

Advanced Cell Biology. Lecture 18

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Outline

Questions and answers

From DNA to RNA

Eukaryotic transcription

RNA processing

RNA splicing

RNA export

Ribosomes



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Previous final question: the answer

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



Previous final question: the answer

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

- ▶ It uses asymmetric nature of promoters



From DNA to RNA

Eukaryotic transcription



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)

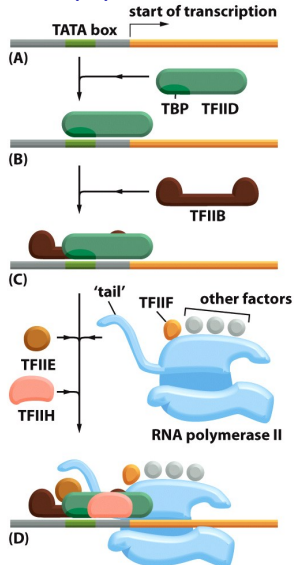


Figure 7-12 part 1 of 2 Essential Cell Biology 3/e (© Garland Science 2010)

Transcription factors (2)

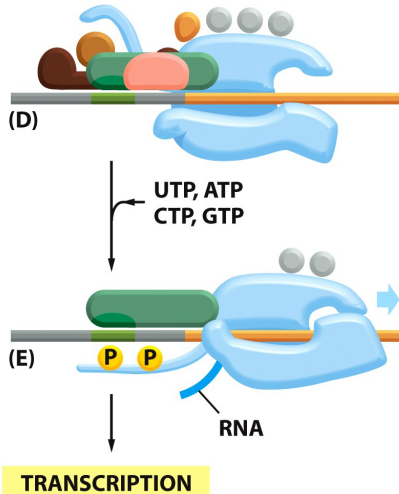


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From DNA to RNA

RNA processing



RNA processing

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



RNA processing

RNA capping and polyadenylation

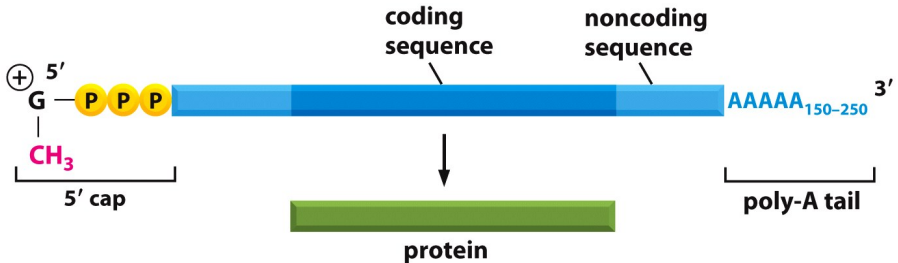


Figure 7-16a Essential Cell Biology 3/e (© Garland Science 2010)



From DNA to RNA

RNA splicing



Introns and exons

- ▶ Non-coding sequences are introns (vary from 1 to 10,000 bp)
- ▶ Other are exons



Introns and exons

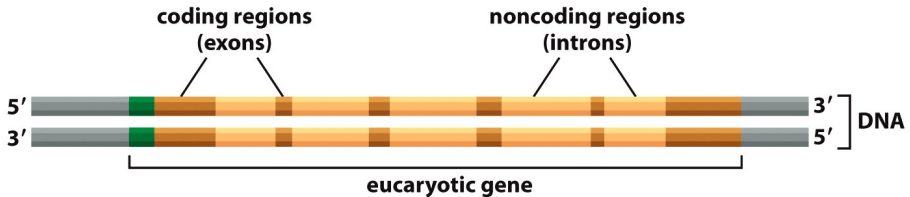
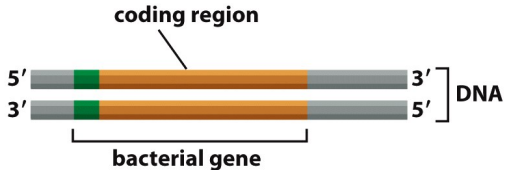


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RNA splicing

- ▶ Introns should be removed from RNA: this is splicing
- ▶ RNA-protein complexes snRPNS (“snurps”) recognize the starts and ends of introns
- ▶ Snurps are core part of spliceosome
- ▶ Introns form lariat structures when spliced



RNA splicing

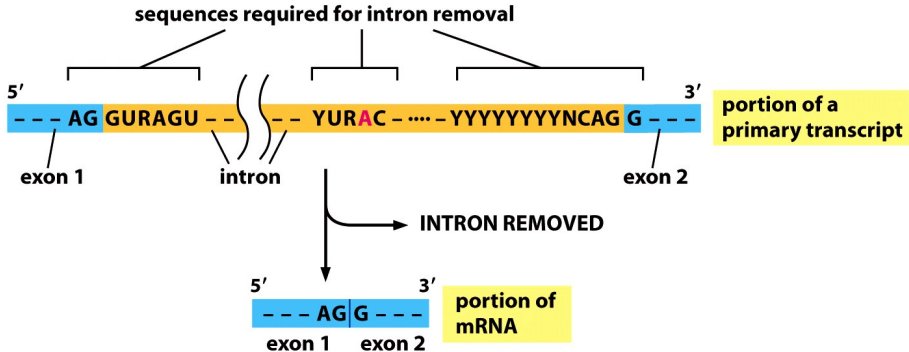


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RNA splicing movie



Alternative splicing

- ▶ One RNA may be spliced differently
- ▶ Every single result of splicing will be the different protein
- ▶ This is one more level of “epigenetic freedom”



Alternative splicing

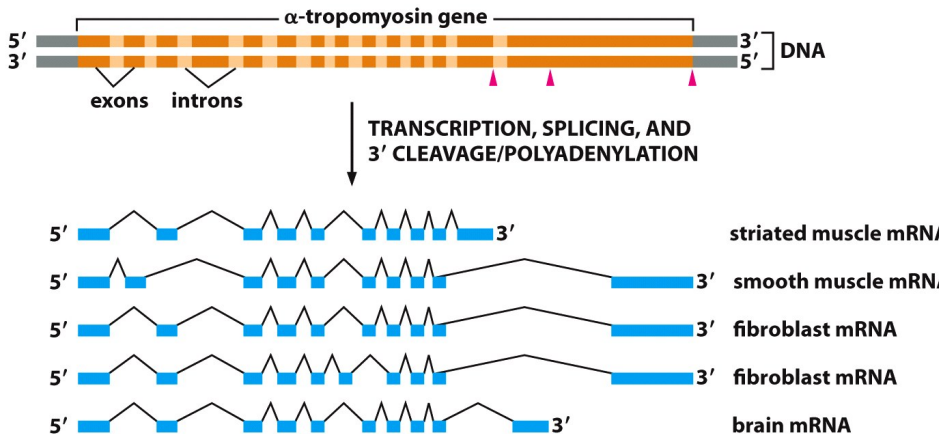


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Origin of introns

- ▶ Introns will increase the flexibility of genome, but lower the speed of cell replication
- ▶ It is therefore possible that prokaryotes are secondary intronless
- ▶ Introns were found in some Archaea



From DNA to RNA

RNA export



Selective export of RNA

- ▶ Nuclear pore will allow only “ready” mRNA to be exported into cytoplasm
- ▶ That will not allow the unprocessed RNA to be translated into protein



RNA export from nucleus

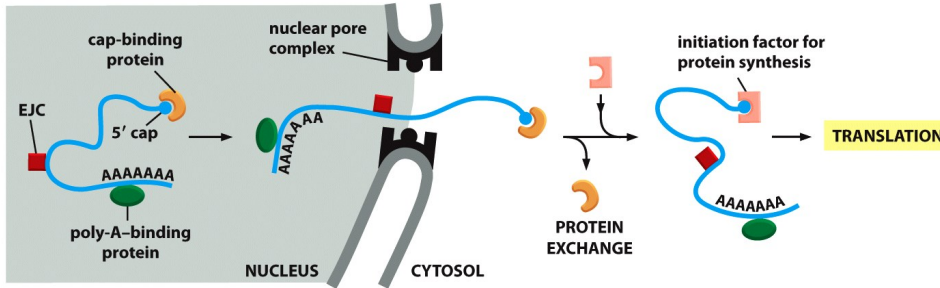


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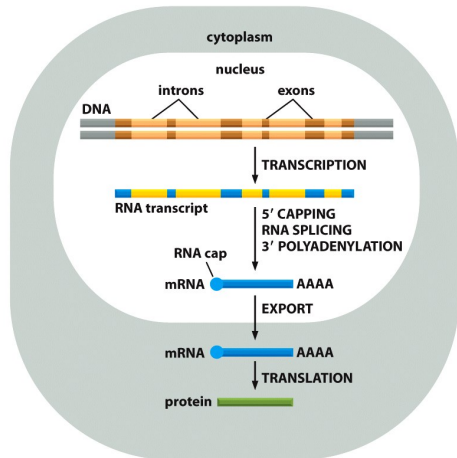
Degrading of RNA

- ▶ Bacterial mRNAs live ≈ 3 min
- ▶ In eukaryotes, mRNA lives longer, and the lifespan depends on how RNA was processed



Transcription: eukaryotes vs. prokaryotes

(A) EUCARYOTES



(B) PROCARYOTES

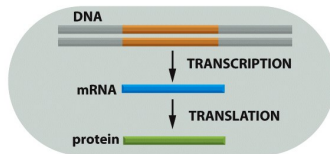


Figure 7-23 Essential Cell Biology 3/e (© Garland Science 2010)



Questions?



From DNA to RNA

Ribosomes



Ribosome

- ▶ Prokaryotes: 70S ribosomes
 - ▶ Small subunit: 30S
 - ▶ 16S RNA
 - ▶ 21 proteins
 - ▶ Large subunit: 50S
 - ▶ 5S RNA + 23S RNA
 - ▶ 34 proteins
- ▶ Eukaryotes: 80S ribosomes
 - ▶ Small subunit: 40S
 - ▶ 18S RNA
 - ▶ 33 proteins
 - ▶ Large subunit: 60S
 - ▶ 5S RNA + 28S RNA + 5.8S RNA
 - ▶ 49 proteins

Structure of eukaryotic ribosome

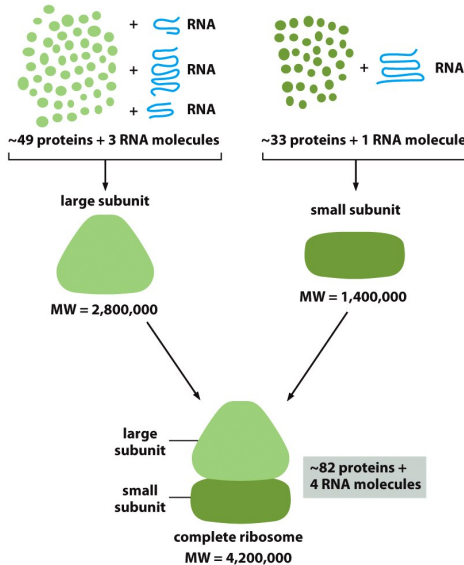


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Final question (2 points)

Name at least one most important difference between prokaryotic and eukaryotic transcription



Summary

- ▶ Transcription processes are seriously different between prokaryotes and eukaryotes
- ▶ Alternative splicing is one of sources of “epigenetic freedom”



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.

