AP Biology 12 - Molecular Genetics
Concept 1: Analyzing the regulation of gene expression.

Name_____ Course/Section_____

Date_____ Professor/TA_____

Activity 18.1 How is gene expression controlled in bacteria?

Fill in the chart to organize what we know about the *lac* and *trp* operons.

Operon:	*lac*		*trp*	
Is the metabolic pathway anabolic or catabolic?	*Catabolic* *Breaks down lactose*		*Anabolic* *Synthesizes tryptophan*	
What regulatory genes are associated with the operon, and what functions does each serve?	Genes:	Functions:	Genes:	Functions:
What structural genes are included in each operon, and what does each produce?	Genes:	Products:	Genes:	Products:
Is the operon inducible or repressible?				
Is the repressor protein produced in active or inactive form?				
The repressor protein becomes active when it interacts with:				

☆ Read pages 351-355 in Campbell to help you with these questions

Diagram of lac and trp operons:

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Activity 18.2 Modeling the *lac* and *trp* operon systems: How can gene expression be controlled in prokaryotes?

Using the information in Activity 18.1 and in Chapter 18 of *Biology*, 8th edition, construct a model or diagram of the normal operation of both the *lac* and *trp* operon systems.

Draw diagrams on page "104"

In your models or diagrams, be sure to include these considerations:

regulatory and structural genes

inducible versus repressible control

anabolic versus catabolic enzyme activity

negative versus positive controls

Use your model to answer the questions.

1. Under what circumstances would the *lac* operon be "on" versus "off"? The *trp* operon?

2. How are the *lac* and *trp* operons similar (in structure, function, or both)?

3. What are the key differences between the *lac* and *trp* operons?

4. What advantages are gained by having genes organized into operons?

5. Strain X of *E. coli* contains a mutated *lac* regulatory gene on its bacterial genome. As a result, the gene produces a nonfunctional *lac* repressor protein. You add a plasmid (an extra circular piece of double-stranded DNA) to these cells. The plasmid contains a normal regulatory gene and a normal *lac* operon.

   Build a model or diagram of what one of these modified *E. coli* cells would look like. Then answer the questions and use your model or diagram to explain your answers.

   a. Before the addition of the plasmid, would the *E. coli* strain X cells be able to produce the enzymes for lactose digestion? Explain.

   b. After the addition of the plasmid, would the plasmid's *lac* operon produce the enzymes for lactose digestion constitutively (all the time) or only when lactose was the available sugar source? Explain.

   c. After the addition of the plasmid, would the bacterial genome's *lac* operon produce the enzymes for lactose digestion constitutively or only when lactose was the available energy source? Explain.

   d. If equal amounts of lactose and glucose were present in the cell, would the *lac* operon in the bacterial DNA be off or on? Would the *lac* operon on the introduced plasmid be off or on? Explain.