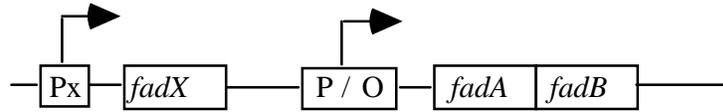


Question 9

Consider the following hypothetical chromosomal region containing two genes, *fadA* and *fadB*, necessary for the breakdown of oleic acid in a bacterium.



P = Promoter
O = Operator

The FadX protein, which is continuously produced, binds to the operator in the presence of oleic acid.

a) Is the FadX protein a repressor or an activator of the *fadA* and the *fadB* genes? Briefly justify your reasoning.

b) For each of the following mutants (m1 - m4), predict the level of FadA in the presence of oleic acid. Circle either "Low" or "High".

		<u>Level of FadA with oleic acid present</u>	
m1	O is deleted	Low	High
m2	Loss-of-function mutation in <i>fadX</i>	Low	High
m3	P is deleted	Low	High
m4	FadX is always bound to O	Low	High

~~Solutions:~~

~~Question 1:~~

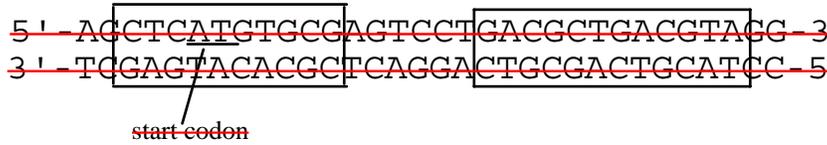
~~a) $10\text{kg} / (.4)(.8)(.5)(.05)(.2)(.5) = 12,500 \text{ kg/week}$~~

~~b) i) This model would predict that 1/2 as much carbon would be fixed by the phytoplankton. Since all efficiencies remain the same, this would cause all flows to decrease to 50% of their non-poisoned levels. This would therefore reduce the detritivore respiration by 50%. This is not consistent with the observed increase.~~

~~ii) This model would predict that 5 kg carbon per week of fish are dying and therefore becoming detritus. Since all efficiencies are the same and the tank remains at steady state, this additional input to the detritus must be made up for by an equal increase in output from detritus. Since the only output from detritus is respiration (refractory carbon cannot increase at steady state), detritivore respiration must increase by 5 kg carbon per day. This is consistent with your measurement.~~

~~Question 6, continued~~

~~b)~~



~~ii) NH₃⁺ - met - cys - glu - arg - COO⁻~~

~~Question 7~~

~~a) i) True.~~

~~ii) False. B cells produce antibodies.~~

~~iii) False. Each B cell makes one distinct kind of antibody.~~

~~b) The rabbit protein is recognized as foreign (non-self) by the guinea pig.~~

~~c) B cells, by gene rearrangement of Ab genes (VDJ rearrangement). Also, T cells (by rearrangement of T cell receptor genes).~~

~~Question 8~~

~~a) An autosome, because individual 6, a male, has 2 alleles.~~

~~b) The mutant phenotype is recessive, because individuals 5 and 6 each have one copy of the mutant allele, m, and are both phenotypically normal.~~

~~c) 1/4. Since individuals 3 and 4 already have an affected child, then they must both be heterozygotes.~~

~~d) 5'...GCCAGCTG...3'~~

~~e) A mutation occurred which led to the production of a new mutant allele, m*. This mutant allele has a recessive phenotype and its PCR product is cut by neither NheI nor PvuII. Individual 9 has the genotype m/m*.~~

~~Question 9~~

~~a) The FadX protein is an activator, since FadA and FadB need to be synthesized in the presence of oleic acid.~~

~~b)~~

~~m1: If the activator FadX cannot bind to the operator, transcription of fadA will be low.~~

~~m2: Without a functional FadX activator transcription of fadA will be low.~~

~~m3: Without the promoter, RNA polymerase cannot transcribe the fadA gene, leading to a low level of FadA.~~

~~m4: If FadX is always bound, it will lead to the constitutive expression of fadA, leading to a high level of FadA.~~