DNA Replication

Carl Andersen Tan – December 4 Textbook Presentation

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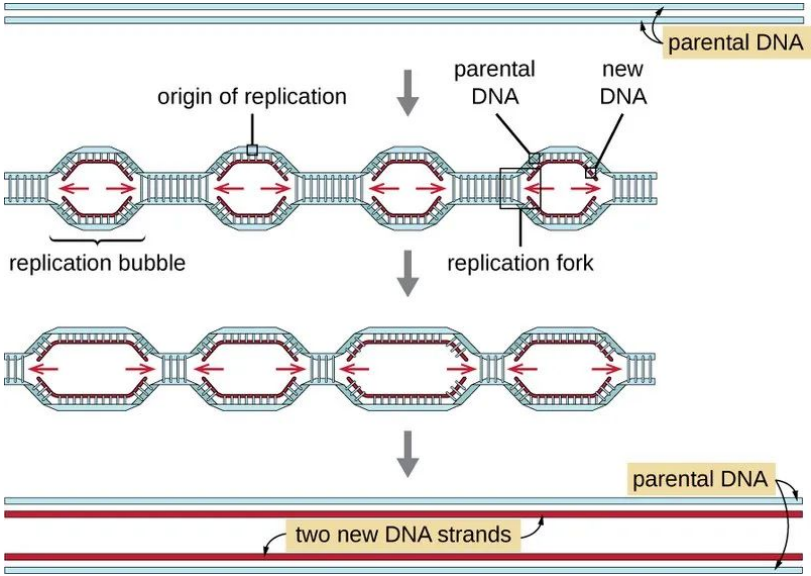
Overview of DNA replication

- DNA replication is the biological process by which a cell copies its DNA.
- Consists of 3 main steps:
  - **Initiation** - Double helix unwinds at origins of replication, creates replication forks
  - **Elongation** - Complementary DNA strands synthesized using original strand as templates (semi conservative replication)
  - **Termination**- Replication ends when the entire DNA molecule is replicated



Overview of DNA replication

- DNA replication is controlled by multiple proteins:
  - DNA Primase
  - DNA Ligase
  - DNA helicase
  - DNA Polymerase
  - Clamp Loader
  - Single Stranded Binding Proteins

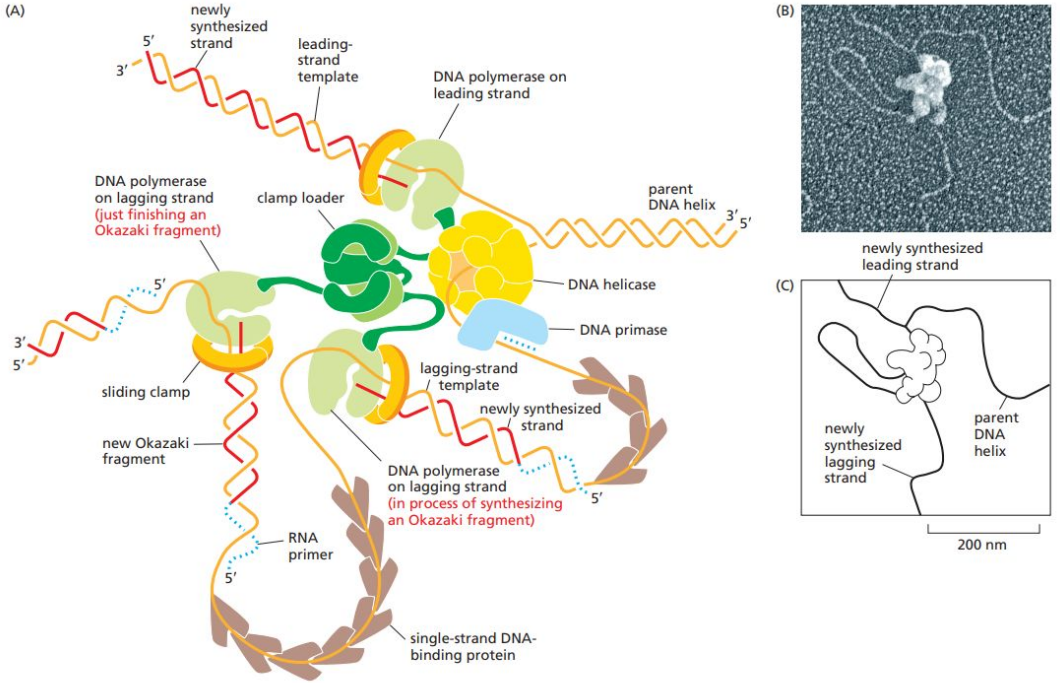
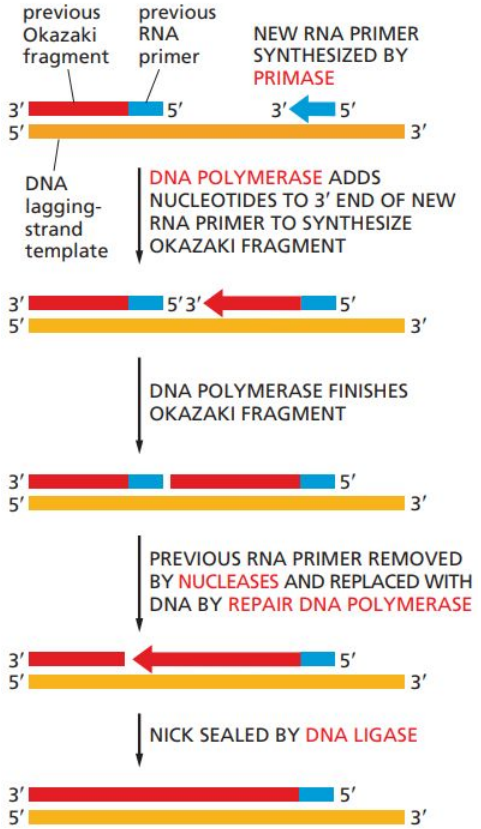


Figure 5–18 **A bacterial replication fork.** (A) In this case, a single DNA polymerase molecule synthesizes the leading strand

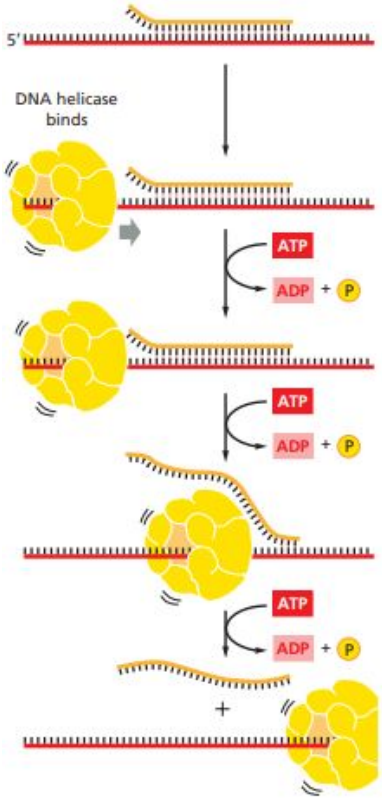
DNA Primase/DNA Ligase

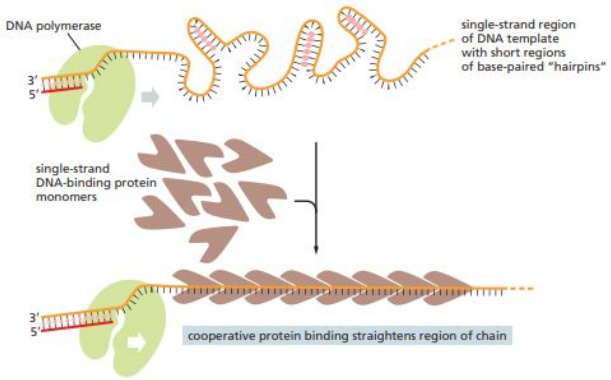
- A **RNA primer** synthesized by DNA primase is needed to start replication. DNA polymerase requires a -OH group at the 3' end to elongate the chain
- RNA primer is used as self-correcting polymerases cannot start chains de novo– these areas are marked for a more-accurate DNA polymerase to replace
- Synthesis of **Okazaki fragments** ends when it runs into a RNA primer
- DNA ligase joins together okazaki fragments using ATP

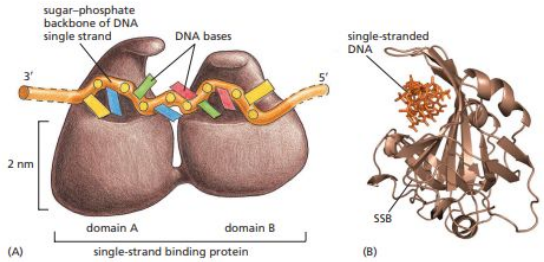


DNA Helicase and Single Stranded Binding Proteins

- DNA helix must open up DNA ahead of the replication fork
- DNA helicase acts as a **“moving wedge”**
- Single Stranded Binding Proteins bind tightly and cooperatively to **prevent DNA annealing.**
- Single Stranded binding proteins coat and straighten out the single stranded DNA

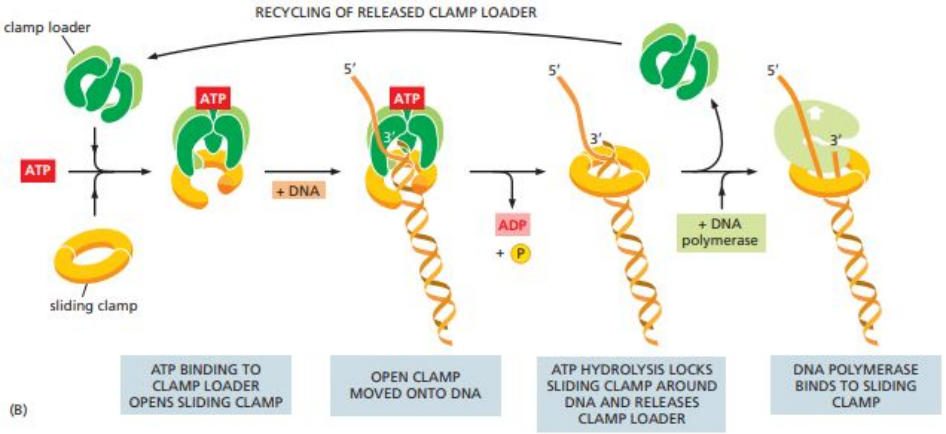






Clamp Loader and DNA Polymerase

- The clamp is a ring-shaped protein that encircles DNA. It acts as a **processivity factor**, ensuring that DNA polymerase remains attached to the DNA strand during replication.
- DNA polymerase synthesizes new DNA strands by adding nucleotides complementary to the template strand.
- Many DNA polymerases have **proofreading activity** through 3’ to 5’ exonuclease activity, ensuring high fidelity



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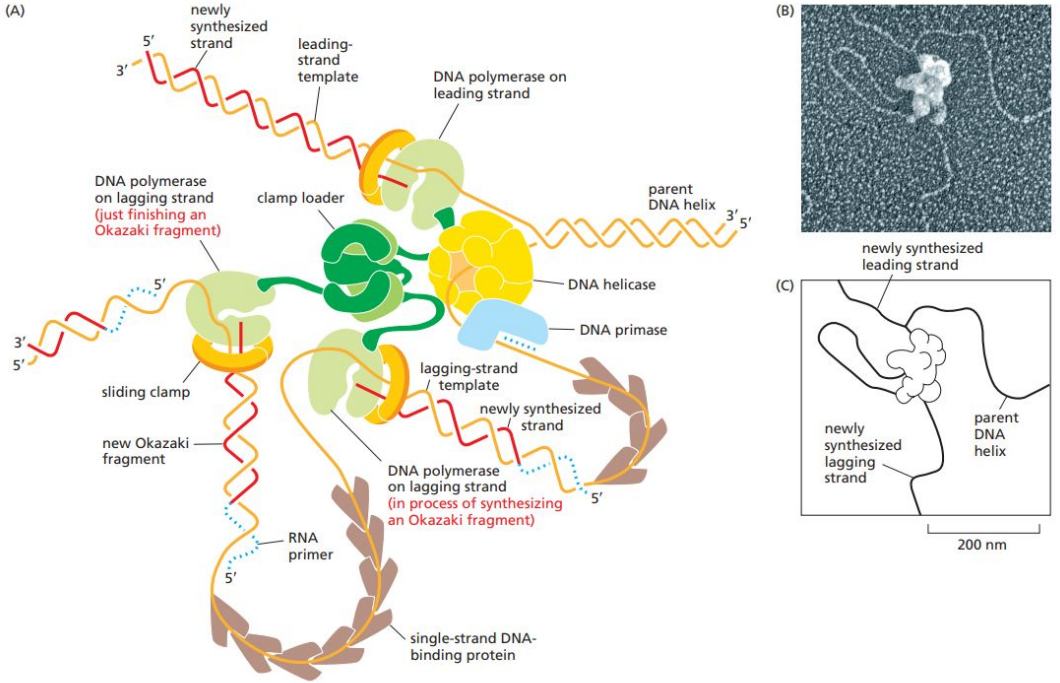

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Thank you