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.

<table>
<thead>
<tr>
<th>Operon:</th>
<th><em>lac</em></th>
<th><em>trp</em></th>
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| 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: |  |  |  |  |
ACTIVITY 18.2 Modeling the lac and trp operon systems: How can gene expression be controlled in prokaryotes?

Answer the following questions. Draw a diagram of the operon to assist you in answering these questions. In your diagram, be sure to including the following:

Regulatory and structural genes
Inducible vs. repressible control – i.e. inducers and repressors
Negative vs. positive controls

1. Under what circumstances would the lac operon be “on” vs. “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 (i.e. lacI) on its bacterial chromosome. As a result, the gene produces a non-functional lacI repressor protein. You add a plasmid containing a normal lacI gene to these bacteria that also possess a normal lac operon.

   a. Before the addition of the plasmid, would the E.coli strain X cells be able to produce the enzymes for lactose digestion? Explain your answer
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 (all the time) or only when lactose was the available sugar source? Explain.

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