Advanced Cell Biology. Lecture 24

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Outline

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Previous final question: the answer

How many signals control the *Lac* operon?

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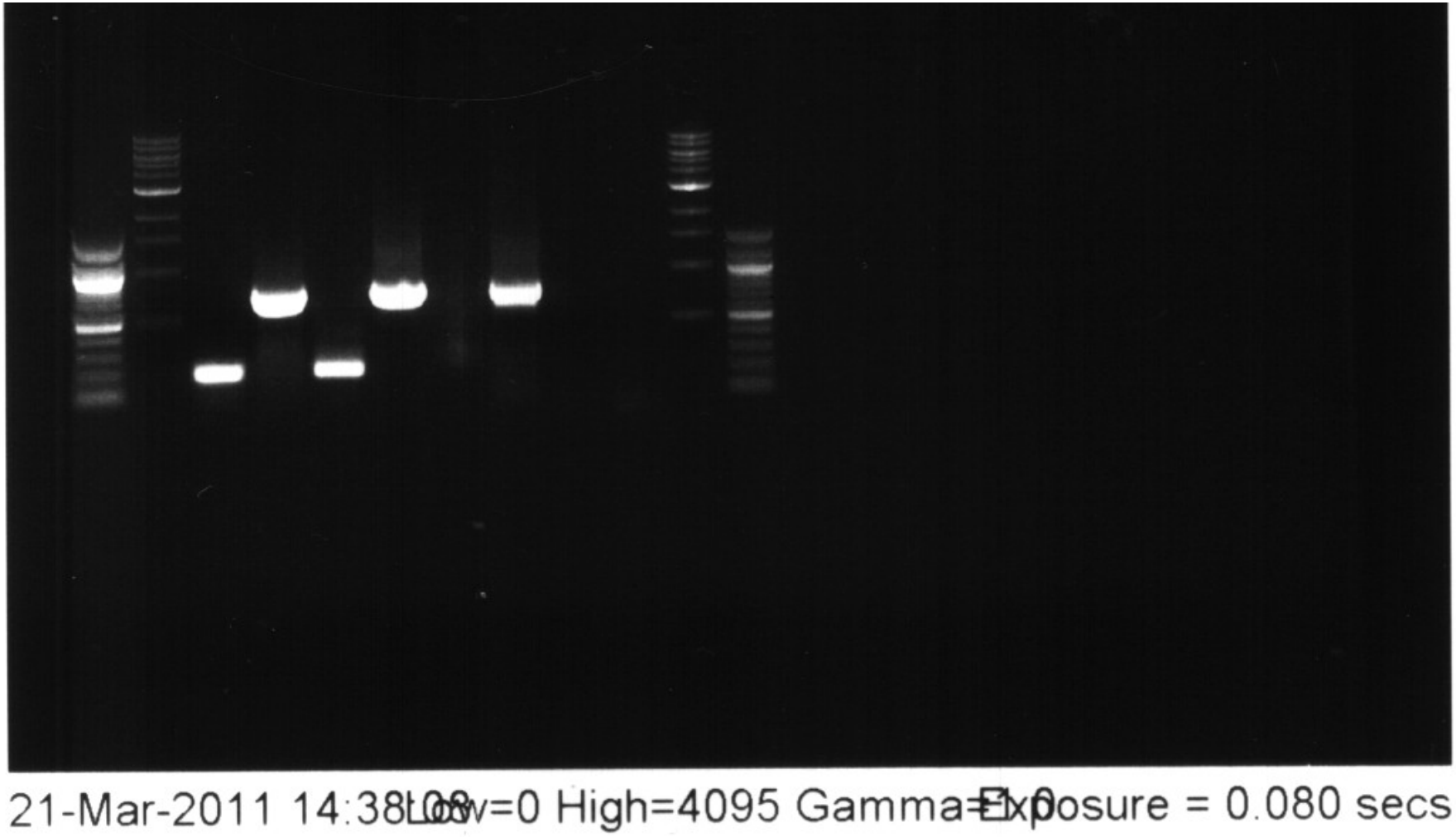
How many signals control the *Lac* operon?

- 2

Lab 6 gel (section 1)



Positional expression in *Drosophila* egg

- In the ovoid fly egg, different proteins are expressed in different parts
- Injection of cytoplasm from posterior end may convert head to the second tail

Double-posterior fly larva

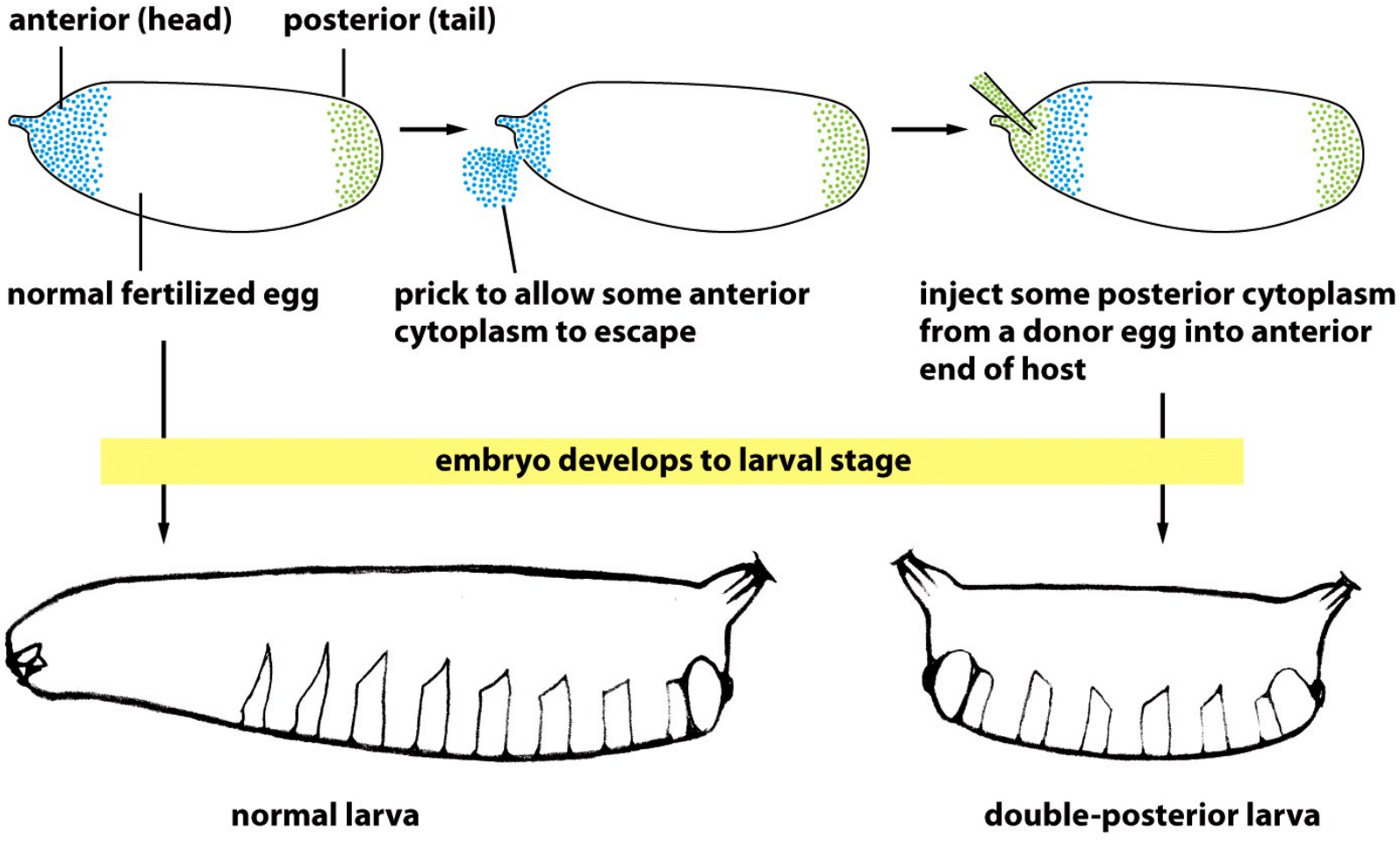
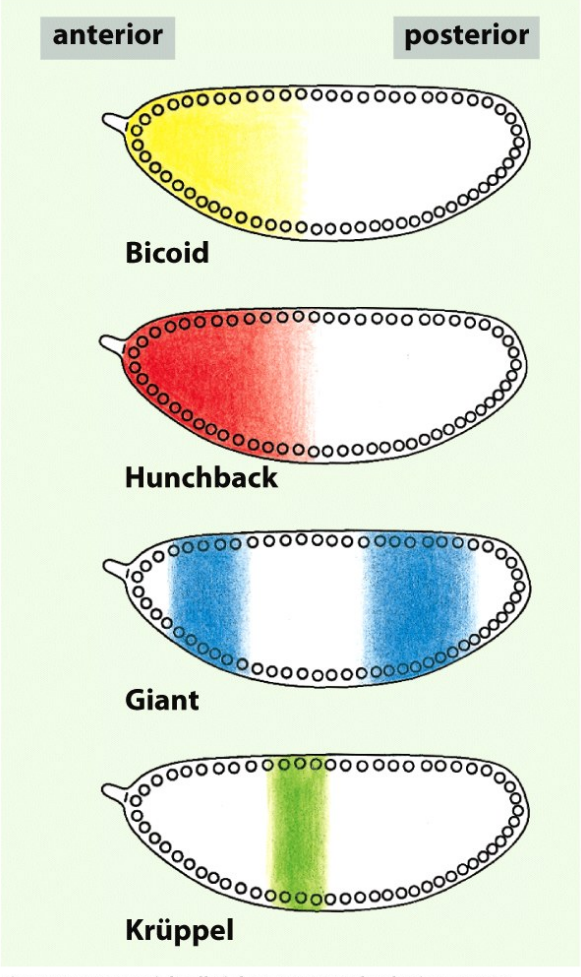


Figure 8-13 Essential Cell Biology 3/e (© Garland Science 2010)

Bicoid, Hunchback, Giant and Krueppel

- Four transcription regulators were discovered using specific antibodies
- Each has its own distribution along the body axis
- They regulate the expression of *Eve* gene

Distributuion of transcription regulators in fly embryo



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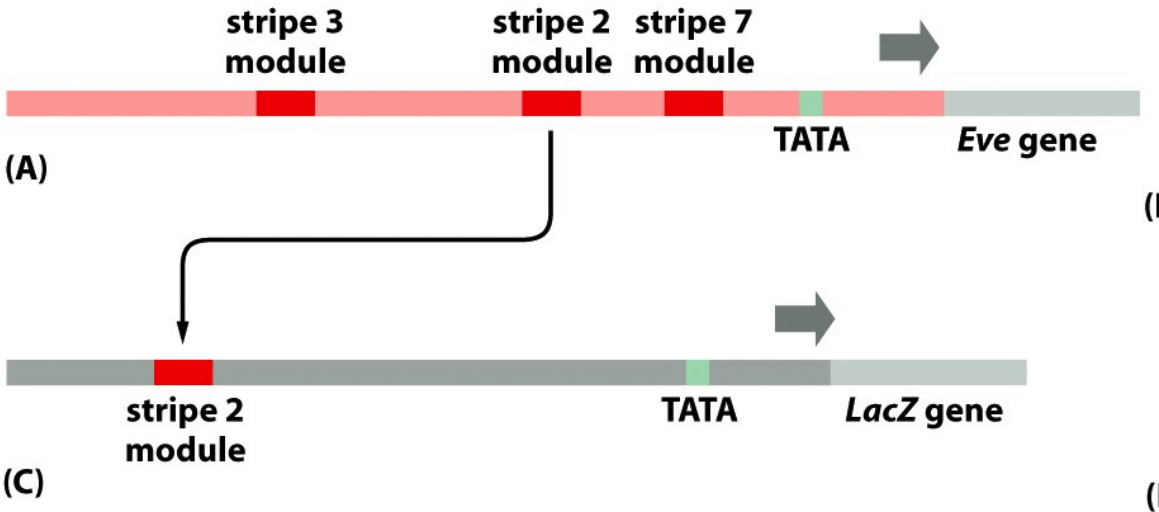
Seven stripes of *Eve*

- Every module will be activated if specific combination of transcription regulators is present
- If module is activated, *Eve* gene expression starts and stripe is formed
- Reporter gene (e.g., LacZ) may help to visualize the role of different activator modules

Stripes



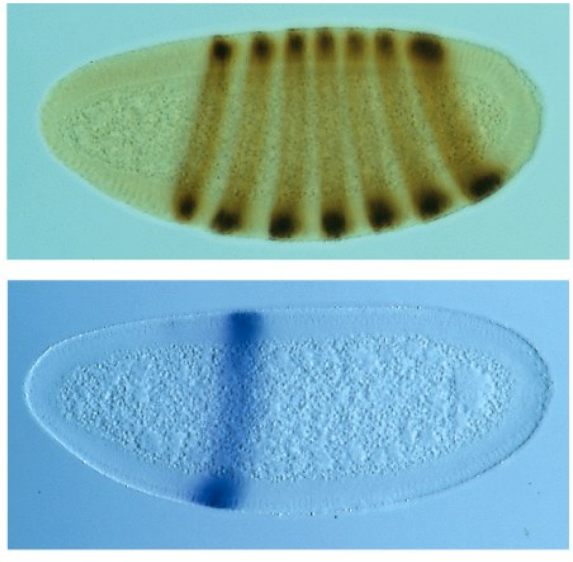
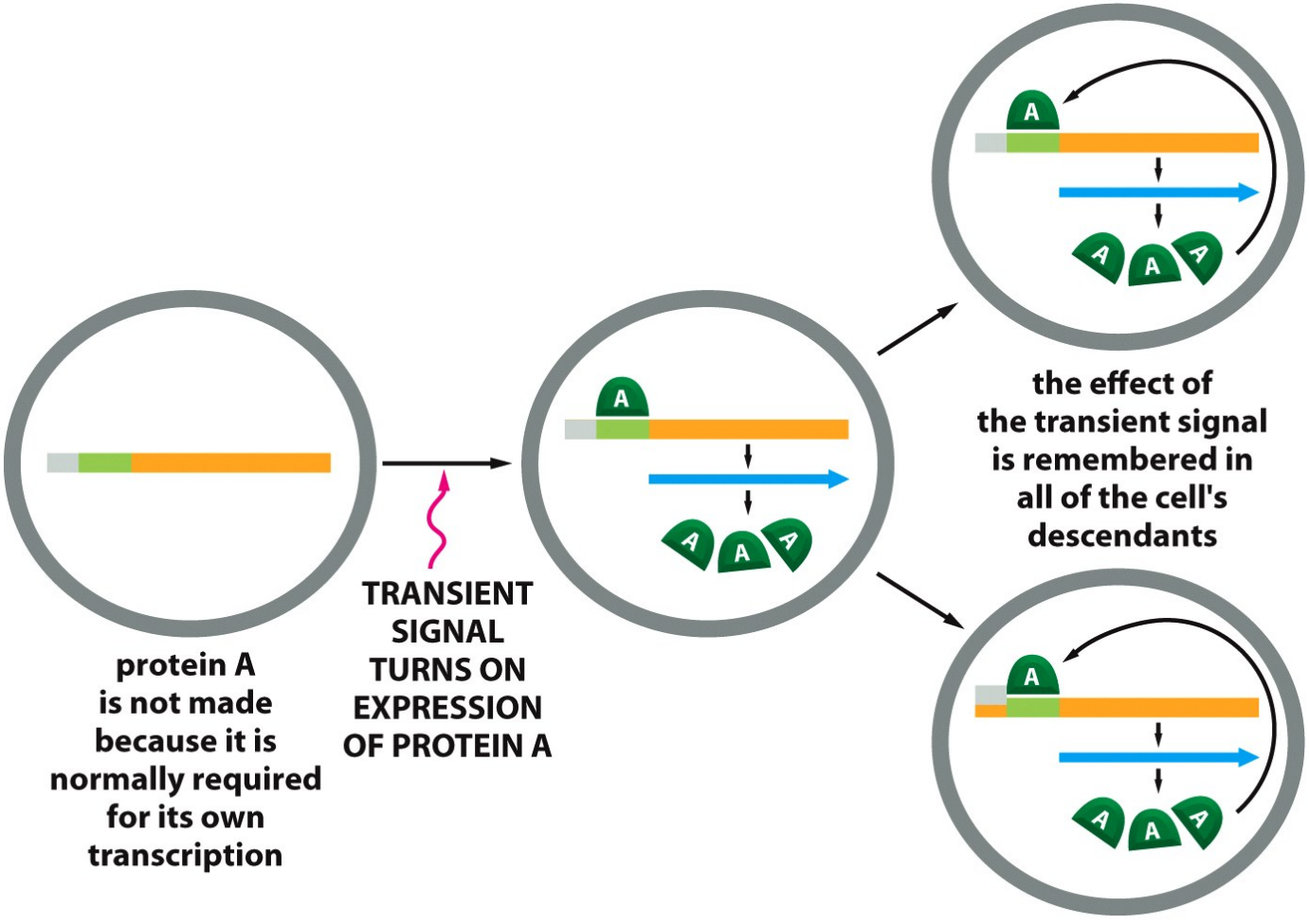


Figure 8-15 Essential Cell Biology 3/e (© Garland Science 2010)

Cell memory

- Positive-feedback loop: transcription activator activated transcription of it own gene
- DNA methylation patterns are inherited in cell lineages

Positive loop inheritance



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DNA methylation

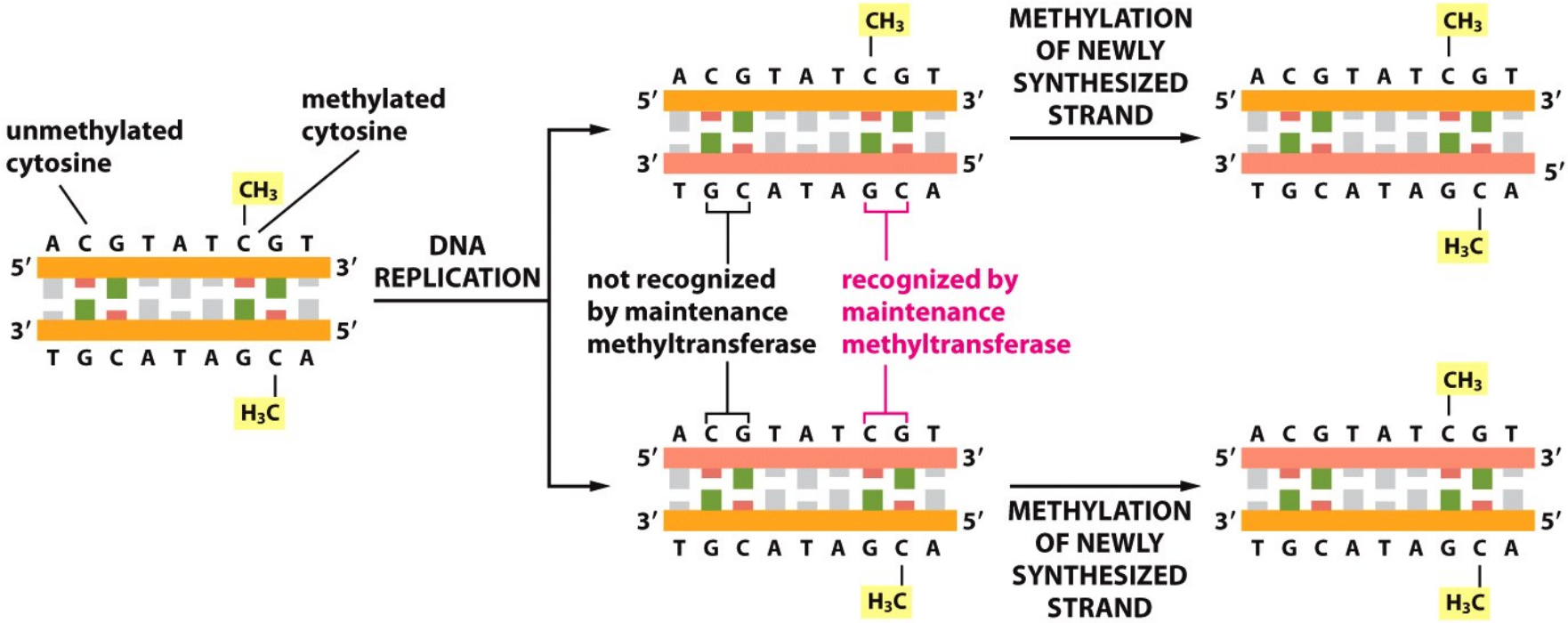


Figure 8-22 Essential Cell Biology 3/e (© Garland Science 2010)

Ey gene

- *Ey*/*Pax*-6 regulators are critical fro eye development in insects/vertebrates
- If expression of *Ey* gene will be turned on, eye may appear even on leg!

Riboswitches

- mRNAs may activate its own synthesis through riboswitches
- Riboswitch is a short sequence which change conformation of mRNA and block/unblock RNA polymerase
- Riboswitches have small molecules to bind with them

Riboswitch

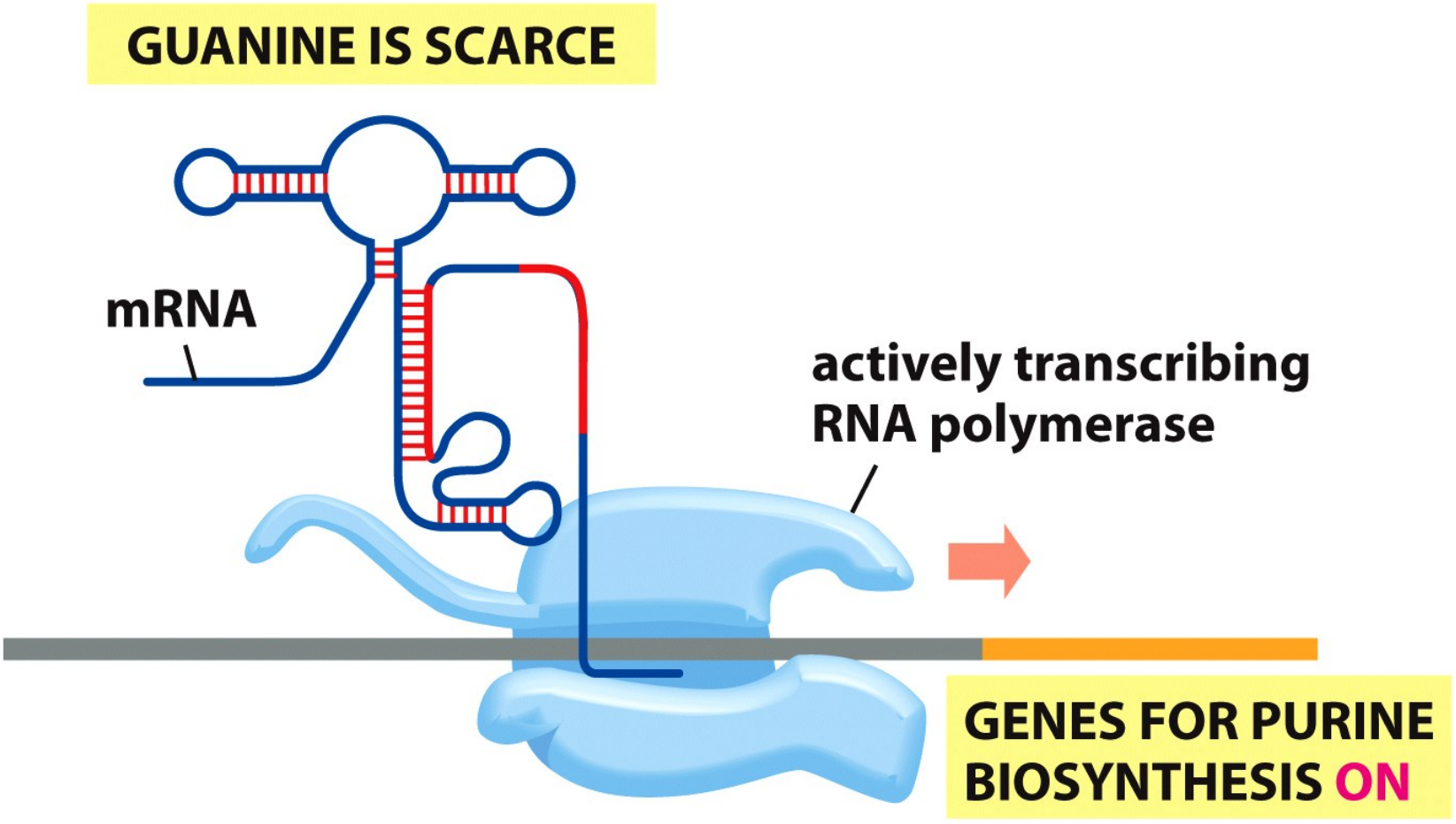


Figure 8-24a Essential Cell Biology 3/e (© Garland Science 2010)

Regulation of translation initiation

- Repressors may bind to ribosome-binding site (upstream to AUG codon) and block translation
- “Thermosensors” change conformation of mRNA and may unblock translation
- Riboswitches may also block/unblock translation
- Antisense complementary RNAs could block translation

mRNA-binding proteins as translation regulators

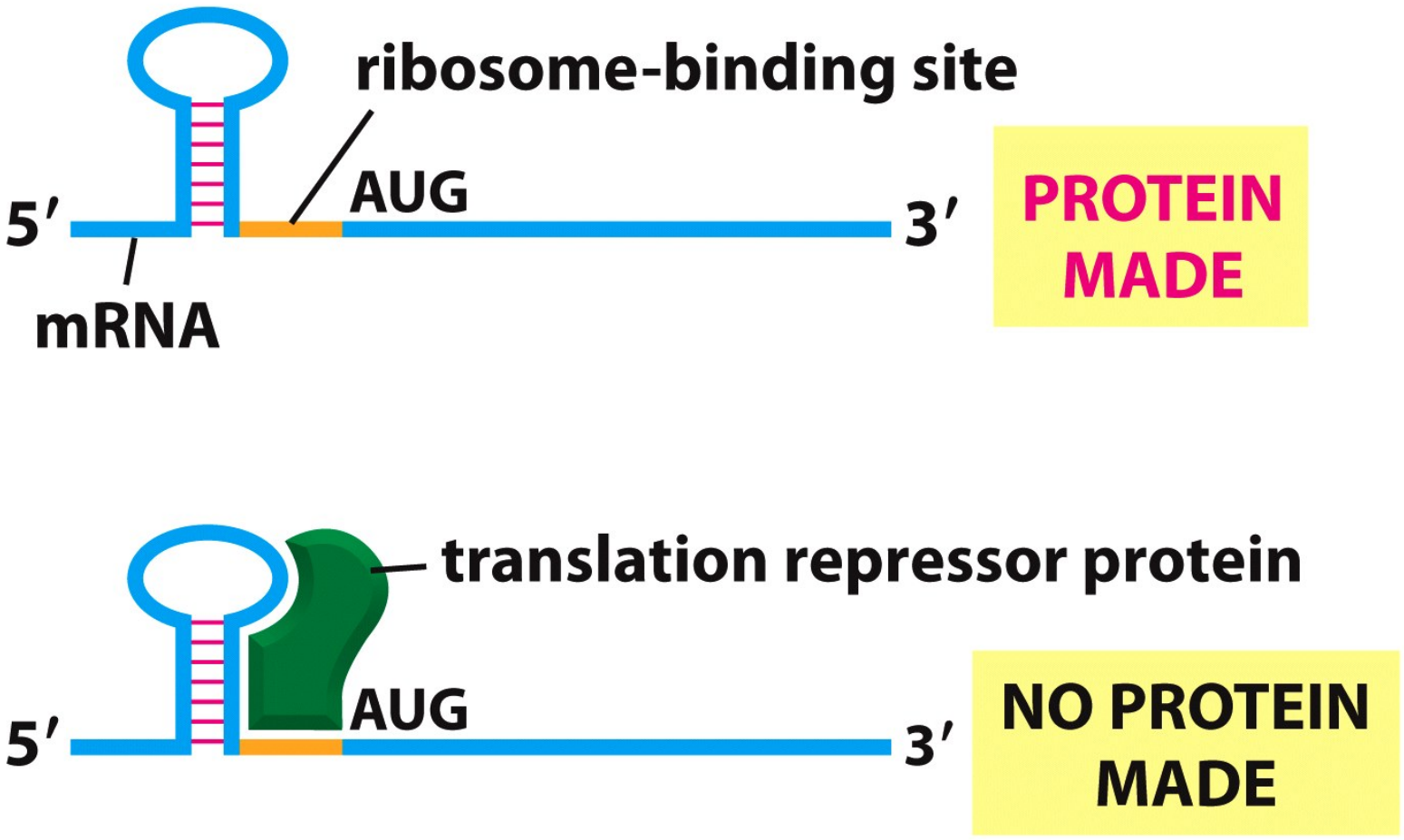
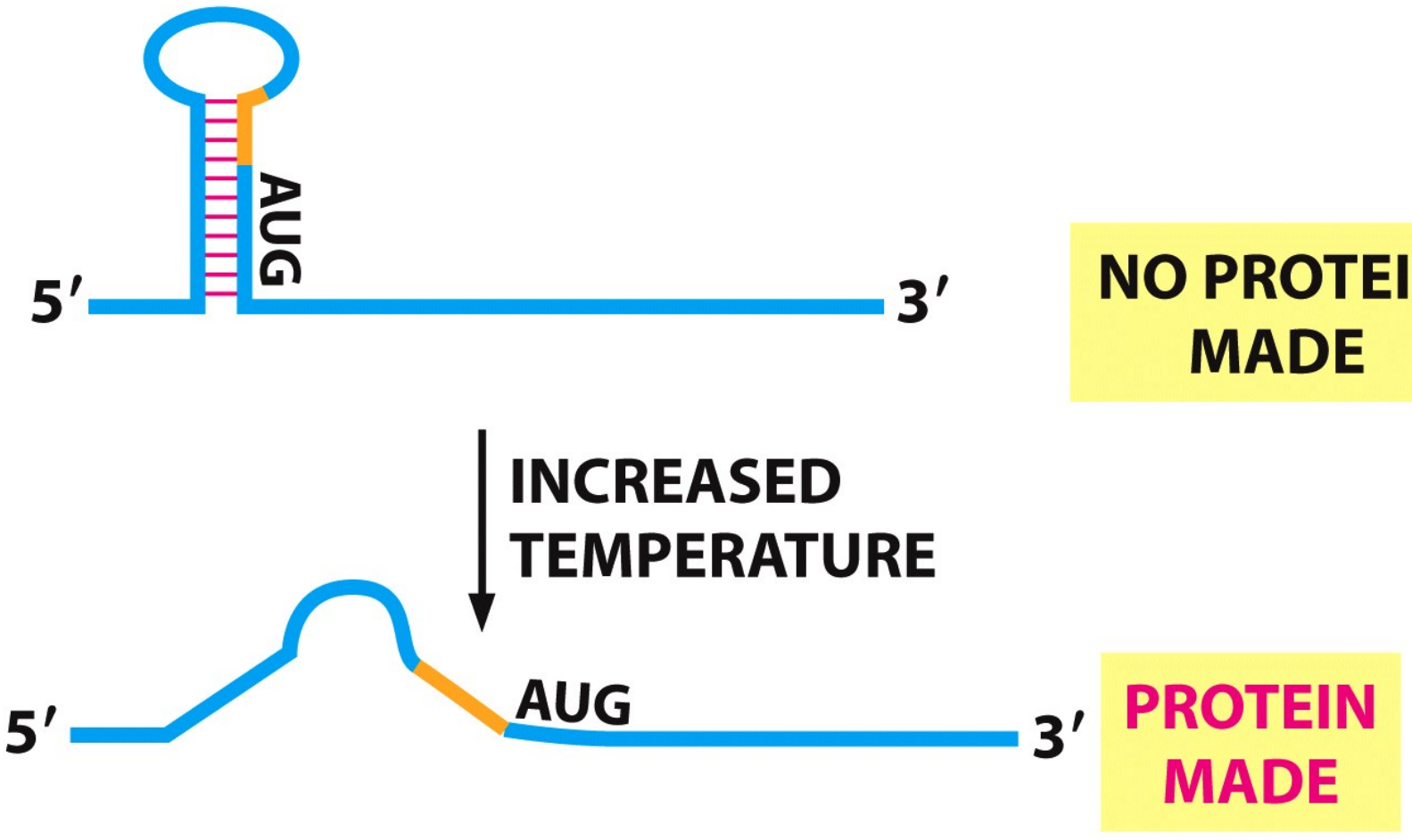


Figure 8-25a Essential Cell Biology 3/e (© Garland Science 2010)

Natural thermosensor RNA as translation regulator



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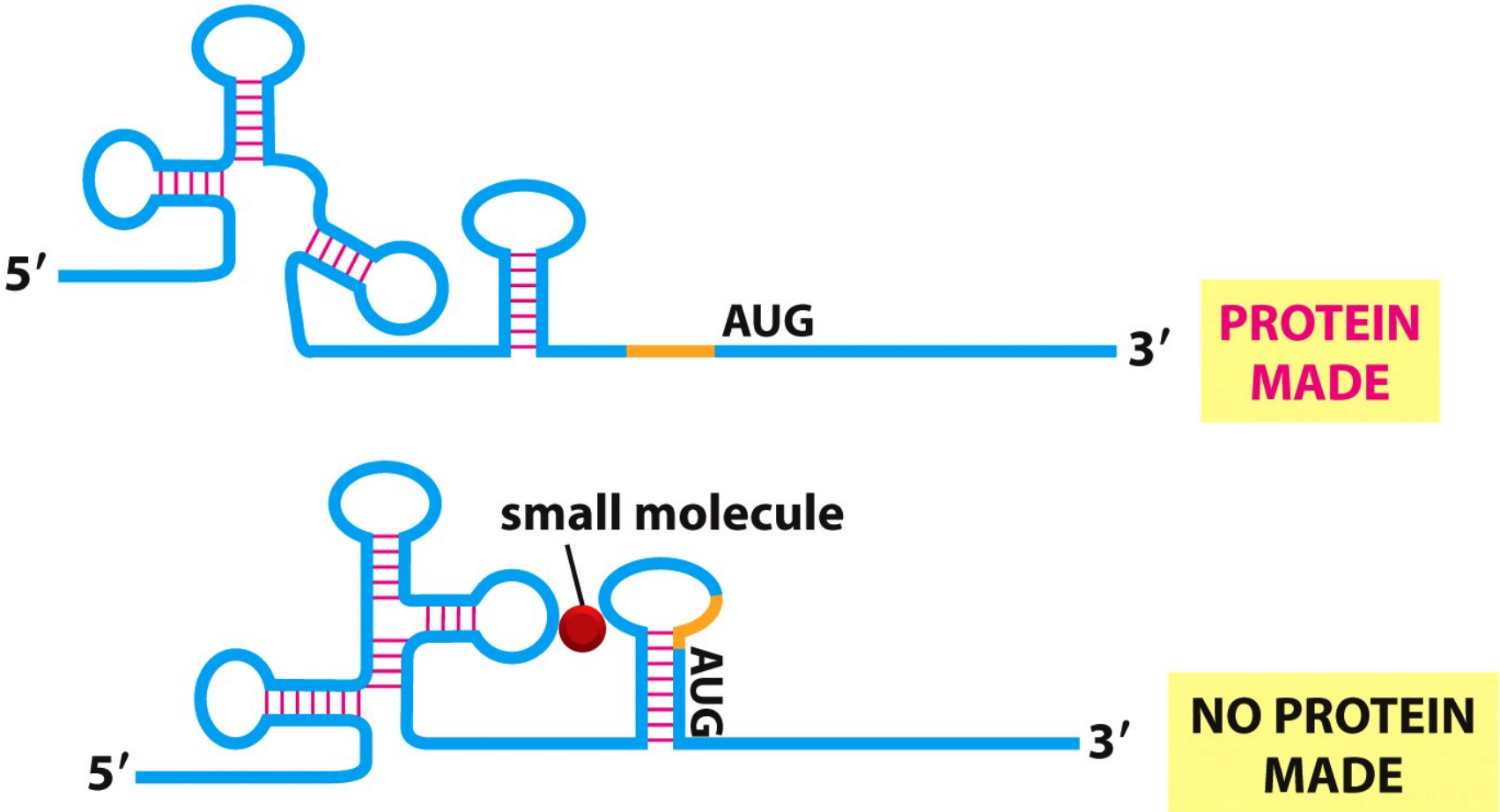
Riboswitches as translation regulators



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Antisense RNAs as translation regulators

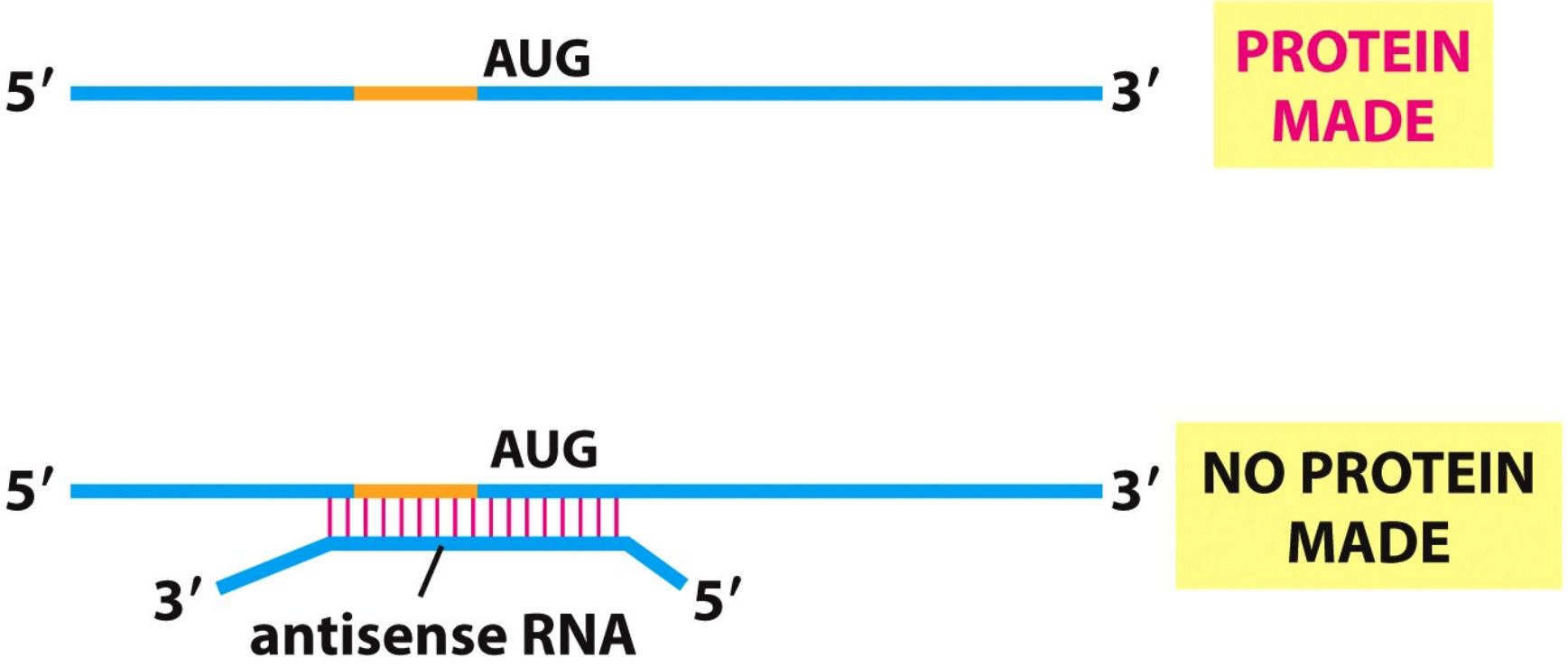

Figure 8-25d Essential Cell Biology 3/e (© Garland Science 2010)

miRNA control

- microRNAs (miRNAs) form a RNA-induced silencing complexes with proteins (RISCs)
- If a RISC finds a complementary mRNA, it blocks translation and destroy this mRNA

miRNA at work

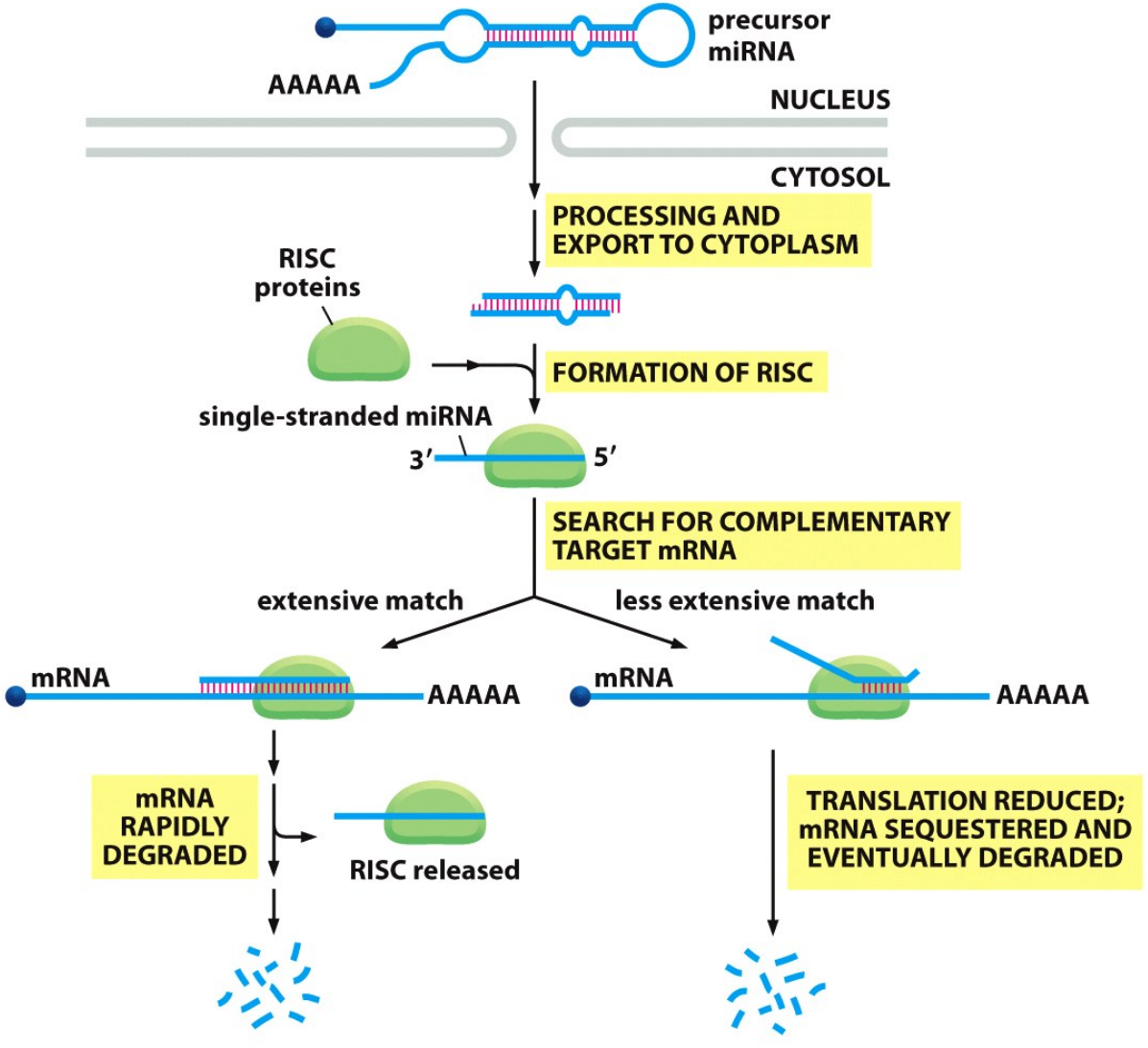

Figure 8-26 Essential Cell Biology 3/e (© Garland Science 2010)

RNA interference

- Dicer nuclease chop dsRNA of virus into fragments
- These fragments (small interfering RNAs, siRNAs) incorporate into RISCs
- Then RISCs become able to “know” invader RNAs

siRNAs

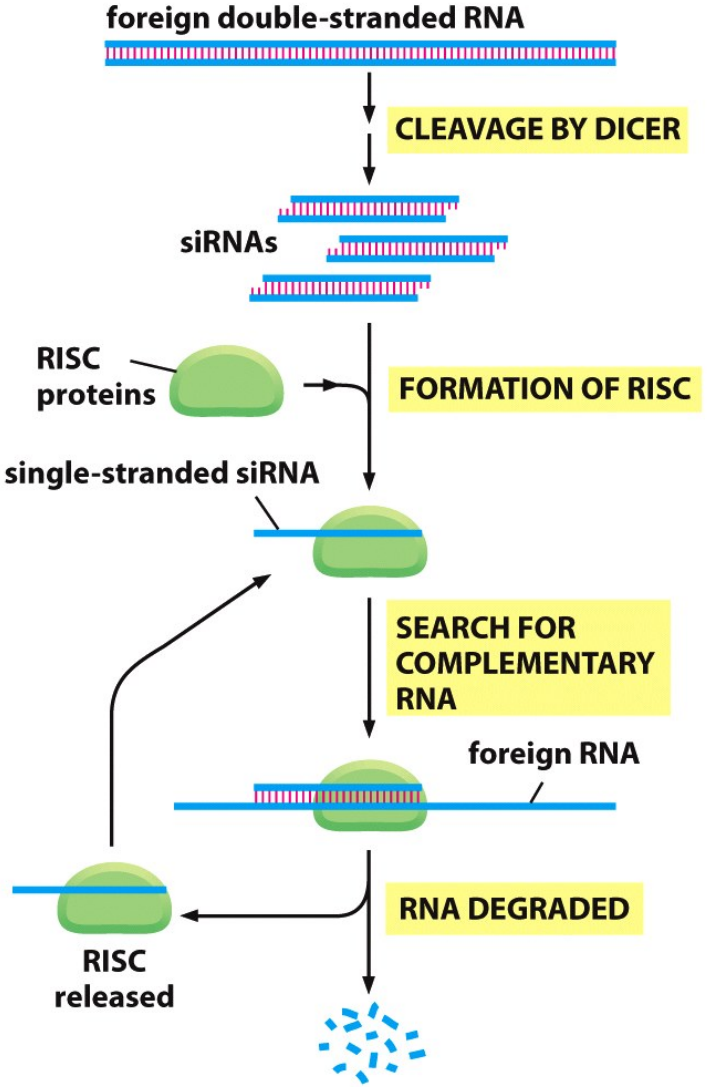

Figure 8-27 Essential Cell Biology 3/e (© Garland Science 2010)

Final question (1 point)

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Are riboswitches capable to facilitate the epigenetic inheritance?

Summary

- Transcription regulation may be specific to place
- Riboswitches and miRNA can regulate gene expression
- miRNAs/RISCs are capable to “memorize” invader RNA

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.