Initiating DNA Replication

Phuc Loi Luu, PhD

Email: Luu.p.loi@googlemail.com

Zalo: 0901802182

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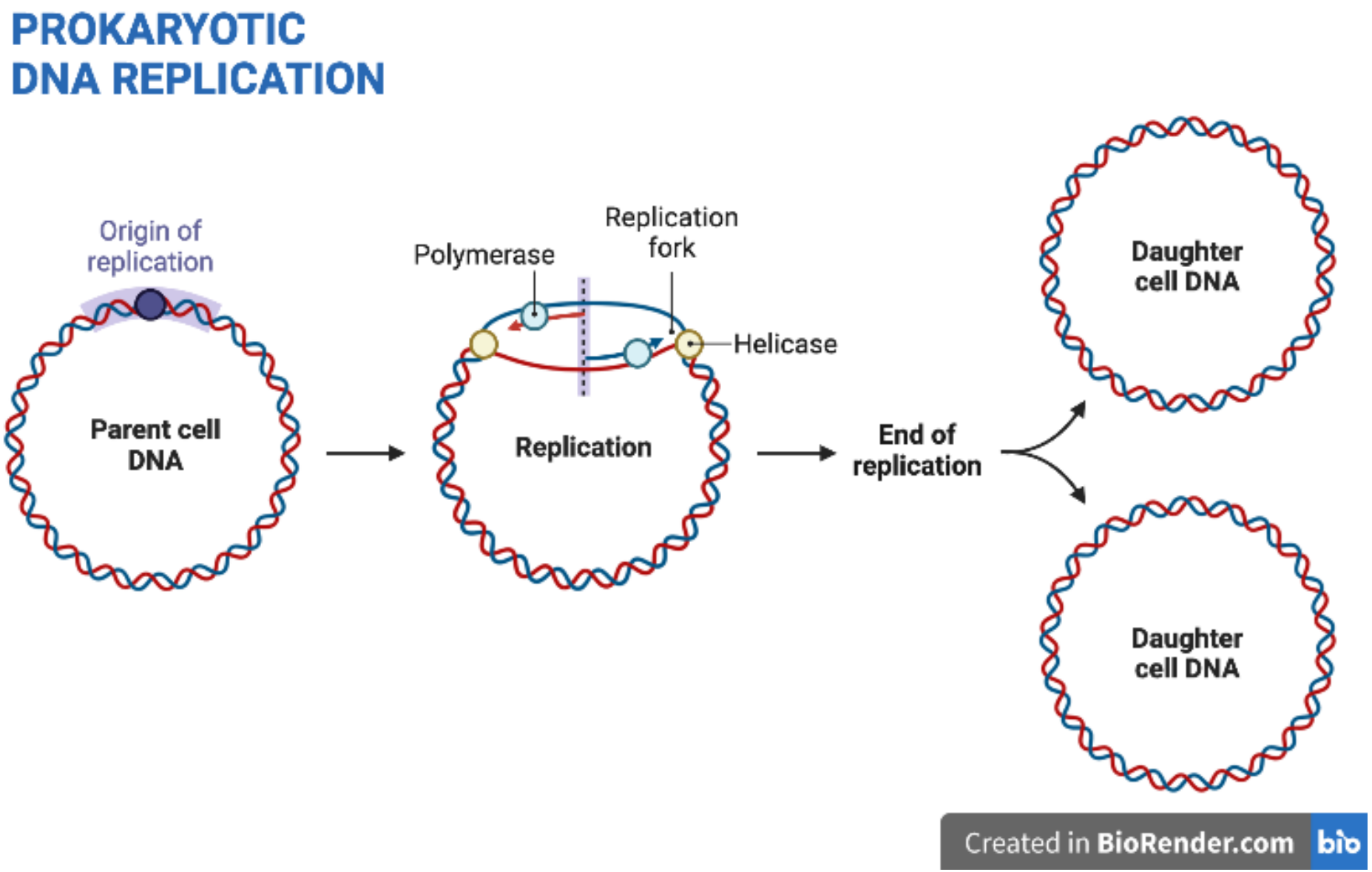
DNA Replication



Beyond the "Ends": Where Replication Begins

- Most organisms do not start replication at the end of a chromosome.
- Bacteria (E. coli): Chromosomes are circular; therefore, there is no "end" to start from.
- Eukaryotes: Though chromosomes are linear, replication still initiates internally rather than at the tips.
- Exceptions: Only a few specific viruses are known to initiate replication from the ends of the genome.

Some Definitions

Term	Definition
Origin of Replication	The **physical site** where DNA is initially unwound and synthesis is initiated.
Efficiency	The percentage of cell divisions in which a specific origin initiates.
Replicon	The total region of DNA replicated by the forks derived from a single origin.

- **Origin Efficiency**: Bacterial origins usually initiate at or near 100%, while most eukaryotic origins are much less efficient.
- **Directionality**: Almost all known origins are bi-directional, generating two replication forks that move in opposite directions.

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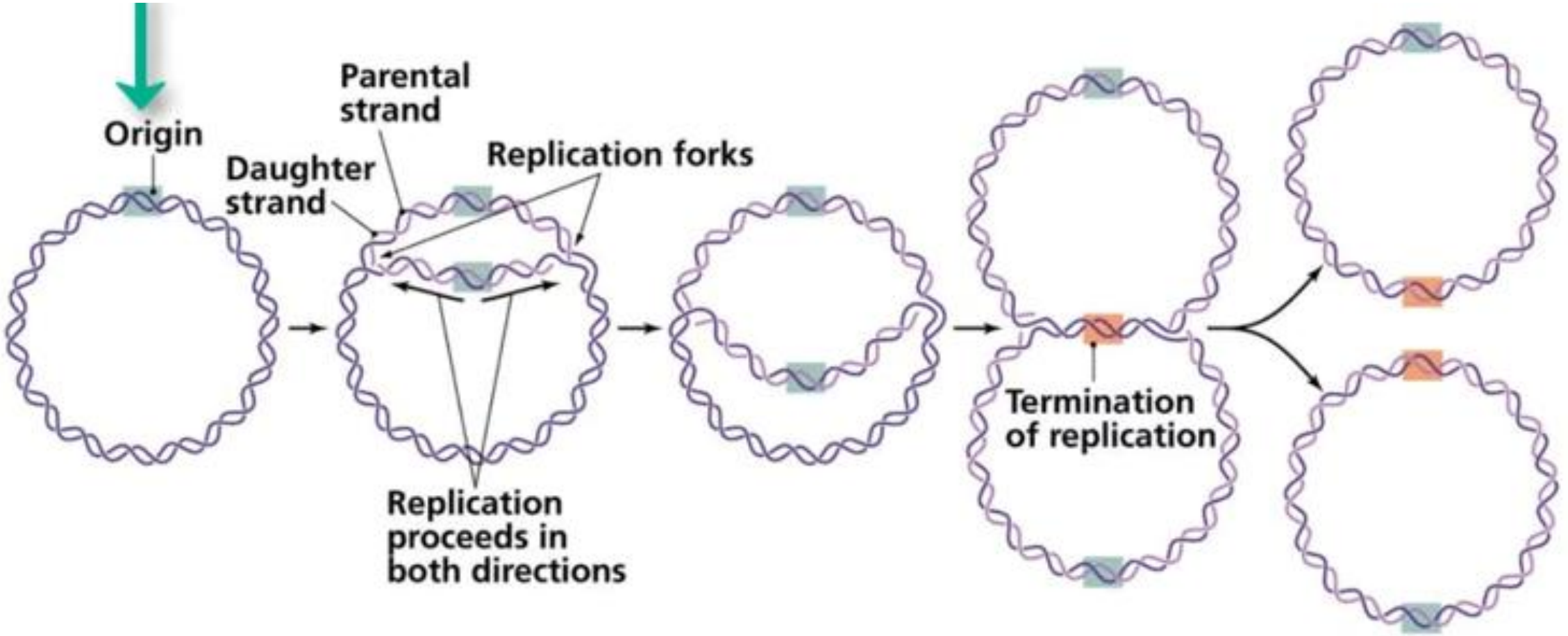


The Replicon Model

Proposed by Sydney Brenner and François Jacob, this model defines two functional components required for initiation:

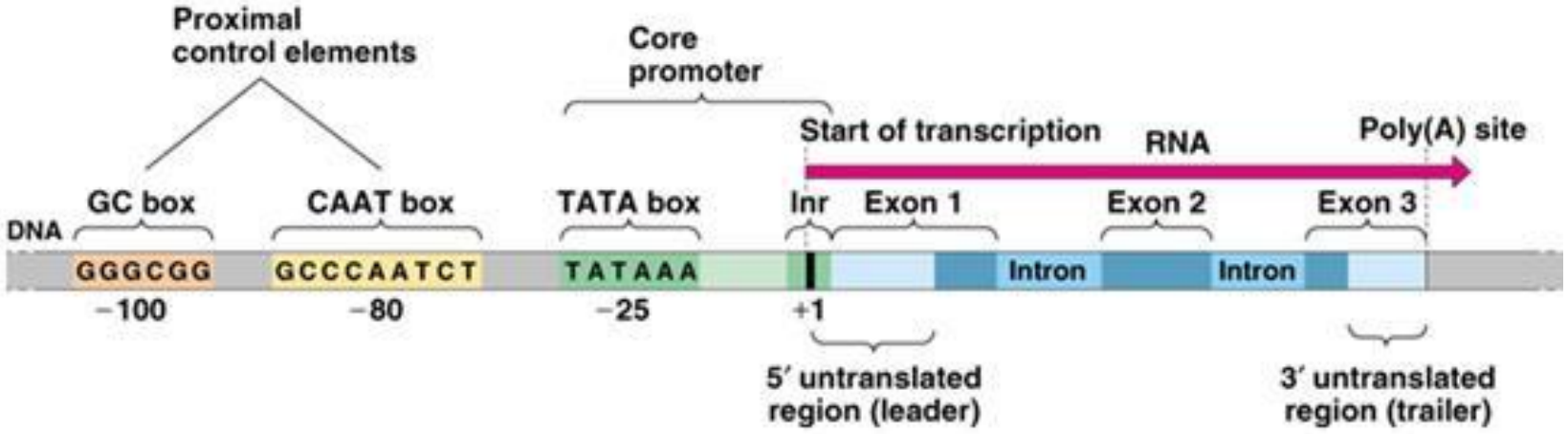
- **The Replicator (Genetic Entity)**: The specific DNA sequence required to initiate replication. If essential parts of this sequence are removed, replication will not start.
- **The Initiator (Protein)**: A protein that recognizes and binds to the replicator to activate the initiation process.

Replicator vs. Origin: The Transcription Analogy

It is vital to distinguish between the genetic instructions and the physical action.

"The replicator is to the origin as a promoter is to a transcription start site."

- Overlap: Replicators and origins typically overlap, but they are not identical.
- Size Variance: The replicator is usually the same size or much larger than the origin.
- Extreme Cases: Some replicators exceed 50 Kb in size, while the physical origin may only be a 100 base pair region.



Test your understanding of the lecture

1. True or False? **Most eukaryotic organisms initiate DNA replication at the very ends of their linear chromosomes.**
Answer: False. In all but a few viruses, replication does not start from the ends.
2. **Efficiency Check: If a specific origin of replication in a eukaryotic cell has an "efficiency" of 60%, what does that mean?**
Answer: It means the origin initiates replication in 60% of cell divisions. Unlike bacterial origins, eukaryotic origins are often much less than 100% efficient.
3. The Genetic vs. Physical: Which term refers to the physical site where DNA is initially unwound?
Answer: The Origin of Replication. The "Replicator" is the genetic DNA sequence required for that initiation to occur.
4. The Initiator's Role: According to the Brenner and Jacob "Replicon Model," what is the function of the Initiator?
Answer: It is a protein that recognizes and binds to the replicator sequence to activate the initiation of replication.