



# Nucleic acid metabolism and Genetic information transfer

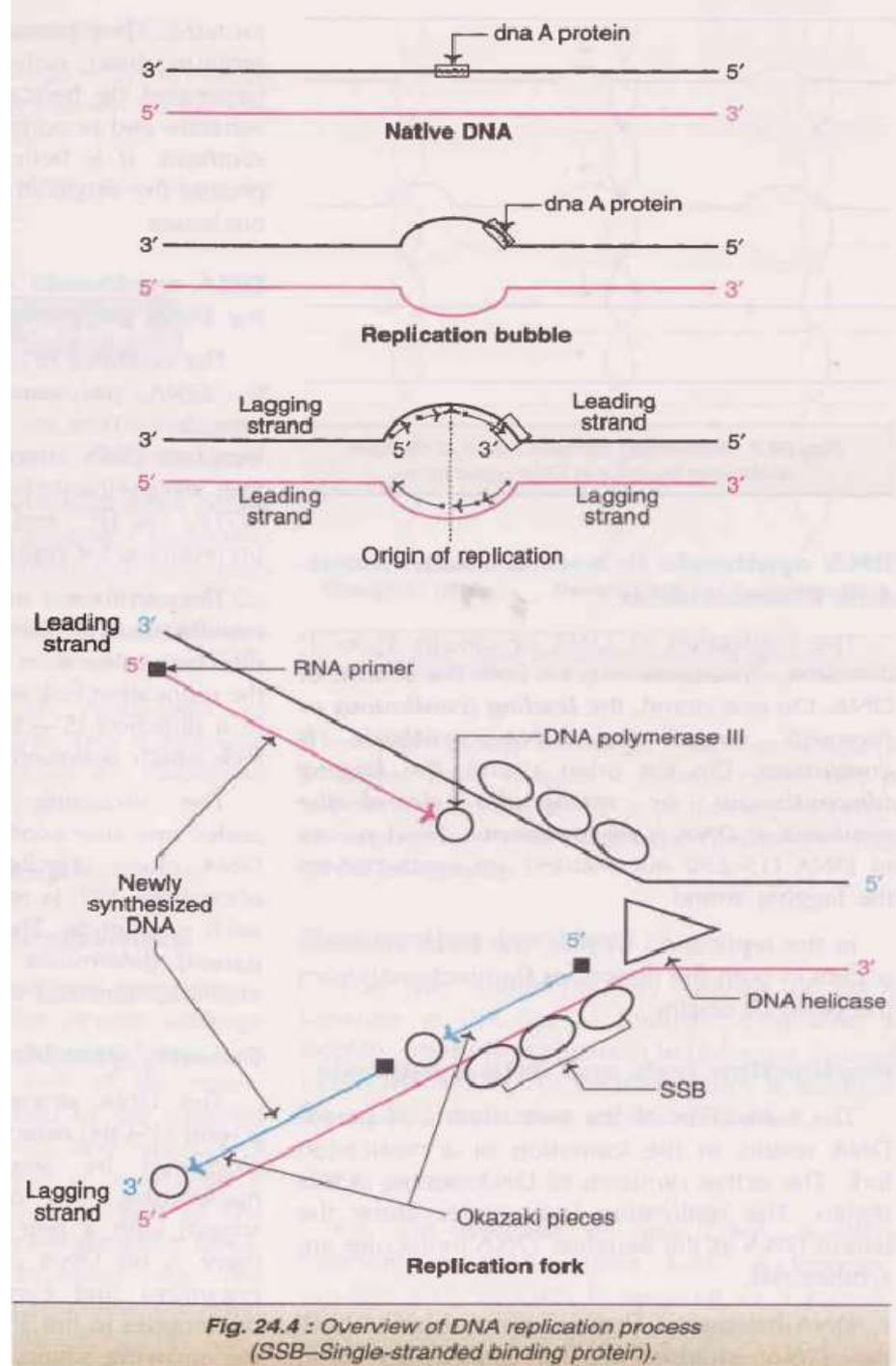
VIJAYA KUMAR MEHER

# DNA replication (semi conservative model)

- Replication is a process in which DNA copies itself to produce identical daughter molecules of DNA.
- Replication is semi conservative.
- The parent DNA has two strands complementary to each other.
- Both the strands undergo simultaneous replication to produce two daughter molecules.
- Each one of the newly synthesized DNA has one-half of the parental DNA (one strand from original) and one-half of new DNA.
- This type of replication is known as semiconservative since half of the original DNA is conserved in the daughter DNA
- Each strand serves as a template, over which a new complementary strand is synthesized

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- A specific protein called **dna A** binds at the **origin for replication** causes the double-stranded DNA to separate.
  - The two complementary strands of DNA separate at the site of replication to **form a bubble**.
  - For the synthesis of new DNA, a short fragment of RNA is required as **a primer**.
  - The replication of DNA occurs in 5' to 3' direction, simultaneously , on both the strands of DNA.
  - DNA synthesis is continuous in the **leading strand** and discontinuous in the **lagging strand**.
  - The separation of the two strands of parent DNA results in the formation of a **replication fork** and the active synthesis of DNA occurs in this region.
  - **DNA helicases** bind to both the DNA strands at the replication fork and separate the strands.
  - **Single-stranded DNA binding (SSB) proteins** / DNA helix-destabilizing proteins provide the template for new DNA synthesis

- The synthesis of a new DNA strand in 5' to 3' is catalyzed by **DNA polymerase III**.
- The DNA strand (leading strand) with its 3'-end (3'-OH) oriented towards the fork can be elongated by sequential addition of new nucleotide.
- **Okazaki pieces** are the small fragments of the discontinuously synthesized DNA.
- These are produced on the lagging strand of the parent DNA.
- Okazaki pieces are joined to form a continuous strand of DNA with the help of **DNA polymerase I** and **DNA ligase**.



# Transcription or RNA synthesis

- Transcription is a process in which **RNA is synthesized from DNA.**
- one of the two strands of DNA serves as a **template**( non-coding strand or sense strand) and produces working copies of RNA molecules.
- The other DNA strand which does not participate in transcription is known as **coding strand or antisense strand.**
- The product formed in transcription is referred to as primary transcript (inactive).
- They undergo certain post-transcriptional modifications to produce functionally active RNA molecules
- Transcription involves three different **stages- initiation, elongation and termination**

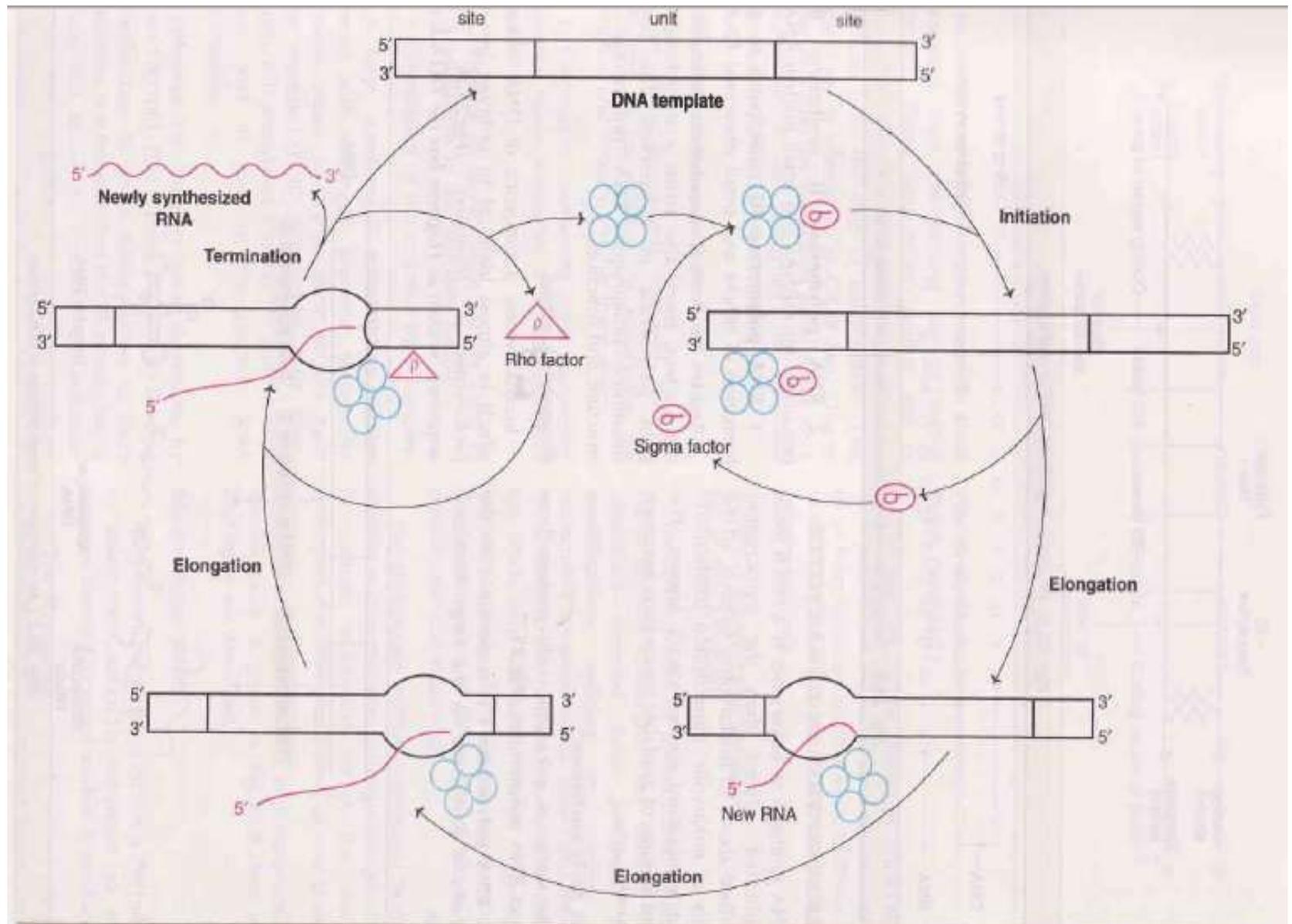


Fig. 25.4 : Synthesis of RNA from DNA template (transcription).

## Initiation:

- **Sigma factor** of RNA polymerase bind to the **promoter region** in DNA
- There are two base sequences on the coding DNA strand which the sigma factor of **RNA polymerase** can recognize for initiation of transcription.
- There are two base sequences on the coding DNA strand
  1. **Pribnowbox (TATA box)** consists of 6 nucleotide bases( TATAAT) located on the left side about 10 bases away from the starting point of transcription.
  2. **The '-35' sequence** contains a base sequence TTCACA, which is located about 35 bases away on the left side from the site of transcription start.

## Elongation:

- The sigma factor is released and transcription proceeds.
- RNA is synthesized from 5' end to 3' end antiparallel to the DNA template.
- RNA polymerase **utilizes ribonucleotide triphosphates** (ATP, CTP, CTP and UTP) for the formation of RNA

## Termination:

- The process of transcription stops by termination signals.
- Two types of termination are identified.

### Rho ( $\rho$ ) dependent termination:

- A specific protein ( $\rho$  factor) binds to the growing RNA or weakly to DNA, and in the bound state it acts as ATPase and terminates transcription and release RNA.

### Rho ( $\rho$ ) independent termination:

- Termination occurs due to the formation of hairpins of newly synthesized RNA.
- This occurs due to the presence of palindromes