PROBLEM SET #3 (lectures 19-21)

1. You should be familiar with the following terms and concepts:

promoter	β-galactosidase	attenuation
operator	permease	polycistonic mRNA
repressor	constitutive synthesis	cAMP
operon	inducible synthesis	cAMP receptor protein
inducer	transcriptional control	*trp* operon
co-repressor	lytic cycle	early and late genes
lactose	cis;trans effects	genetic switch
merozygote	lysogeny	cro, cI cII, cIII, N, Q
glucose feedback	Lex A, rec A	

2. What are the physical and biological consequences of *lac* repressor binding to the *lac* operator?
3. Is β-galactosidase made and is *lac* mRNA synthesis inducible, constitutive, or neither in cells of the following genotypes?

   $lacO^{c}lacZ^{-}lacY^{+}/lacZ^{+}lacY^{+}$

   $lacP^{-}lacZ^{+}/lacO^{c}lacZ^{-}$

   $lacI^{+}lacP^{-}lacZ^{+}/lacI^{-}lacZ^{+}$

   Why?
4. A mutant strain of *E. coli* is found that makes both β-galactosidase and permease whether lactose is present or not.

   a. What are two possible (haploid) genotypes of this mutant?

   b. When a partial diploid is formed with an F1 plasmid carrying a wild-type *lac* operon, synthesis becomes inducible. What was the genotype of the mutant?

5. Certain mutants of the *lacI* repressor gene do not bind lactose but do bind to the operator. In these strains, do you think β-galactosidase synthesis is inducible or constitutive, or neither?

6. Certain bacteria are known that metabolize crude oil. How would you test whether the enzymes that break down the oil are constitutive or inducible?

7. How does bacteriophage lambda decide whether to grow lytically or to lysogenize a newly infect host? What are the roles of the cI, N, and cro proteins in these decisions? What about cll?

8. What are the properties expected of mutants in cI, N, cro, and cII with respect to the propensity for lytic growth or lysogeny? Why?

9. Why do cIII mutants fail to lysogenize?