BIO 184 - PAL Problem Set Lecture 4 (Brooker Chapter 14)
Transcriptional Regulation

Section A. Regulation of gene expression

What is gene expression?

Can a single gene be transcribed multiple times within a cell?

Can a single mRNA be translated multiple times within a cell?

What are the different levels of gene (expression) regulation? Which is the most important? Why?

List multiple reasons why gene regulation is important

What is an operator?

Where is the operator in relation to the promoter?

What is an operon?

Which organisms have operons?

Section B. Regulation of the *lac* operon in *E. coli*

What is the purpose of the genes encoded by the *lac* operon in *E. coli*? When are these gene products needed by *E. coli*?

What would happen if *E.coli* lost its ability to regulate expression of the *lac* operon?

What are the transcriptional regulatory proteins (activator and repressor) involved in *lac* regulation?

What are the inducers for each regulatory protein? Be specific.

What protein is encoded by the *lacZ* gene? What is the role of this protein in lactose metabolism?

What protein is encoded by the *lacY* gene? What is the role of this protein in lactose metabolism?

What protein in encoded by the *lacI* gene?

What is the role of this protein in lactose metabolism?

Is it a part of the *lac* operon? Explain.

How does the presence of lactose in an *E. coli* cell lead to de-repression of the *lac* operon? What enzyme is involved? What is allolactose?

What is cAMP? What are the cAMP levels inside the cell in relation to glucose?

What is the CAP protein and where does it bind on DNA?

If the *lac* operon is repressed in the absence of lactose, why do *E. coli* cells have small amounts of lactose permease and beta-galactosidase present at all times? What would happen to *E. coli*'s ability to metabolize lactose if the LacI repressor protein was 100% efficient at blocking transcription of the operon?

Would *E. coli* cells produce high or basal beta-galactosidase levels under each of the following growth conditions? For each condition, is CAP/cAMP bound to the CAP site? Is the LacI Repressor protein bound to the operator?

minimum media + glucose:

minimum media + lactose:

minimum media + sucrose:

minimum media + water:

What are the *lac* operon expression levels in a *lac*I null mutant?

If a second wild type or normal copy of the *lac*I gene (just *lac*I and not *lac*Z, *lac*Y, or *lac*A) is introduced into the *lac*I mutant cell, what would be the *lac* operon expression levels in this partial diploid?

What are the *lac* operon expression levels in an operator mutant, which prevents the binding of the LacI repressor?

What are the *lac* operon expression levels in a CAP binding site mutant, which has a mutation in the CAP binding site of the *lac* operon?