Viral Lytic and Lysogenic Cycles

Bacteriophages, or ____________, are viruses that infect bacteria. A typical phage consists of _____ inside a ______________ coat. The __________ cycle begins when the tail fibers of the phage stick to receptor sites on the surface of a host bacterium, such as E. coli.

The phage injects its DNA into the host cell, leaving the empty protein coat outside. The DNA of the host cell is _______________, and host cell enzymes and nucleotides are commandeered to ______________ the phage DNA, making more phage DNA.

The host cell’s _______________ and _______________ transcribe the phage genes and translate them into phage proteins. Phage parts accumulate and assemble to form phages. A phage enzyme digests the bacterial cell wall and the cell ruptures, or _____________. As many as 200 phages spill out. Each of them may go on to infect another cell.

In contrast to the lytic cycle, the ____________ cycle reproduces the viral genetic material without destroying the host. The lysogenic cycle of phage lambda begins when a phage binds to the surface of a host bacterium. The phage injects its DNA into the host cell, leaving the empty protein coat outside. The viral DNA is incorporated into the host cell DNA, where it is called a ________________.

Every time the host bacterium reproduces, it replicates the phage DNA along with its own and passes the copies on to daughter cells.

Occasionally, the phage DNA __________ the bacterial chromosome and initiates a lytic cycle. The viral DNA takes over the metabolic machinery of the host cell to make phage ______ and ________________. The host cell ____________, releasing phages which can infect other cells.

The lac Operon in E. coli

Bacteria adapt to changes in their surroundings by using ________________ proteins to turn groups of genes on and off in response to various environmental signals.

The DNA of Escherichia coli is sufficient to encode about _______ proteins, but only a fraction of these are made at any one time. E. coli regulates the expression of many of its genes according to the food sources that are available to it.

In 1961, Francois Jacob and Jacques Monod proposed the operon model of gene regulation in bacteria.

The model was based on their study of the genes in E. coli that code for enzymes that affect the breakdown of _____________.

Because of the pioneering work of Jacob and Monod, the ________________ is typically used to illustrate gene regulation in bacteria. Gene regulation in eukaryotes is quite different.

An ____________ is a cluster of bacterial genes along with an adjacent ________________ that controls the transcription of those genes.

When the genes in an operon are transcribed, a single ____________ is produced for all the genes in that operon.
The ________________ contains short, specific nucleotide sequences that signal the start of a gene and is the site where __________________________ starts transcription.

______________ are regions of DNA that interact with regulatory proteins that control the transcription operons.

Here's an analogy. A promoter is like a ________________, in that the promoters of many operons are similar. An operator is like the ______________ in a door knob, in that each door is locked by only a specific _____, which in this analogy is a specific regulatory protein.

The regulatory gene of the lac operon produces an mRNA that produces a ________________ protein, which can bind to the operator of the lac operon.

The general term for the product of a regulatory gene is a ___________________________________. The lac regulatory protein is called a repressor because it keeps RNA polymerase from transcribing the structural genes. Thus the repressor inhibits transcription of the lac operon.

When ______________ is present, it binds to the ______________ and changes its shape.

As a result of this change, the ________________ can no longer bind to the ________________ region. RNA polymerase can then bind to the ________________ and transcribe the lac genes.

When the ________________ encoded by the lac operon are produced, they break down ______________, eventually releasing the ________________ to stop additional synthesis of lac mRNA.

Messenger RNA also breaks down after a relatively short amount of time.

Practice: Match the component of the lac operon system with its function by writing the correct letter in the blank.

_____1. promoter  
_____ 2. operator  
_____ 3. lactose  
_____ 4. lacI  
_____ 5. lacZ  
_____ 6. RNA polymerase  
_____ 7. lacY  
_____ 8. repressor protein  
_____ 9. lacA

A. DNA segment with instructions for making transacetylase, an enzyme with unknown function
B. DNA segment that binds RNA polymerase and indicates where to start transcribing DNA
C. DNA segment that acts like a switch by controlling access of RNA polymerase to the genes
D. enzyme that transcribes DNA into a complementary mRNA molecule for translation into a protein
E. DNA segment found adjacent to lac operon with instructions for making the repressor protein
F. DNA segment with instructions for making permease, an enzyme that transports lactose into the cell
G. DNA segment with instructions for making β-galactosidase, an enzyme that splits lactose
H. disaccharide sugar that is found most notably in milk and is formed from galactose and glucose
I. protein that binds to the operator and blocks RNA polymerase from transcribing lac operon