Transcription Elongation, Pausing, Arrest, and Termination: Structure and Mechanism

MULTI-SUBUNIT RNA POLYMERASES

<table>
<thead>
<tr>
<th></th>
<th>β'</th>
<th>β</th>
<th>α'</th>
<th>α''</th>
<th>ω</th>
</tr>
</thead>
<tbody>
<tr>
<td>bacterial RNA polymerase</td>
<td>β'</td>
<td>β</td>
<td>α'</td>
<td>α''</td>
<td>ω</td>
</tr>
<tr>
<td>archaeal RNA polymerase</td>
<td>A''/A'</td>
<td>B</td>
<td>D</td>
<td>L</td>
<td>K</td>
</tr>
<tr>
<td>eukaryotic RNA polymerase I</td>
<td>RPA1</td>
<td>RPA2</td>
<td>RPC5</td>
<td>RPC9</td>
<td>RB6</td>
</tr>
<tr>
<td>eukaryotic RNA polymerase II</td>
<td>RB1</td>
<td>RB2</td>
<td>RB3</td>
<td>RB11</td>
<td>RB6</td>
</tr>
<tr>
<td>eukaryotic RNA polymerase III</td>
<td>RPC1</td>
<td>RPC2</td>
<td>RPC5</td>
<td>RPC9</td>
<td>RB6</td>
</tr>
</tbody>
</table>

Dr. Richard Ebright, Rutgers (KITP Bio Networks Program 1/22/03)
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\[ R + P \leftrightarrow RP_c \rightarrow RP_o \rightarrow RP_{ltc} \rightarrow RD_e \]

abortive synthesis

\[ R + P \leftrightarrow RP_c \rightarrow RP_o \rightarrow RP_{ltc} \rightarrow RD_e \]

abortive synthesis
pausing
editing
Transcription elongation: key issues

- Elongation mechanisms
  - Force generation
  - Coupling of chemical and mechanical energy
- Termination mechanisms
- Pausing mechanisms
- Editing mechanisms
- Sequence effects
- Quantitative simulation
- Informatics

Transcription elongation: reaction

\[ \text{RNA}_n + \text{NTP (ATP, CTP, GTP, UTP)} \rightarrow \text{RNA}_{n+1} + \text{PP}_i \]
Transcription elongation: structure
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-2
(REVERSE TRANSLATED)

-3
(REVERSE TRANSLATED)
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0 (UNTRANSLOCATED)

+1 (FORWARD TRANSLOCATED)
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![Diagram](image)

+2
(FORWARD TRANSLOCATED)

+1
(FORWARD TRANSLOCATED, NTP BOUND)
Transcription elongation: current work

- Experimentation
  - Elongation
  - Termination
  - Pausing
  - Editing
  - Cooperative effects
    - Multiple RNAP molecules
    - Ribosomes
  - Quantitative simulation
  - Informatics