Viral and Bacterial Genetics

Part 1: Viral Reproduction

You will be assigned to create a flow chart of one of the viral life cycles listed below.

1. The Lytic Cycle
2. The Lysogenic Cycle
3. A Typical Animal Cell Virus
4. A Typical Plant Cell Virus
5. A Retrovirus

Please make sure that your diagram is a complete and thorough representation of your assigned viral life cycle. A list of some helpful vocabulary terms is provided below to help you start thinking about your topic:

When you have finished this assignment, attach your diagram to the end of this handout.

AIDS (acquired immunodeficiency syndrome) phage
bacteriophage prophage
capsid provirus
HIV (human immunodeficiency virus) retrovirus
host range reverse transcriptase
lysogenic cycle temperate phage
lytic cycle vaccine
nucleoid viral envelope

Part 2: Mechanisms of Bacterial Genetic Recombination

1. Explain how transformation increases genetic diversity in a bacterial population.
2. How do phages function in the process of bacterial transduction?

3. How is bacterial conjugation similar to and different from sexual reproduction?

4. What kind of genes can be exchanged between bacteria?

5. Evaluate the overall concept of bacterial recombination. What are some of the strengths and limitations of these approaches?
Part 3: Bacterial Control of gene expression.

Fill in the chart to organize what you 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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</thead>
<tbody>
<tr>
<td>Briefly explain the purpose of each of the metabolic pathways that the operons are involved in. Are the pathways anabolic or catabolic?</td>
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<tr>
<td>What regulatory genes are associated with the operon, and what functions does each serve?</td>
<td>Genes:</td>
<td>Functions:</td>
</tr>
<tr>
<td>What structural genes are included in each operon and what does each produce?</td>
<td>Genes:</td>
<td>Functions:</td>
</tr>
<tr>
<td>Is the operon inducible or repressible?</td>
<td></td>
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<tr>
<td>Is the repressor protein produced in an active or inactive form?</td>
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<tr>
<td>What conditions are necessary for the repressor protein to become active?</td>
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</tbody>
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Answer the Following Questions:

1. Under what circumstances would the \textit{lac} operon be “on” versus “off”? How is this different from the \textit{trp} operon?

2. How are the \textit{lac} and \textit{trp} operons similar (in structure and function)?

3. What are the key differences between the \textit{lac} and \textit{trp} operons?

4. What are the advantages of having genes organized into operons?
5. You are working with a strain of *E. coli* that has a mutated and non-functional lac regulatory gene in its genome. You add a plasmid to these cells containing a normal lac operon and normal lac regulatory genes.
   
a. Draw a diagram of the modified bacterial cell. Label all important parts.

b. Before the addition of the plasmid, would the *E. coli* mutants be able to produce the enzymes for lactose digestion? Explain your answer.

c. After the addition of the plasmid, would the plasmid’s lac operon produce the enzymes for lactose digestion constitutively or on only when lactose was the available sugar source. Explain your answer.

d. 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 your answer.