




## 13.4 Gene Regulation and Expression

### Lesson Objectives

-  Describe gene regulation in prokaryotes.
-  Explain how most eukaryotic genes are regulated.
-  Relate gene regulation to development in multicellular organisms.

### Lesson Summary

**Prokaryotic Gene Regulation** Prokaryotes do not need to transcribe all of their genes at the same time. They can conserve energy and resources by regulating their activities, producing only those genes necessary for the cell to function. In prokaryotes, DNA-binding proteins regulate genes by controlling transcription. An **operon** is a group of genes that are regulated together. An example is the *lac* operon in the bacterium *E. coli*:

- ▶ This group of three genes must be turned on together before the bacterium can use lactose as food.
- ▶ When lactose is not present, the DNA-binding protein called *lac* repressor binds to a region called the **operator**, which switches the *lac* operon off.
- ▶ When lactose binds to the repressor, it causes the repressor to fall off the operator, turning the operon on.

**Eukaryotic Gene Regulation** Transcription factors are DNA-binding proteins. They control the expression of genes in eukaryotes by binding DNA sequences in the regulatory regions. Gene promoters have multiple binding sites for transcription factors, each of which can influence transcription.

- ▶ Complex gene regulation in eukaryotes makes cell specialization possible.
- ▶ The process by which microRNA (miRNA) molecules stop mRNA molecules from passing on their protein-making instructions is **RNA interference (RNAi)**.
- ▶ RNAi technology holds the promise of allowing scientists to turn off the expression of genes from viruses and cancer cells, and it may provide new ways to treat and perhaps even cure diseases.

**Genetic Control of Development** Regulating gene expression is especially important in shaping the way a multicellular organism develops. Gene regulation helps cells undergo **differentiation**, becoming specialized in structure and function. Master control genes are like switches that trigger particular patterns of development and differentiation in cells and tissues.

- ▶ **Homeotic genes** are master control genes that regulate organs that develop in specific parts of the body.
- ▶ **Homeobox genes** share a similar 180-base DNA sequence called homeobox. They code for transcription factors that activate other genes that are important in cell development and differentiation in certain regions of the body.
- ▶ **Hox genes** are a group of homeobox genes that tell the cells of the body how to differentiate as the body grows.

Environmental factors can also affect gene expression.

# 13 4 Gene Regulation And Expression Answers

**Sankar Adhya**



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