AP Biology Name ________________________________

Operons-Class Review

Use the following figures complete the tasks below. Figures 1-2 represent one system while Figures 3-4 represent another system.

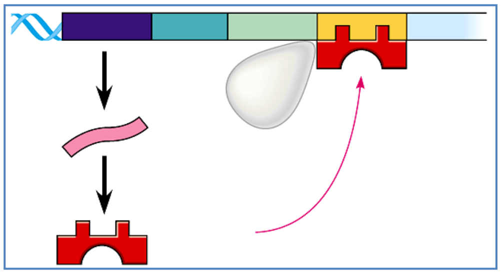

Figure 1

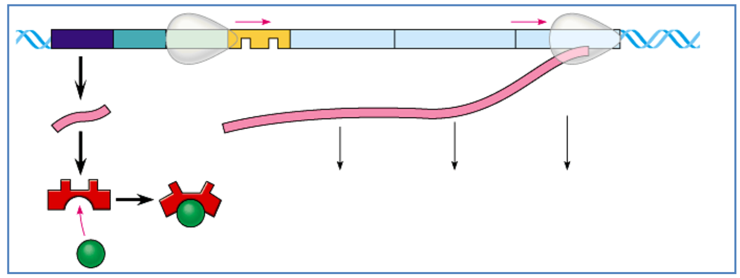

Figure 2

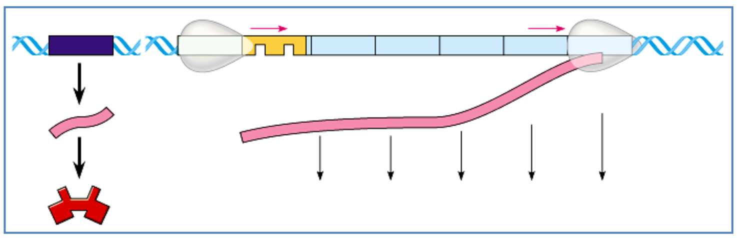

Figure 3

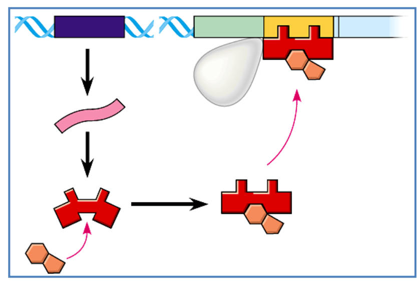

Figure 4

1) Label the operator in Figure 2.
2) Label RNA polymerase in Figure 4.
3) Label the operon in Figure 3.
4) Label the promoter in Figure 1.
5) Which set of figures represents the lac operon system? ________________
6) Which set of figures represents the trp operon system? ________________
7) Which set of figures shows an inducible enzyme pathway? _______________
8) Which set of figures shows a repressible enzyme pathway? _______________
9) Which set of figures shows a pathway used for anabolism? ________________
10) Which set of figures shows a pathway used for catabolism? ________________
11) Choose one set of figures (1-2 OR 3-4) and explain how this system works (in detail) and why it is important to the survival of *E.coli* (bacteria). (Use the backside for more space.)

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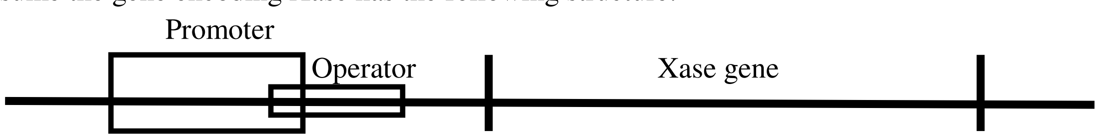
Problem Set 14 – Operons

1) The LAC operon of *E. coli* (bacteria) has the following structure: LacI---OP---LacZ---LacY---LacA LacI codes for the repressor protein which binds to the operator region (O). Binding of the repressor at O blocks the transcription of the operon. Lac Z, Y, and A code for the three enzymes of the operon which are B-galactosidase, lac permease, and transacetylase, respectively. The promoter region (P) is the site where RNA polymerase binds and begins transcription. Some mutants of the promoter (P-) cannot be bound by the RNA polymerase enzyme. Mutants of the operator (O^c) cannot be bound by the repressor. When no lactose is present the LacI repressor protein binds the operator. When lactase is present it binds to the repressor, changes its shape, and removes it from the operator. Mutants of LacI that code for a repressor protein that cannot bind the operator are called i^c. Mutants of LacI that cannot bind lactose are called i^s. Below is a list of mutants. Indicate whether there will be high levels of B-galactosidase present if the strains are grown with and without lactose.

	B-galactosidase enzyme activity	
Strain of E.coli	No lactose present	Lactose present
a) IPOZYA	-	+
b) IP-OZYA		
c) i^cPOZYA		
d) i^sPOZYA		
e) IPO^{c}ZYA		
f) i^sPO^{c}ZYA		
g) i^cP-OZYA		

2) Assume the gene encoding Xase has the following structure:



The boxes indicate the DNA sequence that make up the operator and promoter. The DNA sequence between the vertical lines represents the coding sequence of the Xase gene. A separate gene (R) codes for a repressor that binds to the operator in the absence of the inducer (X). If the inducer is present, the repressor no longer binds to the operator. Three different mutations were isolated that affect the ability of E.coli to manufacture the Xase enzyme. When the inducer (X) is added to wild type E.coli cells, Xase is quickly synthesized. In the absence of the inducer (X), very little Xase is made (see first line in table below). The three mutation (a-, b-, c-) affect synthesis of Xase differently.

	Units of Xase enzyme	
Strain genotype	-X	+X
a+b+c+ (all wild type)	0.01	100
a-b+c+	100	100
a+b-c+	<0.001	<0.001
a+b+c-	1.0	10,000

a) Determine where each of the mutants maps (to the promoter, operator, Xase gene or R gene). For each mutant there are two likely possibilities. What are they? For each possibility describe how the mutation leads the phenotype observed in the table.

b) Explain what you would expect for the double mutant (a-b+c-) in the absence and presences of X