Transcription

Carl Andersen Tan – February 26 Textbook Presentation

Review of transcription from previous textbook presentation + extra

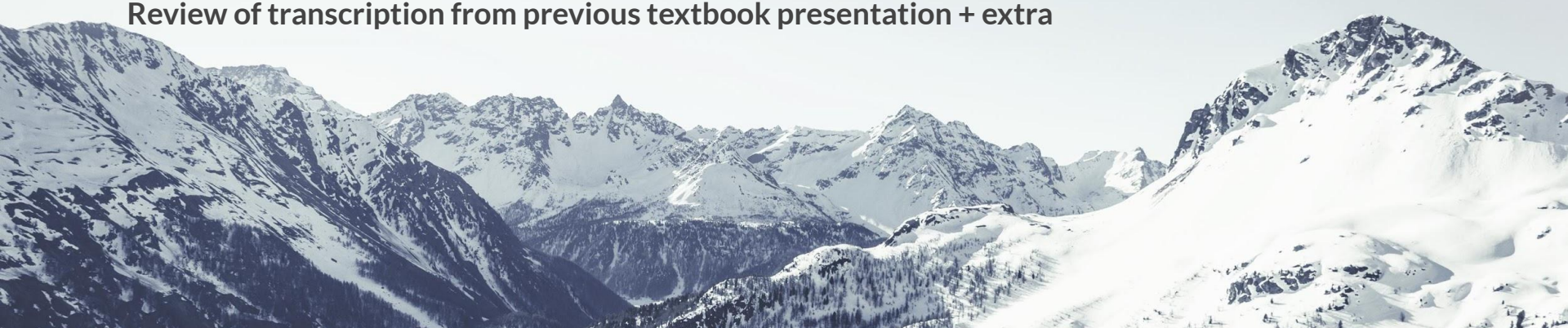
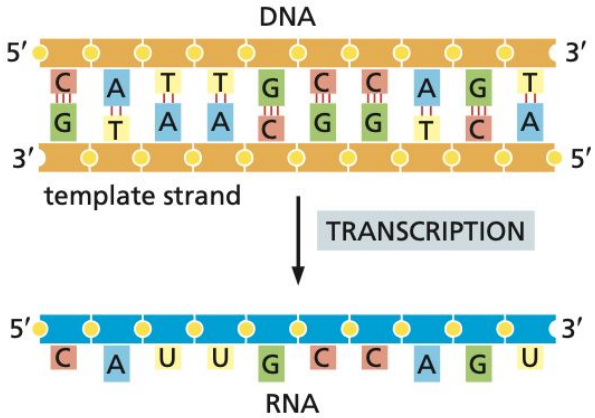


Table of Contents

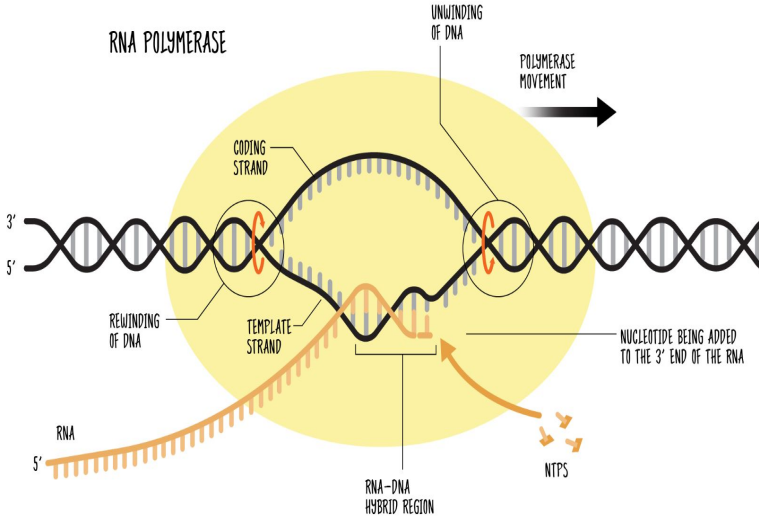
Transcription

- Transcription: DNA → RNA
- Occurs in nucleus of eukaryotic cells. Cytoplasm of prokaryotic cells.
- RNA detaches itself from DNA immediately after synthesis
- Catalysed by **RNA Polymerase**



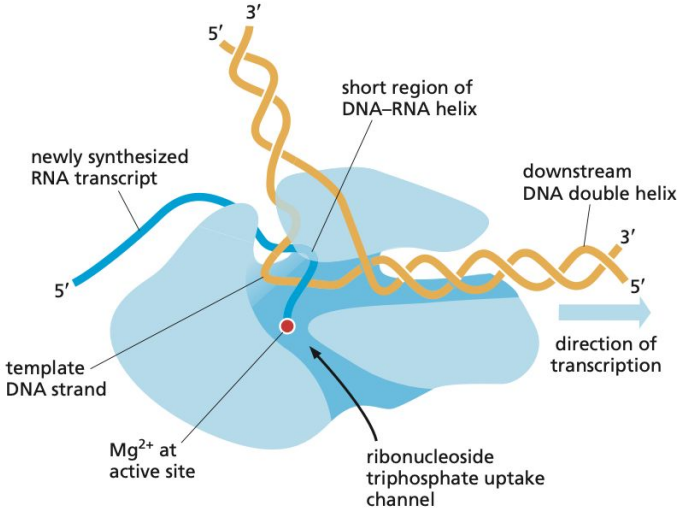
RNA Polymerase

- RNA polymerase:
  - Links ribonucleotides instead of deoxyribonucleotides.
  - Does not require a primer
  - Has a higher error rate but has greater efficiency
  - Completes transcription without dissociating from the template.



RNA Polymerase

- Helicase activity: Unwinds DNA using Mg^{2+} ion for catalysis
- Nucleotides are added one by one at the polymerization site
- A short DNA–RNA hybrid forms temporarily before the RNA detached
- Multiple RNA polymerases can transcribe a DNA molecule



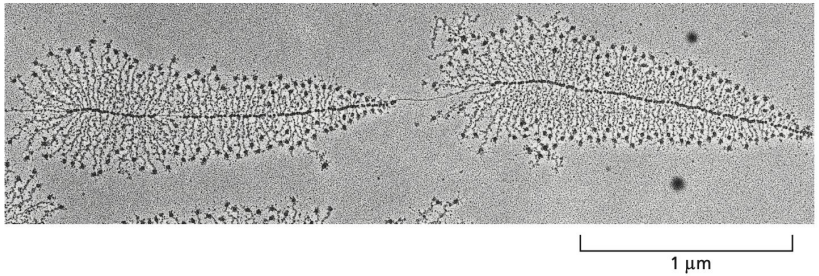


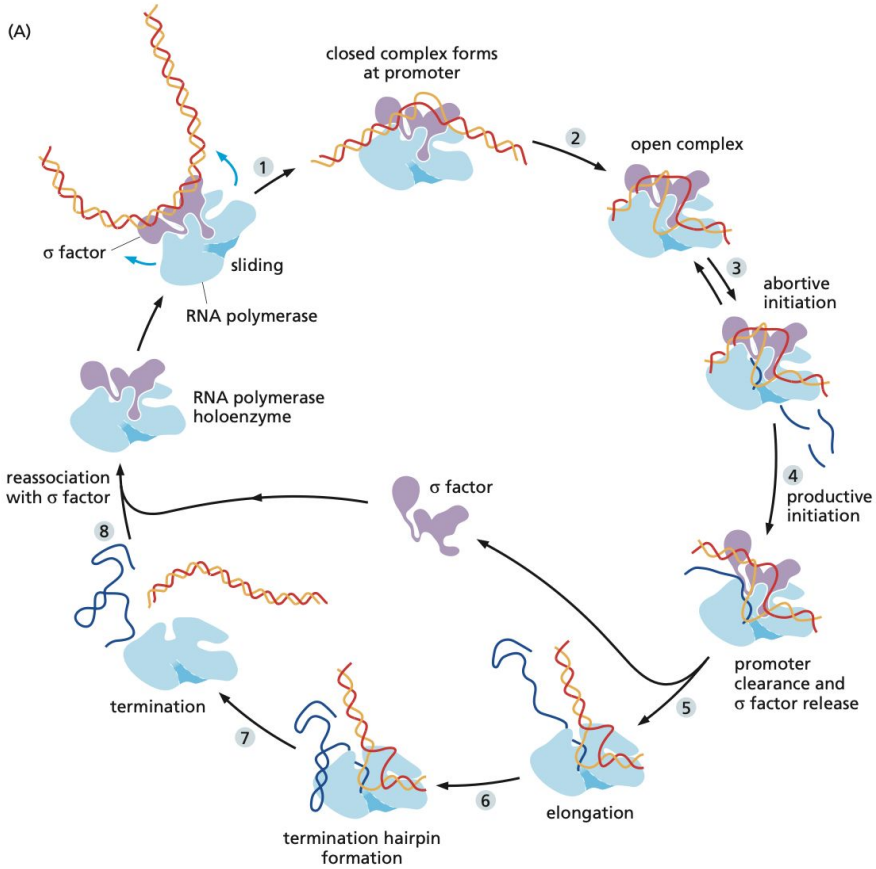
TABLE 6–1 Principal Types of RNAs Produced in Cells

Type of RNA	Function
mRNAs	Messenger RNAs, code for proteins
rRNAs	Ribosomal RNAs, form the basic structure of the ribosome and catalyze protein synthesis
tRNAs	Transfer RNAs, central to protein synthesis as the adaptors between mRNA and amino acids
Telomerase RNA	Serves as the template for the telomerase enzyme that extends the ends of chromosomes
snRNAs	Small nuclear RNAs, function in a variety of nuclear processes, including the splicing of pre-mRNA
snoRNAs	Small nucleolar RNAs, help to process and chemically modify rRNAs
lncRNAs	Long noncoding RNAs, not all of which appear to have a function; some serve as scaffolds and regulate diverse cell processes, including X-chromosome inactivation
miRNAs	MicroRNAs, regulate gene expression by blocking translation of specific mRNAs and causing their degradation
siRNAs	Small interfering RNAs, turn off gene expression by directing the degradation of selective mRNAs and helping to establish repressive chromatin structures
piRNAs	Piwi-interacting RNAs, bind to piwi proteins and protect the germ line from transposable elements

Transcription in Prokaryotes

Transcription mechanism in Bacteria:

1. RNA Polymerase Holoenzyme Assembly
2. DNA Unwinding at the Promoter
3. Abortive Initiation
4. Promoter Clearance and σ Factor Release
5. Elongation Phase
6. Transcription Termination



Transcription in Eukaryotes

- Eukaryotes have three RNA polymerases:

1. **RNA Polymerase I:** Transcribes rRNA genes (except 5S rRNA).
2. **RNA Polymerase II:** Transcribes protein-coding genes (mRNA) and some non-coding RNAs.
3. **RNA Polymerase III:** Transcribes tRNA, 5S rRNA, and other small RNAs.

- Require multiple general transcription factors

TABLE 6–3 The General Transcription Factors Needed for Transcription Initiation by Eukaryotic RNA Polymerase II

Name	Number of subunits	Roles in transition initiation
TFIID	12	Recognizes TATA box and other DNA sequences near the transcription start point
TFIIB	1	Recognizes BRE element in promoters; accurately positions RNA polymerase at the start site of transcription
TFIIA	2	Not required in all promoters; stabilizes binding of TFIID
TFIIF	3	Stabilizes RNA polymerase interaction with TFIIB; helps attract TFIIE and TFIIH
TFIIE	2	Attracts and regulates TFIIH
TFIIH	10	Unwinds DNA at the transcription start point, phosphorylates Ser5 of the RNA polymerase C-terminal domain (CTD); releases RNA polymerase from the promoter

TFIID is composed of TBP and 11 additional subunits called TAFs (TBP-associated factors).

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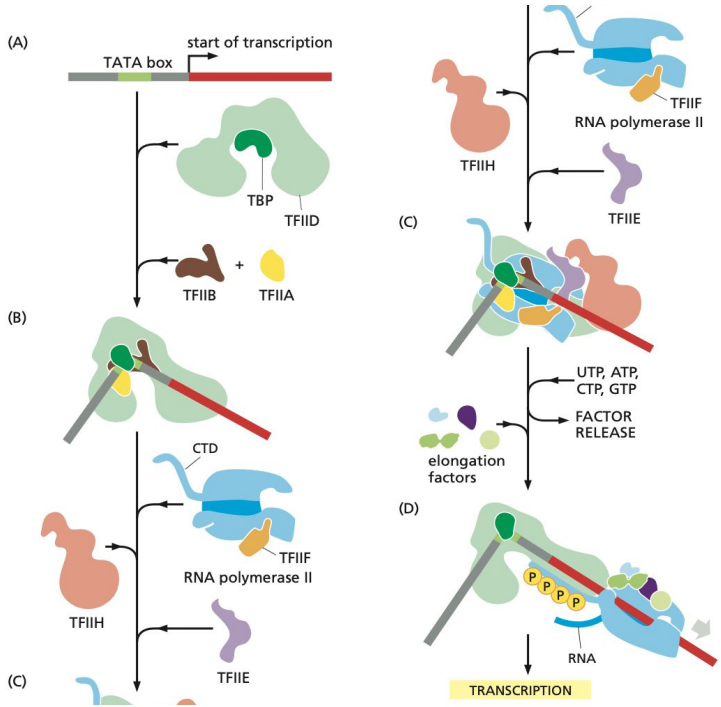
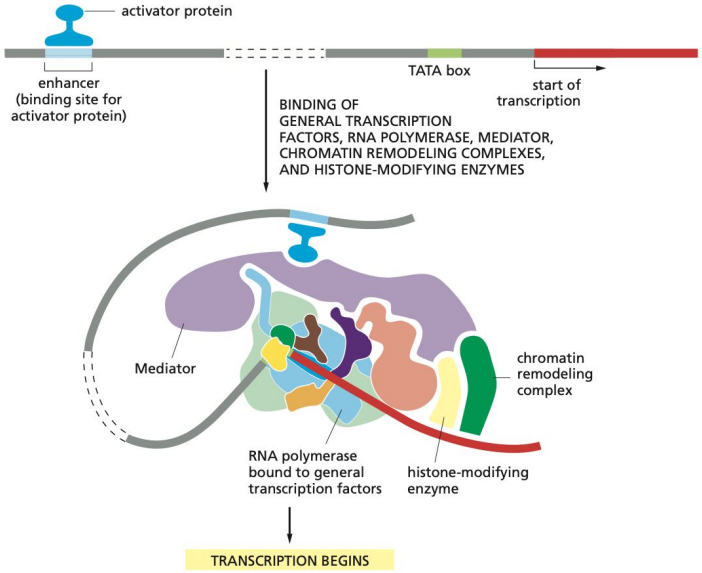


Transcription in Eukaryotes

- In Eukaryotes, Transcription Initiation Also Requires:
- **Transcriptional activators**- bind to enhancers to help recruit general transcription factors
- **Mediator:** large protein complex, bridges communication between activators, RNA polymerase II, and general transcription factors.
- **Chromatin-modifying enzymes**



Thank you