

## 7.012 SECTION PROBLEM: PROKARYOTIC GENE REGULATION

The imaginary bacterium *E. fictionalis* requires two enzymes for the metabolism of the imaginary sugar froyose. Enzyme 1 converts froyose to yumbose; enzyme 2 converts yumbose to glucose. Both enzymes are synthesized from a single mRNA and are induced in response to froyose; the operon is known to be regulated by repression.

You have isolated several mutants (A through G) that are altered in their metabolism of froyose. In the following charts, + indicates wild-type sequence; - indicates a mutant allele; you may assume that all mutations are **loss of function** that is, they inactivate the component they mutate. You have an assay for the level of enzymes 1 and 2. The results with haploid strains are shown below:

Genotype	- froyose		+ froyose	
	Enz 1	Enz 2	Enz 1	Enz 2
wild-type	low	low	high	high
A <sup>-</sup>	low	low	low	low
B <sup>-</sup>	high	high	high	high
C <sup>-</sup>	low	low	low	low
D <sup>-</sup>	low	low	low	high
E <sup>-</sup>	low	low	high	low
F <sup>-</sup>	high	high	high	high
G <sup>-</sup>	low	low	high	low

- 1) Which mutation(s) are likely to be in the coding region of enzyme 1?
- 2) Which mutation(s) are likely to be in the coding region of enzyme 2?
- 3) Which mutation(s) are likely to be in the promoter for enzyme 1 and 2?
- 4) Which mutation(s) are likely to be in the repressor or operator?

You then construct the following diploids:

	Genotype	- froyose		+ froyose	
		Enz 1	Enz 2	Enz 1	Enz 2
1	$\frac{D^{+} E^{-}}{D^{-} E^{+}}$	low	low	high	high
2	$\frac{E^{+} G^{-}}{E^{-} G^{+}}$	low	low	high	low
3	$\frac{A^{-} D^{+} E^{+}}{A^{+} D^{-} E^{-}}$	low	low	low	low
4	$\frac{B^{-} D^{+} E^{+}}{B^{+} D^{-} E^{-}}$	high	high	high	high
5	$\frac{F^{-} D^{+} E^{+}}{F^{+} D^{-} E^{-}}$	low	low	high	high

- 5) Explain the phenotypes of strains 1 through 5. Which mutation(s) are in the repressor? the operator?