

Review Sheet Regulation of Gene Expression

Lester BIOL 150

General things to do to prepare for the exam:

- study the PowerPoints
- write out the answers to the learning objectives found with each PowerPoint
- listen to my lecture recordings

Chapter 18

Why do prokaryotes and eukaryotes need to alter gene expression?

Describe the process of feedback inhibition. What kinds of enzymes are regulated this way?

How do bacteria control gene expression?

Describe the structure of an operon.

Compare and contrast inducible and repressible operons.

What is a corepressor?

What kind of operon is the tryptophan operon? Describe how the cell regulates the production of tryptophan.

What kind of operon is the lactose operon? Describe how the cell turns on the lac operon and under what conditions.

Turning operons on and off when necessary saves what?

Describe the effect of histone acetylation on gene expression.

Describe the effect of DNA methylation on gene expression.

What do you call these two kinds of modifications (acetylation and methylation)?

How does chromatin configuration affect transcription (gene expression)?

Describe how genomic imprinting affects the expression of genes inherited from different parents.

What is epigenetic inheritance?

Describe how alternative RNA splicing ultimately results in more than one type of protein.

mRNA lasts longer in which cell type: prokaryote or eukaryote? What determines this difference?

Describe micro RNA's (miRNA) and small interfering RNA's (siRNA)

Sample Test Questions

Which of the following molecules is a protein produced by a regulatory gene?

- A) operon B) inducer C) promoter D) repressor

When taken up by a cell, which of the following molecules binds to a repressor so that the repressor no longer binds to the operator?

- A) inducer B) promoter C) repressor D) corepressor

Which of the following conditions is most likely to cause the lactose operon to be transcribed?

- A) There is more glucose in the cell than lactose.
- B) There is glucose but no lactose in the cell.
- C) The cyclic AMP and lactose levels are both high within the cell.
- D) The cAMP level is high and the lactose level is low.

How does the transcription of structural genes in an inducible operon occur?

- A) It occurs continuously in the cell.
- B) It starts when the pathway's substrate is present.
- C) It starts when the pathway's product is present.
- D) It stops when the pathway's product is present.

For a repressible operon to be transcribed, which of the following conditions must occur?

- A) A corepressor must be present.
- B) RNA polymerase and the active repressor must be present.
- C) RNA polymerase must bind to the promoter, and the repressor must be inactive.
- D) RNA polymerase must not occupy the promoter, and the repressor must be inactive.

Altering patterns of gene expression in prokaryotes would most likely serve an organism's survival by _____.

- A) organizing gene expression, so that genes are expressed in a given order
- B) allowing each gene to be expressed an equal number of times
- C) allowing an organism to adjust to changes in environmental conditions
- D) allowing environmental changes to alter a prokaryote's genome

Suppose an experimenter becomes proficient with a technique that allows her to move DNA sequences within a prokaryotic genome. If a researcher moves the promoter for the *lac* operon to the region between the beta galactosidase (*lacZ*) gene and the permease (*lacY*) gene, which of the following results would be most likely?

- A) The three genes of the *lac* operon will be expressed normally.
- B) RNA polymerase will no longer transcribe permease.
- C) The operon will still transcribe the *lacZ* and *lacY* genes, but the mRNA will not be translated.
- D) Beta galactosidase will not be produced.

Which of the following results would occur if the repressor of an inducible operon were mutated so that it could not bind the operator?

- A) the irreversible binding of the repressor to the promoter
- B) the reduced transcription of the operon's genes
- C) the continuous transcription of the operon's genes
- D) the overproduction of cAMP receptor protein (CRP)

Under what conditions does the *trp* repressor block transcription of the *trp* operon?

- A) when the repressor binds to the inducer
- B) when the repressor binds to tryptophan
- C) when the repressor is not bound to tryptophan
- D) when the repressor is not bound to the operator

The reason for differences in the sets of proteins expressed in a nerve and a pancreatic cell of the same individual is that nerve and pancreatic cells contain different _____.

- A) genes
- B) regulatory sequences
- C) sets of regulatory proteins
- D) promoters

DNA methylation and histone acetylation are examples of which of the following processes?

- A) genetic mutation
- B) chromosomal rearrangements
- C) epigenetic phenomena
- D) translocation

How are bacteria able to change their patterns of protein synthesis so quickly in response to environmental changes?

- A) mRNAs that are produced are short-lived and degraded within a few minutes of being synthesized.
- B) mRNA have long lifespans, allowing the bacteria to use them many times for translation.
- C) mRNA is stored for later use.
- D) Operons are activated in the presence of transcription factors.

At the beginning of this century, there was a general announcement regarding the sequencing of the human genome and the genomes of many other multicellular eukaryotes. Many people were surprised that the number of protein-coding sequences was much smaller than they had expected. Which of the following types of DNA make up the rest of the human genome?

- A) DNA that consists of histone coding sequences
- B) DNA that is translated directly without being transcribed
- C) non-protein-coding DNA that is transcribed into several kinds of small RNAs with biological function
- D) non-protein-coding DNA that serves as binding sites for reverse transcriptase

If a particular operon encodes enzymes for making an essential amino acid and is regulated like the *trp* operon, then

- A) the amino acid inactivates the repressor.
- B) the repressor is active in the absence of the amino acid.
- C) the amino acid acts as a corepressor.
- D) the amino acid turns on transcription of the operon.

What would occur if the repressor of an inducible operon were mutated so it could not bind the operator?

- A) irreversible binding of the repressor to the promoter
- B) reduced transcription of the operon's genes
- C) buildup of a substrate for the pathway controlled by the operon
- D) continuous transcription of the operon's genes

Within a cell, the amount of protein made using a given mRNA molecule depends partly on

- A) the degree of DNA methylation.
- B) the rate at which the mRNA is degraded.
- C) the number of introns present in the mRNA.
- D) the types of ribosomes present in the cytoplasm.