Advanced Cell Biology. Lecture 20

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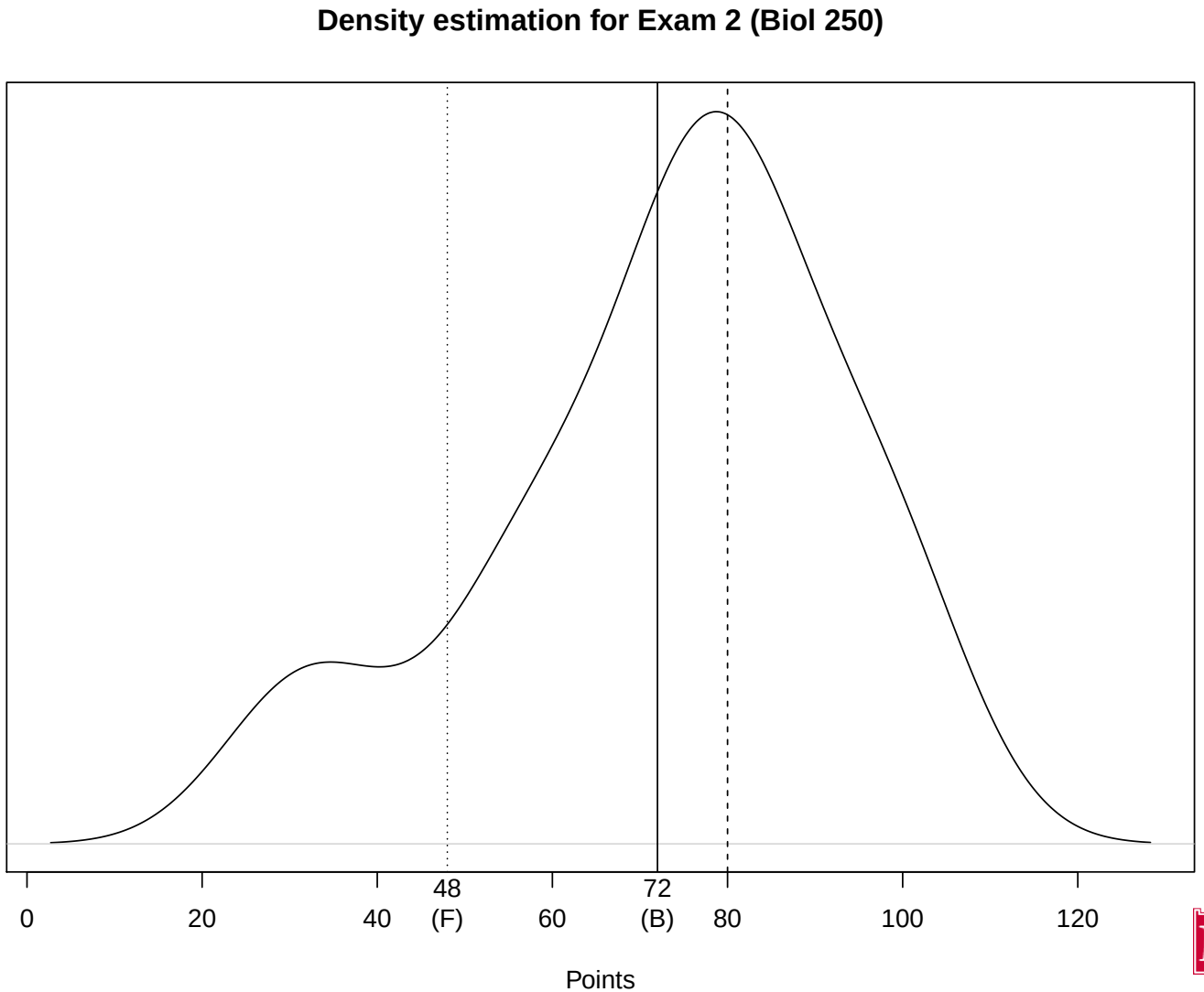
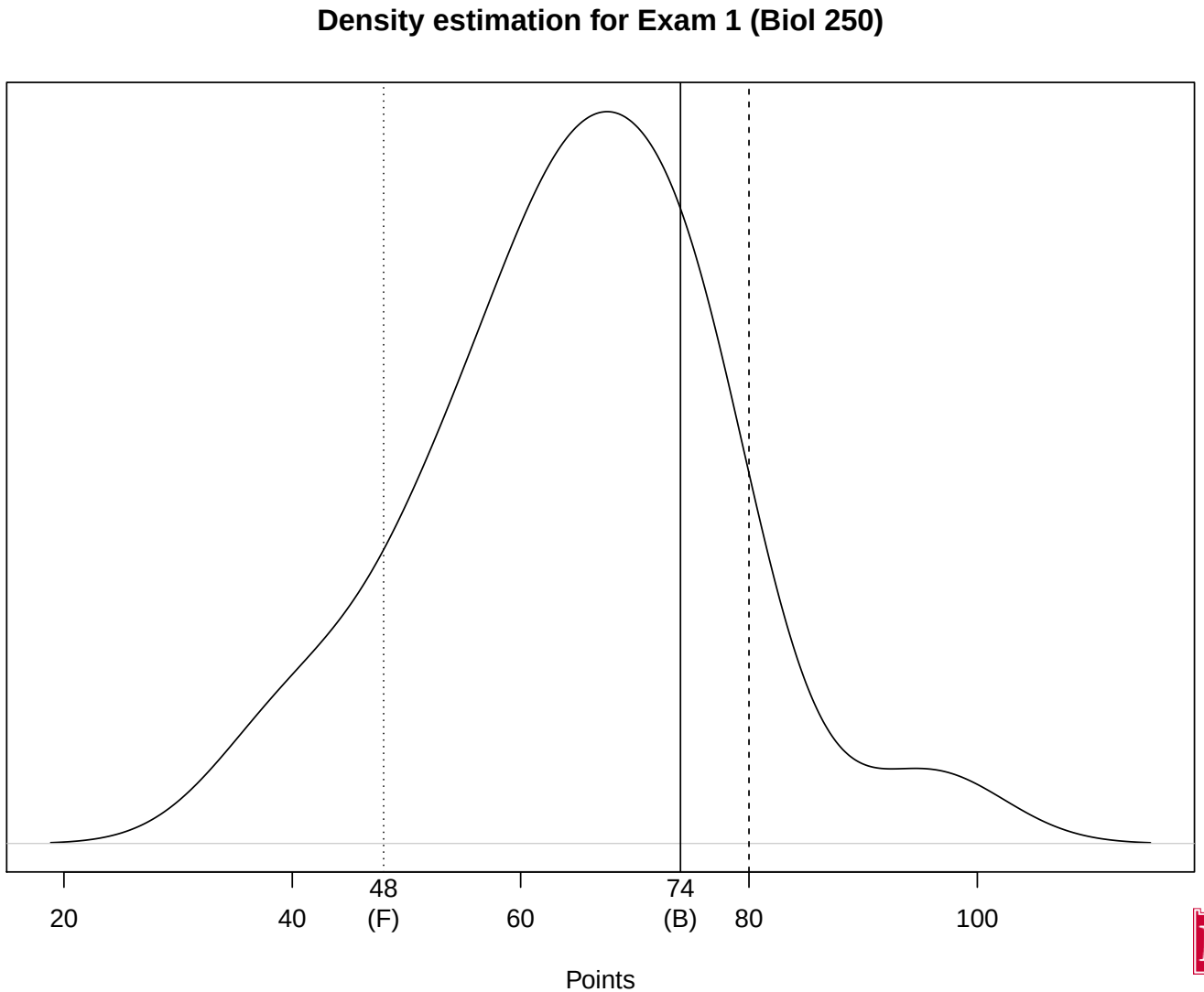
Outline

Outline

Results of Exam 2



Results of Exam 1



Results of Exam 2 (statistic summary)

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Summary:
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.    NA's
  29.00   63.00   77.00   72.82   86.00  102.00    4.00
Grades:
  F   D   C   B max
 48  56  64  72  80
```

Exam 2: key points, problems and solutions

Previous final question: the answer

What is chaperone?

Previous final question: the answer

What is chaperone?

- Protein which help to fold other proteins

Expression

The basics of expression

Gene expression and cell differentiation

- Different cells will produce different sets of proteins (except housekeeping proteins)
- Differentiated cell expressed 20–50% of existing genes

Cloning of multicellular organisms

- Organisms of “higher” evolutionary position are cloned with more and more difficulties
- Whereas plants are capable to develop new organism almost from any cell, mammals will need extremely complicated technique including transition of nucleus

Making new mammal from a cell

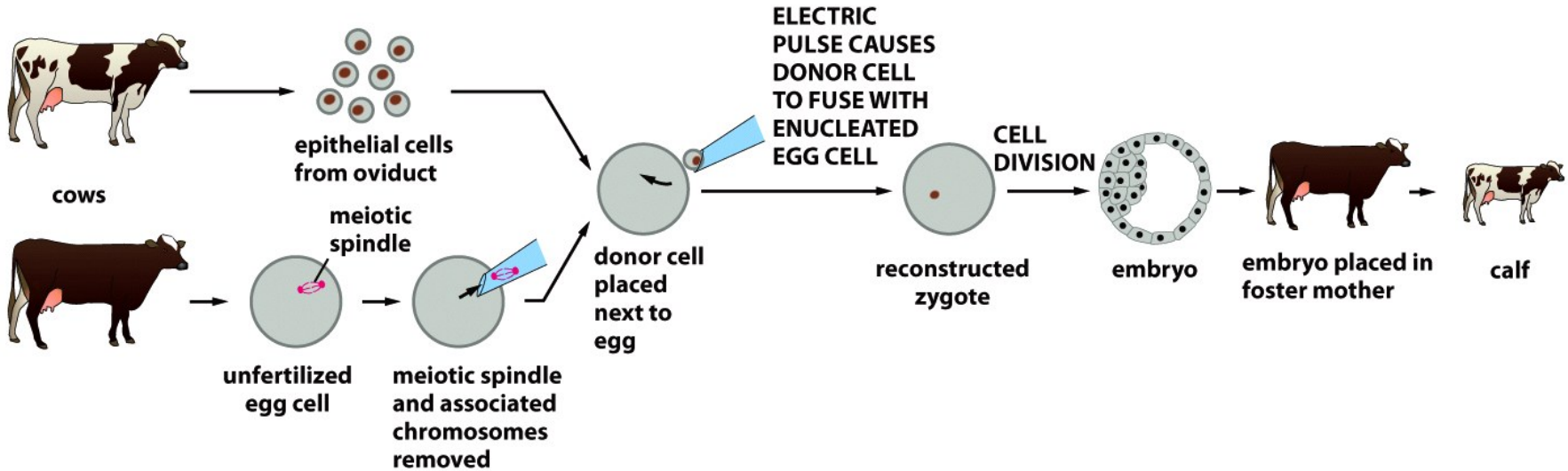

Figure 8-2c Essential Cell Biology 3/e (© Garland Science 2010)

Places of expression regulation

1. Transcription
2. RNA processing
3. RNA transport
4. RNA degradation
5. Translation
6. Protein

Control of gene expression

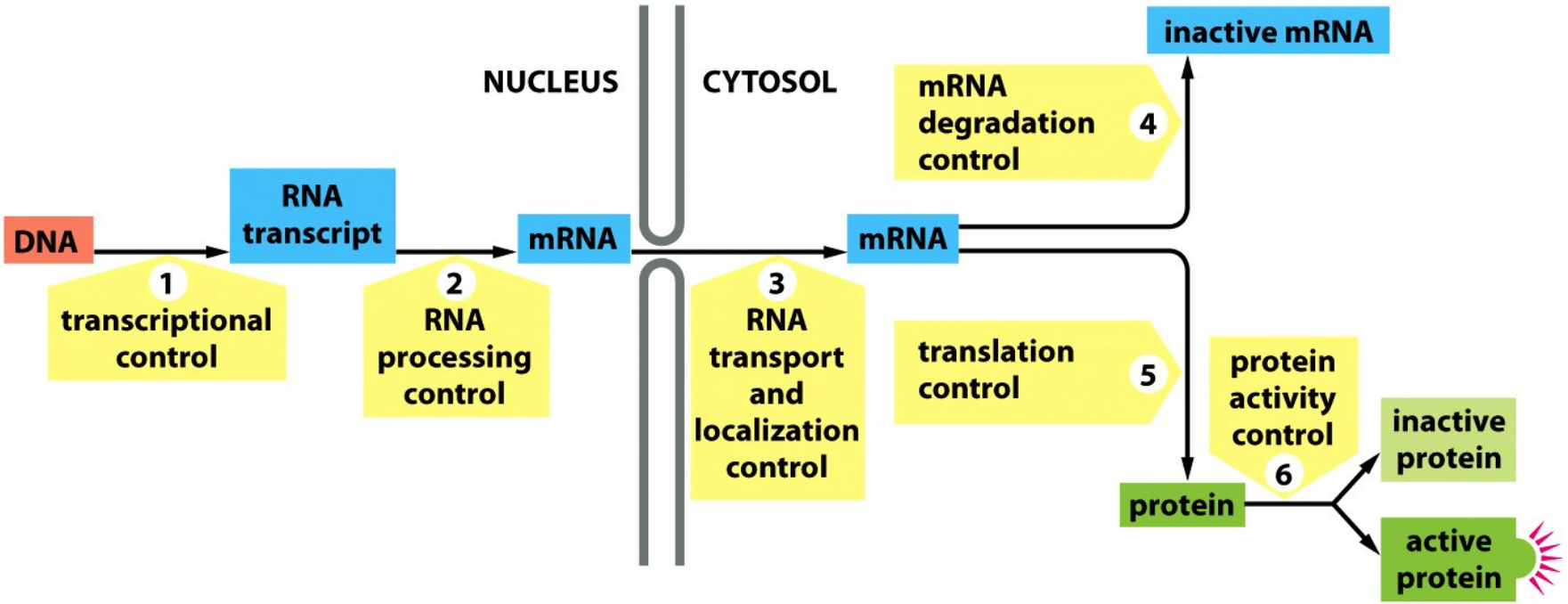

Figure 8-3 Essential Cell Biology 3/e (© Garland Science 2010)

Regulatory sequences

- Promoters + initiation sites upstream to the actual gene
- Regulatory DNA sequences upstream to the promoters
- Transcription regulators to bind with regulatory DNA sequences

DNA-binding motifs

- Homeodomain
- Zinc finger
- Leucine zipper

Homeodomain movie

Zinc finger movie

Leucine zipper movie

Repressors

- Repressor binds to operator and blocks access of RNA polymerase to promoter
- Tryptophan repressor of *E. coli* works when concentration of tryptophane is high (activated by tryptophane)
- However, it will allow small transcription even in “off” position (constitutive expression)

Tryptophane repressor

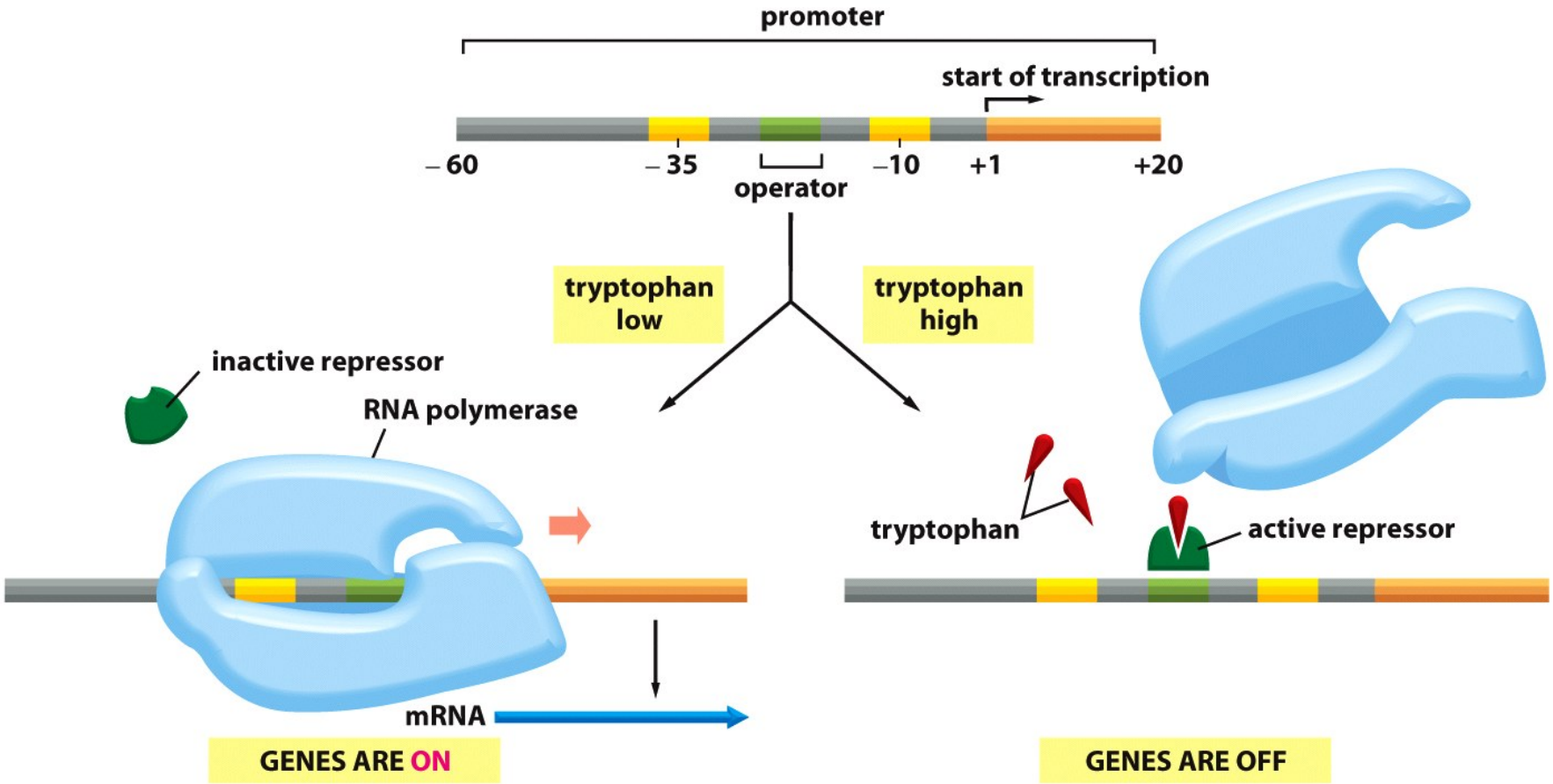

Figure 8-7 Essential Cell Biology 3/e (© Garland Science 2010)

Activators

- Activator sequences are “sleeping promoters”, they work as promoters only if activator protein is bound to them
- *E. coli* activator CAP is activated by cyclic AMP (cAMP) which is a signal of lacking glucose; CAP activate proteins which utilize other sugars

Activator

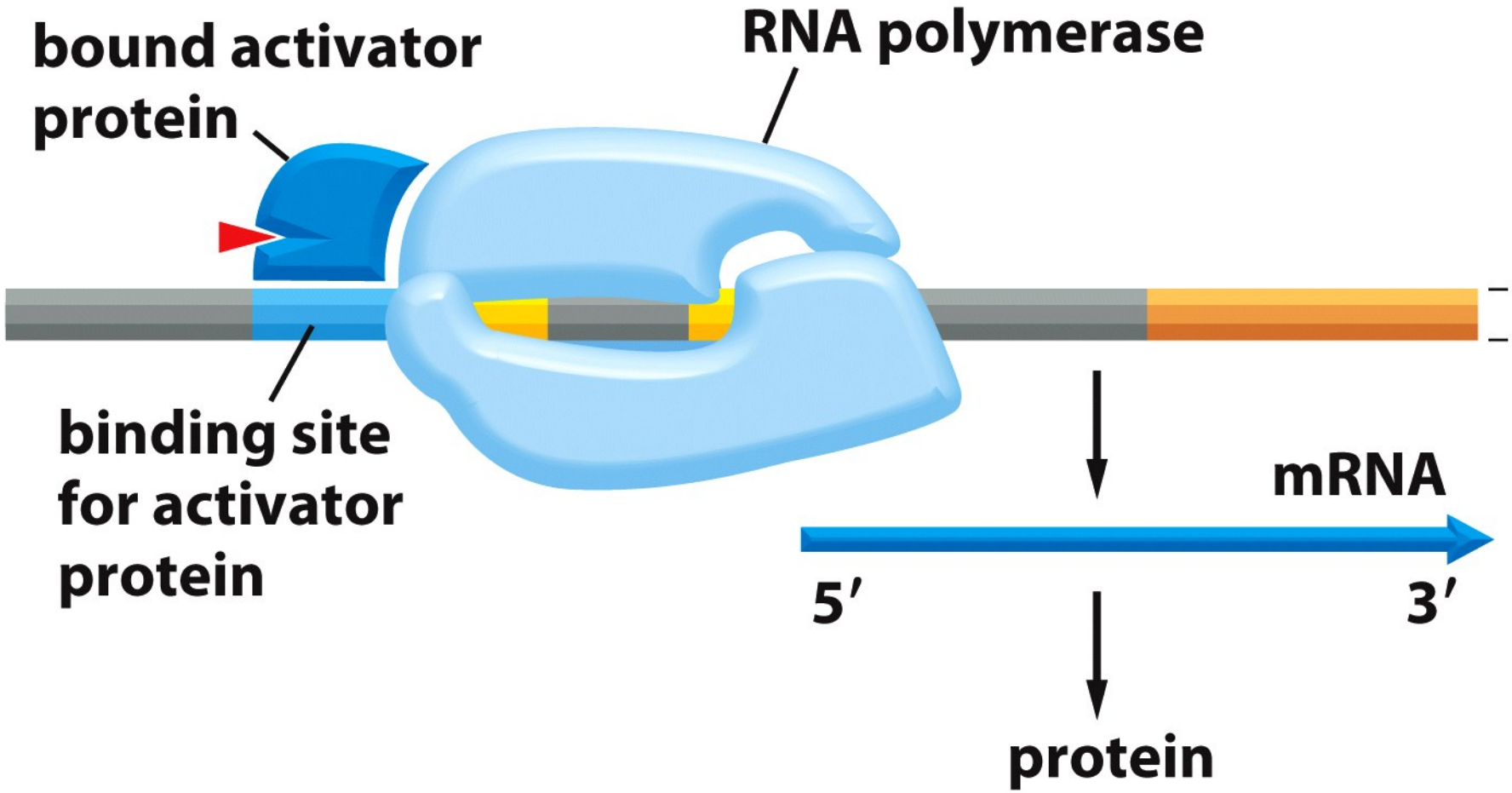

Figure 8-8 Essential Cell Biology 3/e (© Garland Science 2010)

Lac operon

- LacZ gene encodes β-galactosidase protein which breaks lactose to galactose and glucose
- Only if lactose is prsend AND glucose is absent, Lac repressor detaches from operator and CAP activator promote RNA polymerase to bind with promoter

Lac operon

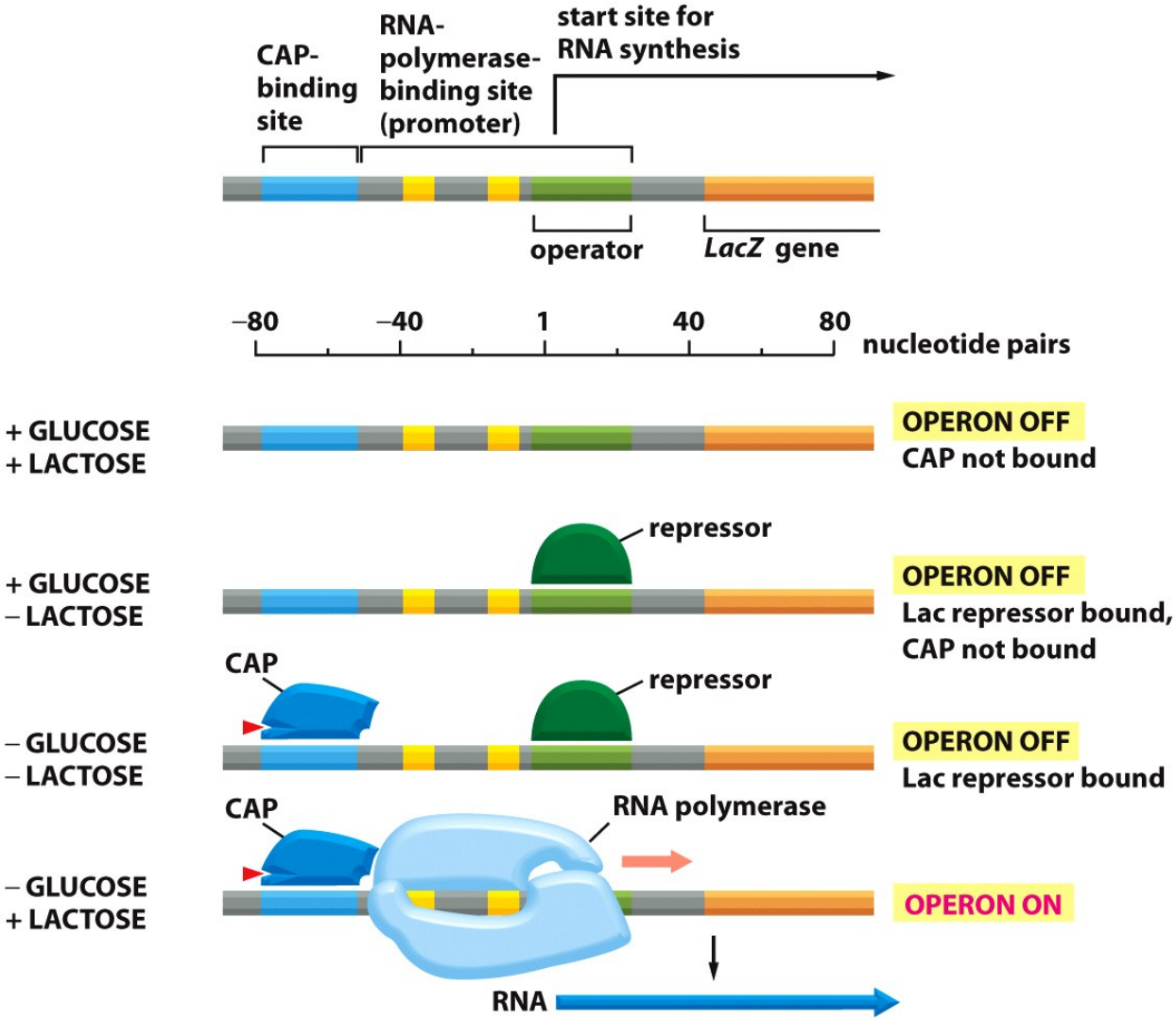

Figure 8-9 Essential Cell Biology 3/e (© Garland Science 2010)

Eukaryotic transcription regulators

- Enhancers may be located upstream or downstream from activated gene
- They work through mediators when DNA form a loop

Enhancer and mediator

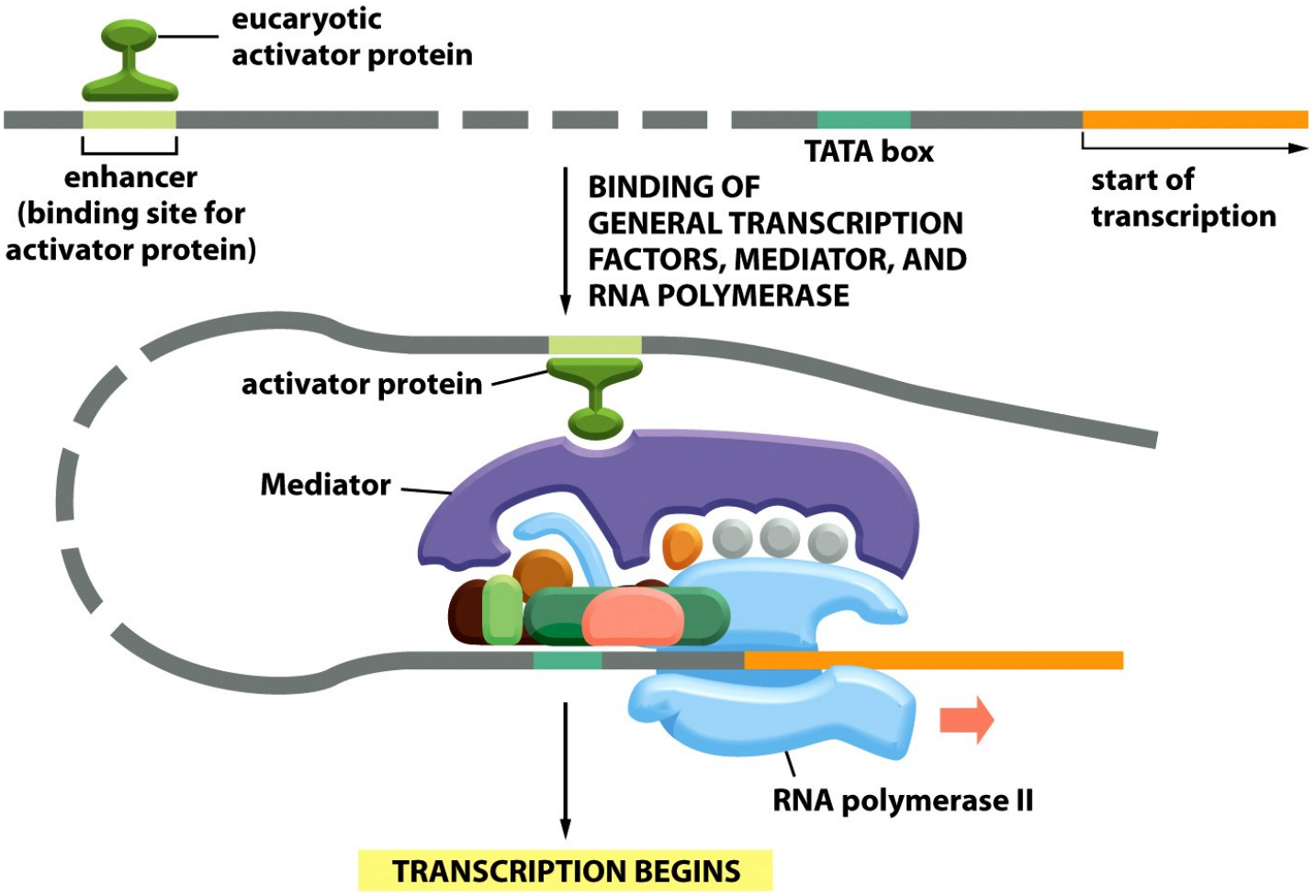

Figure 8-10 Essential Cell Biology 3/e (© Garland Science 2010)

Histones and transcription regulation

- Eukaryotic repressors and activators may work even more “distantly”, through histones and chromatin-remodeling complex
- Activators may attract histone acetylases which alter the 3D structure of histones and allow an access to some DNA parts; repressors may attract histone deacetylases

Transcription committee

- Combinatorial control means that multiple regulatory proteins will determine an expression of single gene
- In eukaryotes, each gene is controlled by dozens of regulators

Eukaryotic transcription regulators

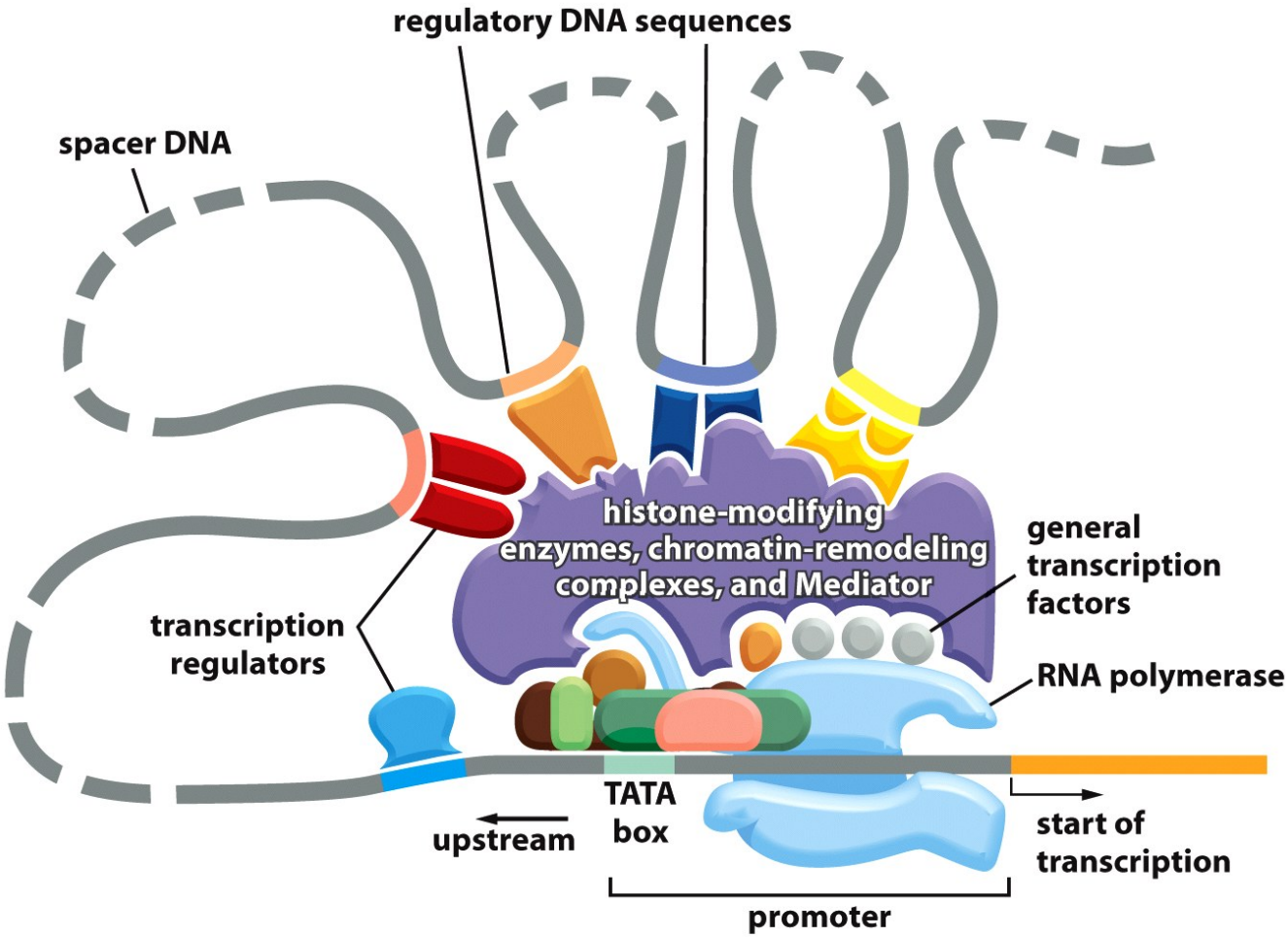

Figure 8-12 Essential Cell Biology 3/e (© Garland Science 2010)

Summary

- Cell differentiation is a result of nonuniform gene expression
- Activators and repressors could switch transcription on and off
- Different combinations of transcription regulators activate gene expression in different places and in different ways

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 8.