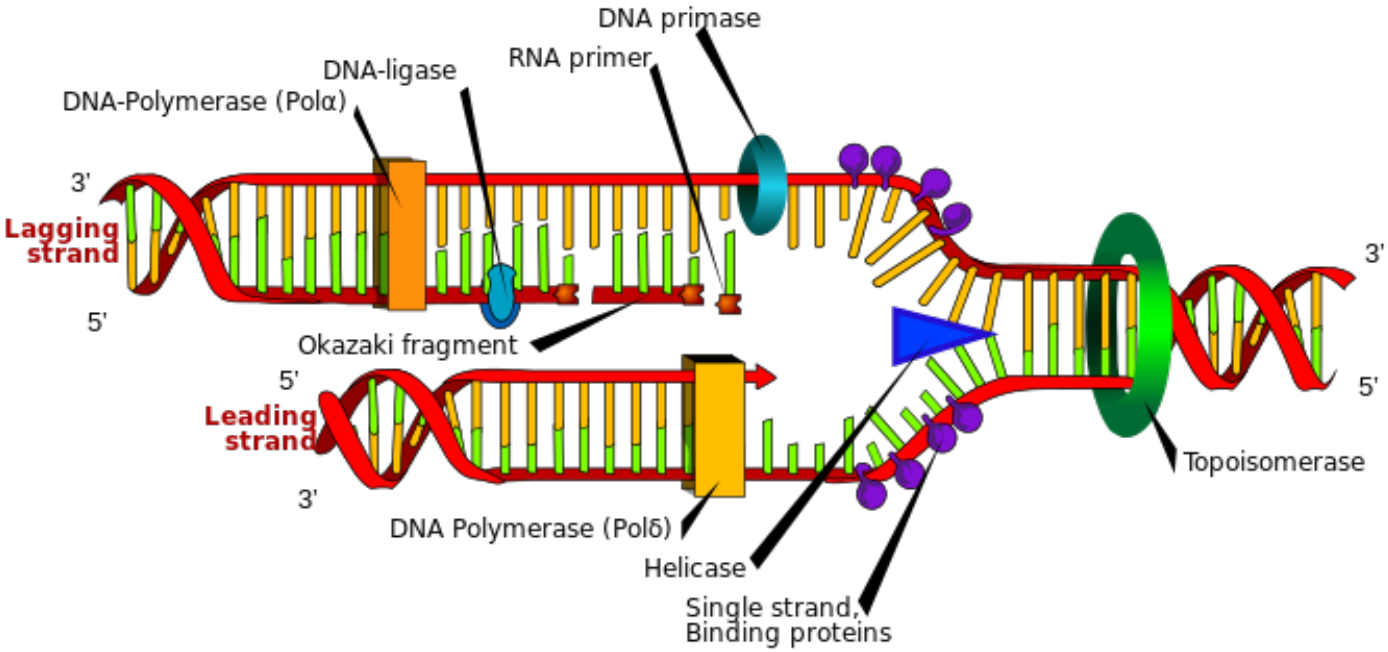
- Without accessory proteins, DNA pol III would only add around 10 nucleotides before falling off the DNA

□ To start replication the **primase (primosome)** enzyme synthesizes RNA primers

- DNA pol III recognizes these primers and starts DNA replication

- **DNA pol I** removes the RNA primers and replaces them with DNA after replication has started

EXAMPLE:



● The lagging strand is replicated discontinuously, creating many replicated DNA _____

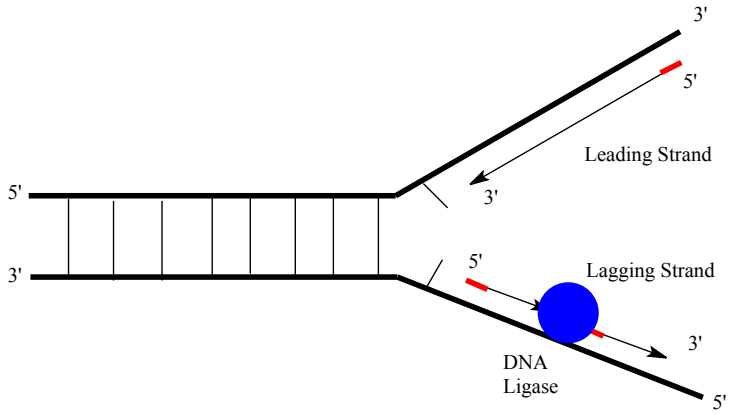
□ As the helix is unwound, primase adds RNA primers onto the 3' end of the template strand

- Replication continuous until it reaches the beginning of the strand, or a previous fragment

- **Okazaki fragments** are created by the discontinuous replication on the lagging strand

□ **DNA ligase** joins all Okazaki fragments together, to create a single new replicated strand of DNA

EXAMPLE:



Proofreading

● DNA replication occurs with extremely high _____

□ There is less than 1 error per every 10^{10} nucleotides replicated

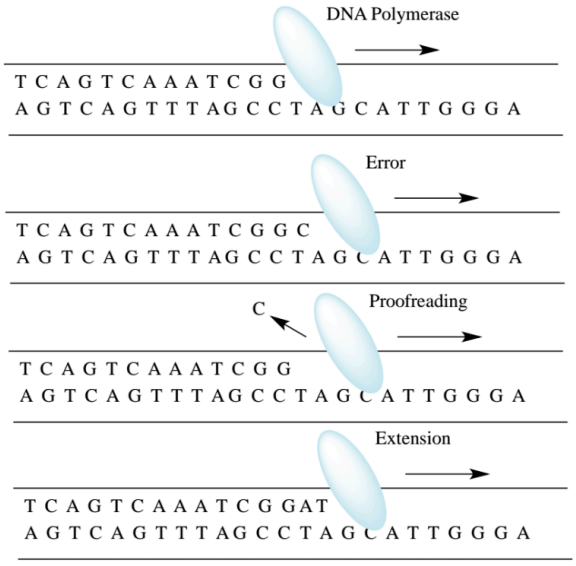
- Nearly 1000 nucleotides are replicated per strand, per second

□ The DNA polymerase has **proofreading** abilities

- If a DNA mismatch is made between two base pairs, it will pause, excise the base, and replace it

- DNA polymerase has 3' to 5' **exonuclease** activity – meaning it can excise a mismatched nucleotide

EXAMPLE:



PRACTICE

1. Which of the following proteins is responsible for unwinding the double stranded DNA?
    a. Topoissomerases
    b. Single-stranded binding proteins
    c. DNA helicase
    d. DNA polymerase III

2. DNA replication synthesizes DNA in which direction?
    a. 5’ to 3’
    b. 3’ to 5’
    c. Leading strand 5’ to 3’, lagging strand 3’ to 5’
    d. Leading strand 3’ to 5’, lagging strand 5’ to 3’

3. What would happen to DNA replication in DNA polymerase lost its 3' to 5' exonuclease activity?
    a. Replication would speed up
    b. Proofreading would stop and replication would stall
    c. Replication would only occur on the leading strand
    d. Replication would only occur on the lagging strand

4. Which of the following proteins is responsible for synthesizing RNA primers?
    a. Topoisomerases
    b. Single-stranded binding proteins
    c. Primase
    d. DNA polymerase III

5. The short DNA fragments created during lagging strand replication are called what?
    a. Primers
    b. Okazaki Fragments
    c. Replicates
    d. Exonucleases