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Chapter 18: Regulation of Gene Expression

Overview

The overview for Chapter 18 introduces the idea that while all cells of an organism have all genes in the genome, not all genes are expressed in every cell. What regulates gene expression? Gene expression in prokaryotic cells differs from that in eukaryotic cells. How do disruptions in gene regulation lead to cancer? This chapter gives you a look at how genes are expressed and modulated.

Concept 18.1 Bacteria often respond to environmental change by regulating transcription

1. All genes are not "on" all the time. Using the metabolic needs of *E. coli*, explain why not.

E. coli works by activating a metabolic pathway that makes tryptophan. This only happens when the human does not eat any meat. Once meat is eaten, E. coli stops to save its energy for when the meat is gone.

2. What are the two main ways of controlling metabolism in bacterial cells?
- Cells can adjust the activity of enzymes already present with chemical cues through feedback inhibition
- Cells can adjust the production level of the genes encoding the enzymes

3. *Feedback inhibition* is a recurring mechanism throughout biological systems. In the case of *E. coli* regulating tryptophan synthesis, is it *positive* or *negative inhibition*? Explain your choice.

It is negative inhibition because the accumulation of the product stops the enzyme from catalyzing it.

4. What is a *promoter*?

A promoter is a sequence of DNA nucleotides where RNA polymerase binds to in order to start transcription.

5. What is the *operator*? What does it do?

An operator is a sequence of nucleotides near the start of an operon where an active repressor can attach. It prevents RNA polymerase from attaching to the promoter and transcribing the genes of the operon.

6. What is an *operon*?

An operon is a unit of genetic function found in bacteria and phages. It includes a promoter, an operator, and the genes they control.

7. List the three components of an *operon*, and explain the role of each one.
- Promoter- starts transcription
- Operator- On/Off switch- synthesizes enzymes at once
- Genes they control- determines whether or not a certain amino acid will be coded for

8. How does a *repressor* protein work?

A repressor protein binds to the operator and blocks the attachment of RNA polymerase tot the promoter, which prevents transcription of a gene.

9. What are *regulatory genes*?

Regulatory genes code for a protein that controls the transcription of another gene or group of genes.

10. Distinguish between *inducible* and *repressible operons*, and describe one example of each type.
- Repressible operons are usually on but can be inhibited when a specific small molecule binds allosterically to a regulatory protein. (ex: tryptophan operon)
- An inducible operon is usually off but can be stimulated when a specific small molecule interacts with regulatory proteins. (ex: lactose operon)

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