Advanced Cell Biology. Lecture 20

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Outline

Questions and answers

From DNA to RNA

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From DNA to RNA

Previous final question: the answer

If you see a male tricolored cat, what does it mean genetically?

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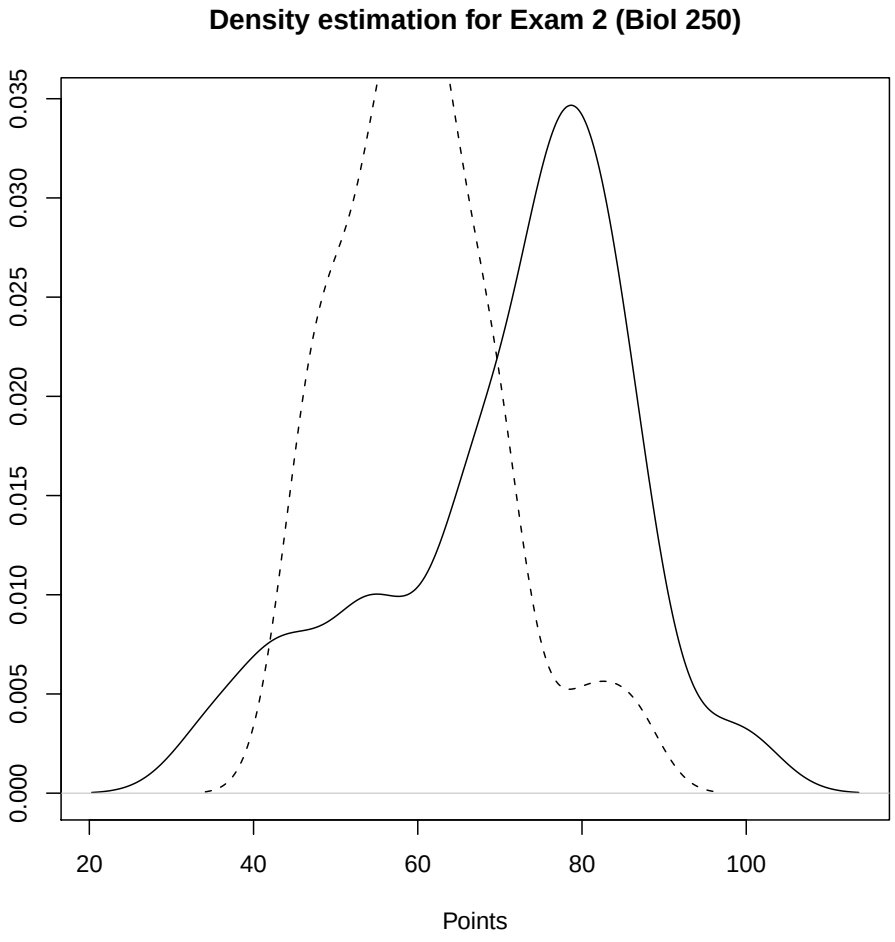
- $X(X)_nY$

Exam 2 distribution



Exam 2 notes

Basic dogma of molecular biology

- $\text{DNA} \xrightarrow{\text{transcription}} \text{RNA} \xrightarrow{\text{translation}} \text{Protein}$
- However, reverse transcriptase does
  $\text{DNA} \xleftarrow{\text{reverse transcription}} \text{RNA}$

Transcription basics

- RNA polymerase(s) copies the chunk of one DNA strands into RNA
- Gene expression depends on intensity of this process (which is generally much faster than DNA synthesis)

Transcription in prokaryotes

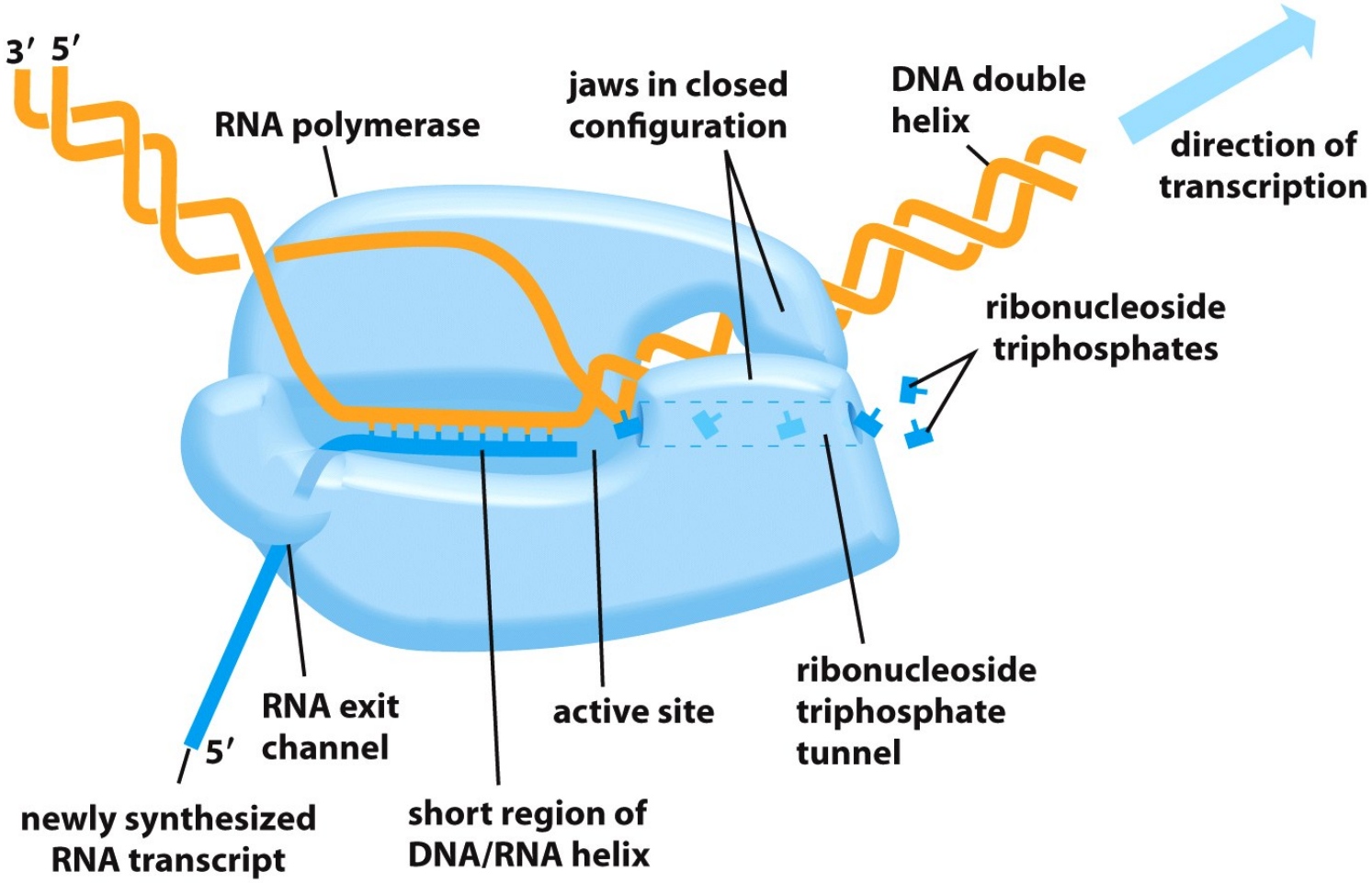


Figure 7-7 Essential Cell Biology 3/e (© Garland Science 2010)

Transcription movie

Types of RNA

- mRNA
- rRNA
- tRNA
- miRNA

RNAs

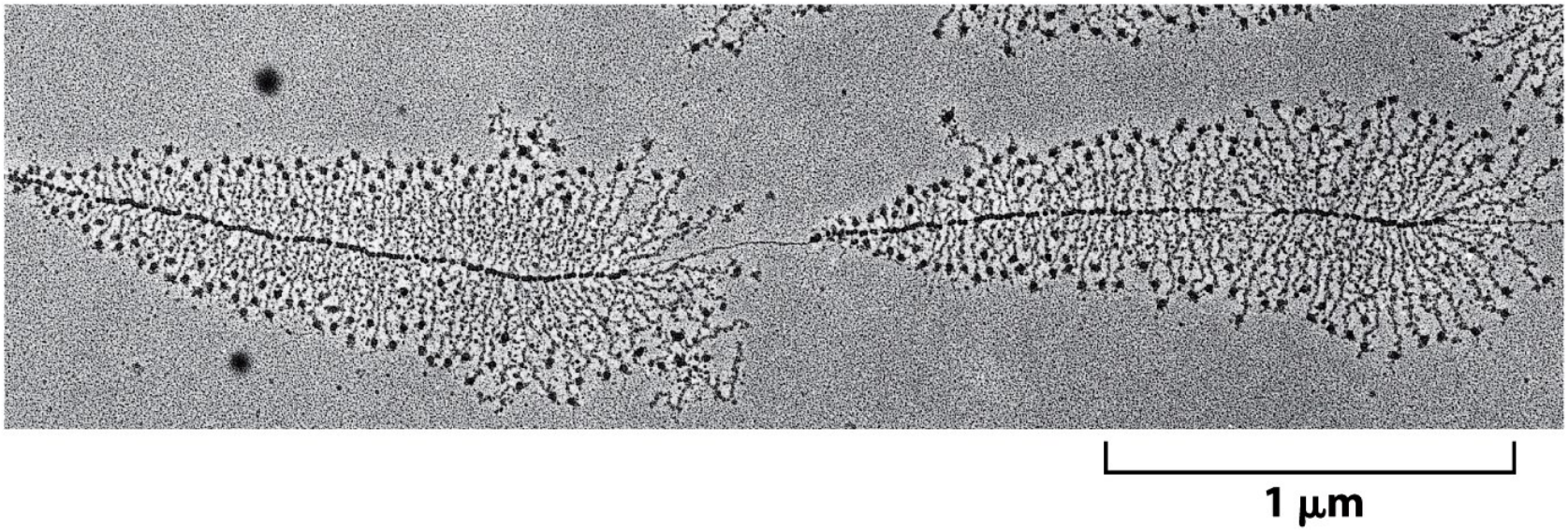


Figure 7-8 Essential Cell Biology 3/e (© Garland Science 2010)

Template and coding strands

- RNA polymerase works with template strands
- RNA is synthesized in 5'→3' direction
- Resulted RNA will copy the other, coding strand

Promoter and terminator

- Promoter will specify the binding place for RNA polymerase
- Terminator specifies unbinding place
- σ factor of RNA polymerase recognizes promoter

Direction of transcription

- Promoter is asymmetric, therefore RNA polymerase may proceed in only one direction (= work with only one strand)
- Both strands may be templates for different genes

Promoter and terminator

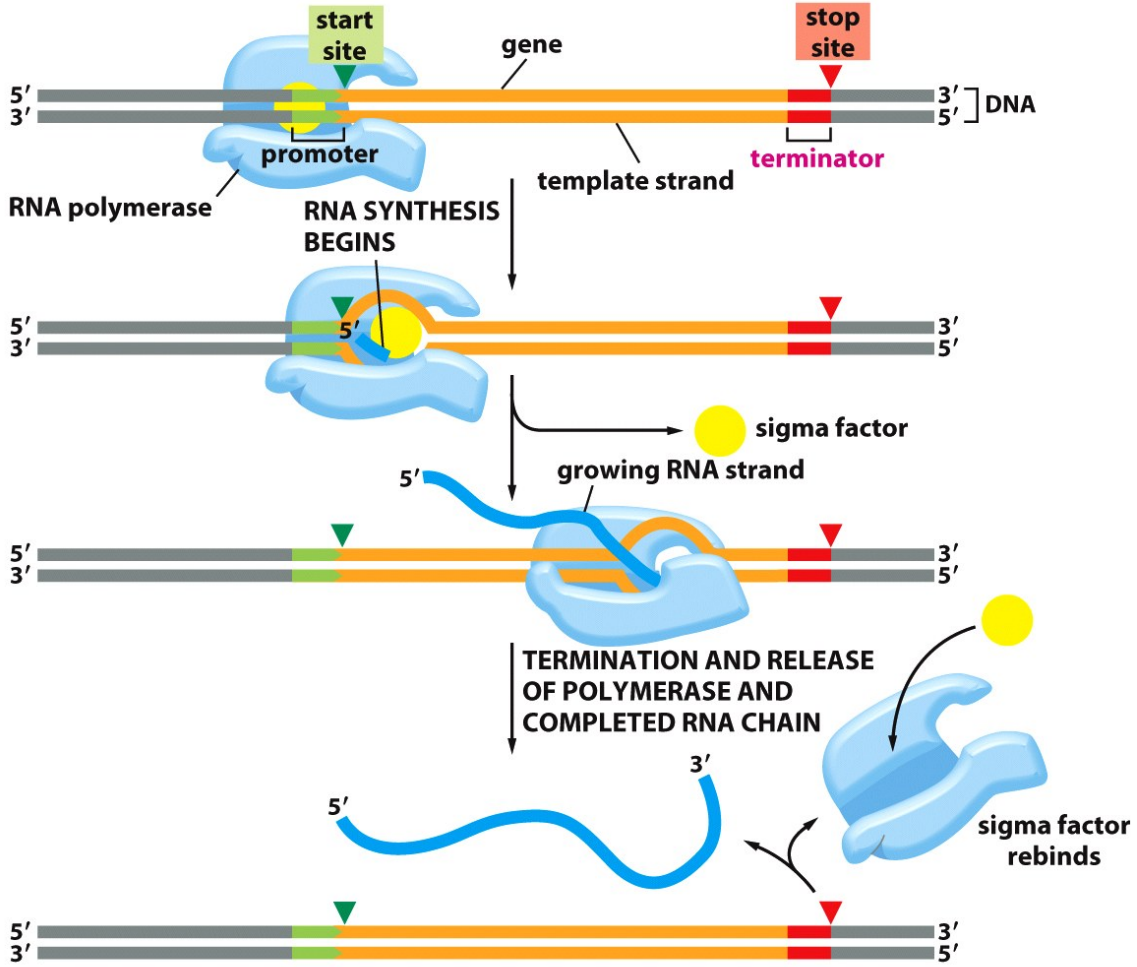


Figure 7-9 Essential Cell Biology 3/e (© Garland Science 2010)

Promoter and terminator sequences

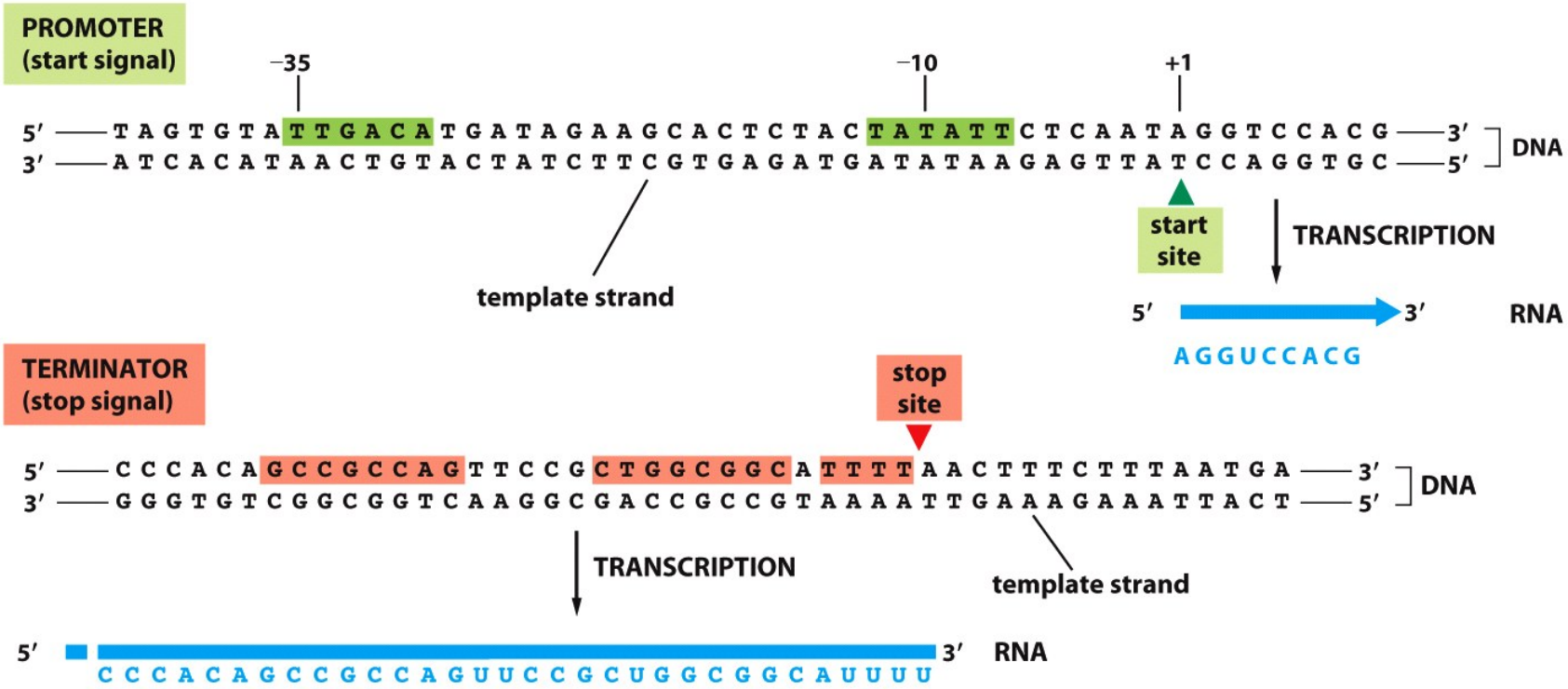


Figure 7-10 Essential Cell Biology 3/e (© Garland Science 2010)

Directions of transcription

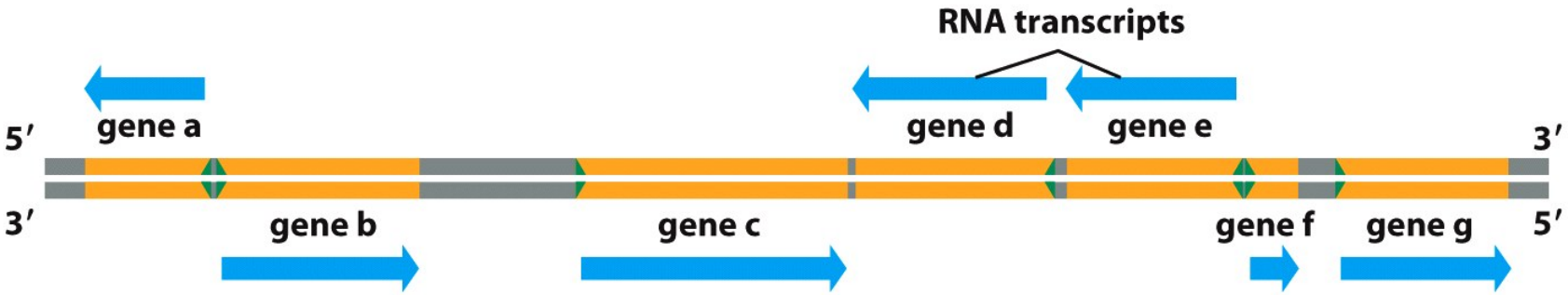


Figure 7-11 Essential Cell Biology 3/e (© Garland Science 2010)

Eukaryotic transcription: differences

- Multiple polymerases: I (rRNA genes), II (tRNA genes, 5S rRNA gene) and III (other genes)
- General transcription factors
- DNA is much bigger and more compactized

Eukaryotic RNA polymerase II movie

Transcription factors

- TFIID recognizes TATA box
- TFIIB binds to it as well
- TFIIE, TFIIF and especially TFIIH will help RNA polymerase II to start transcription

Transcription factors movie

Transcription factors (1)

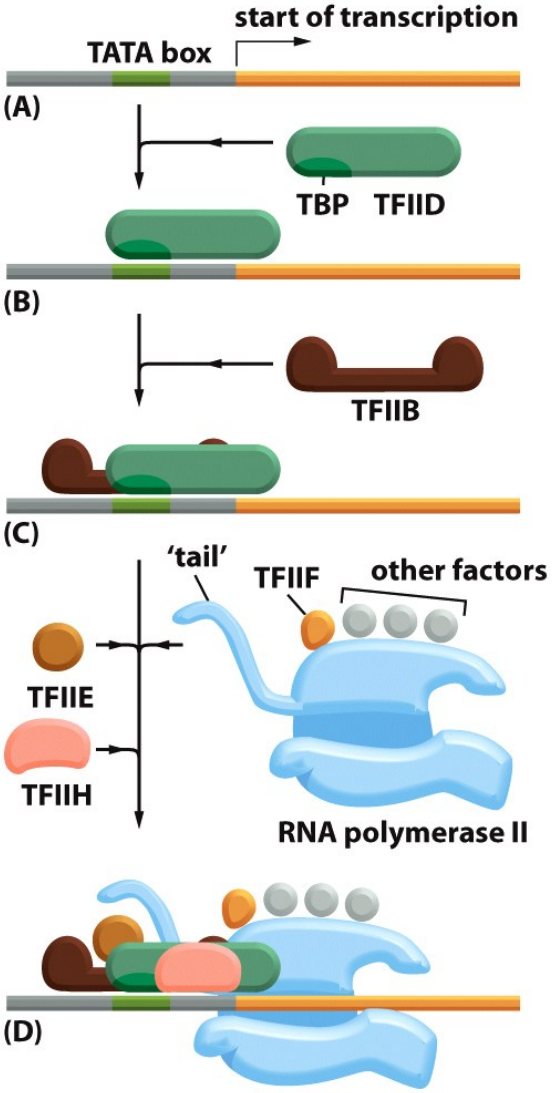


Figure 7-12 part 1 of 2 Essential Cell Biology 3/e (© Garland Science 2010)

Transcription factors (2)

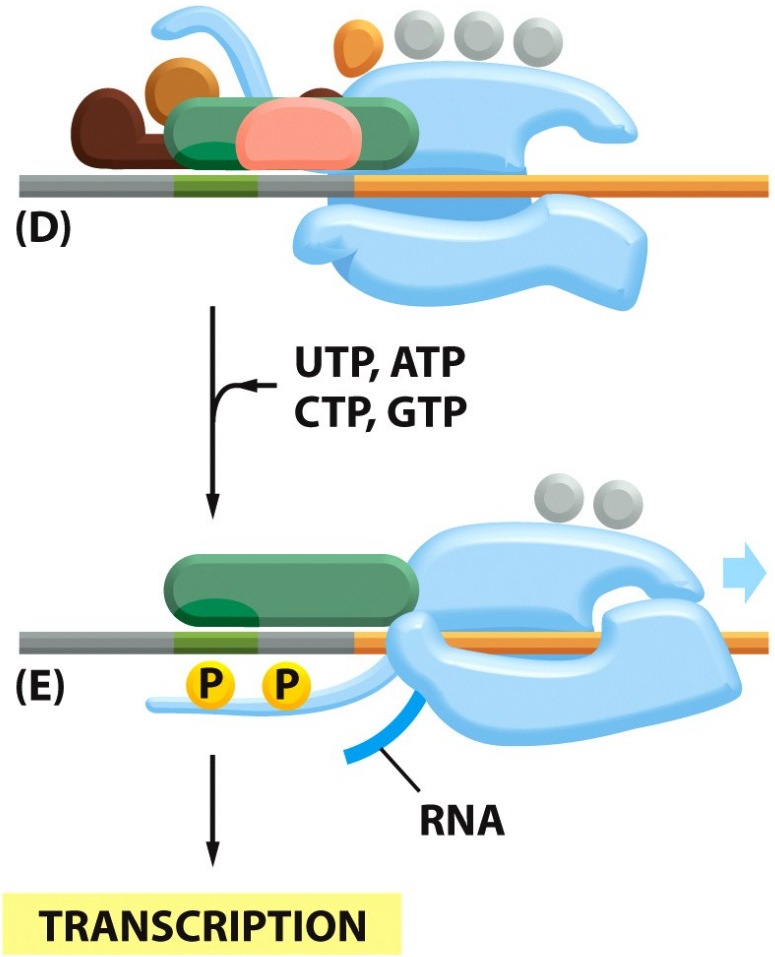


Figure 7-12 part 2 of 2 Essential Cell Biology 3/e (© Garland Science 2010)

RNA processing

- RNA capping: adds methylated G to 5' end of RNA (occurs before transcription completes)
- RNA polyadenilation: adds poly-A tail to 3' end of mRNA
- Increase stability, make mRNA recognizable from other RNAs

RNA processing

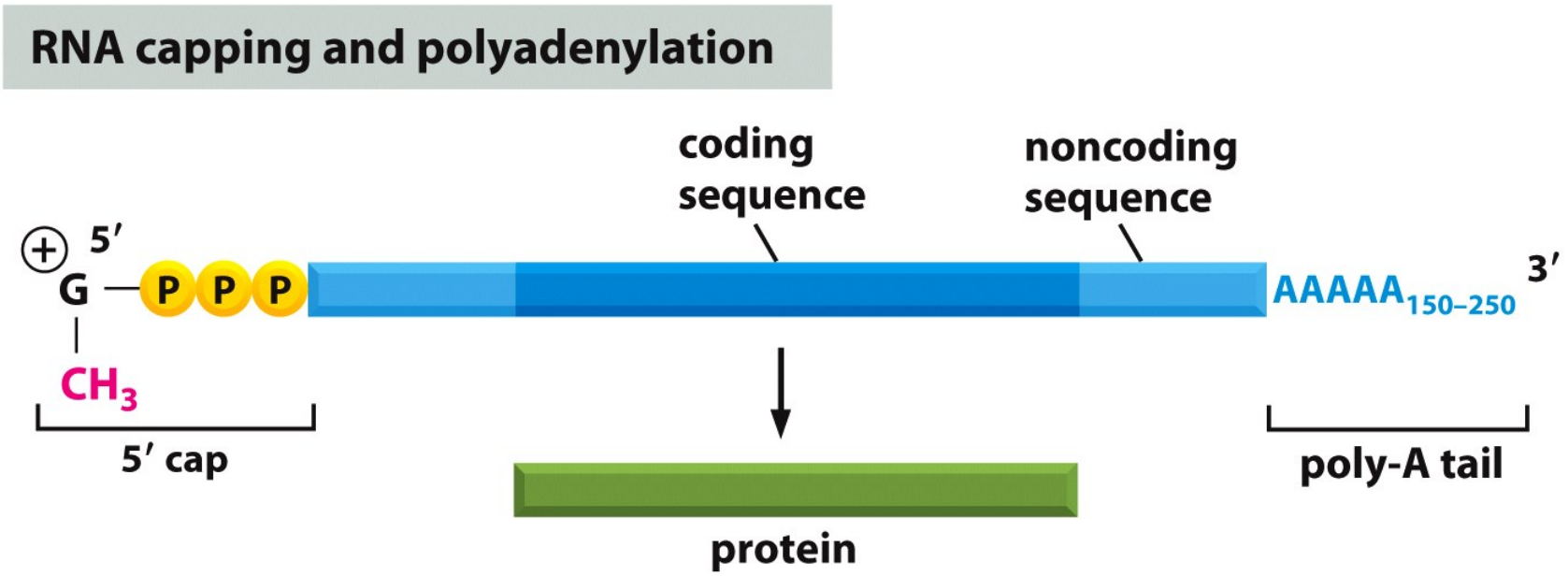


Figure 7-16a Essential Cell Biology 3/e (© Garland Science 2010)

Final question (2 points)

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How RNA polymerase recognizes the “proper” strand of DNA?

Summary

- Asymmetric promoters determine which DNA strand will be template and in with direction transcription will go
- Transcription processes are seriously different between prokaryotes and eukaryotes

For Further Reading

A. Shipunov.
Advanced Cell Biology [Electronic resource].
2011—onwards.
Mode of access: http://ashipunov.info/shipunov/school/biol_250.

B. Alberts et al.
Essential Cell Biology. 3rd edition.
Garland Science, 2009.
Chapter 7: 231–246.