

Introduction to biology

Assignment 2

Deadline - 6th sept 2019

Q1. Align the sequences and find the consensus sequence from the given sequences. Calculate the probability of the occurrence of the consensus nucleotide at each position and probability of occurrence of the whole consensus sequence. Also calculate the probability of occurrence of the consensus sequence if all the nucleotides are equally probable.

1. AGCCGTCGTA
2. ACGTCTAGTC
3. ACGCCGTCTC
4. AGTTCCCGTC
5. CCGTCAGCAT

Q2. The production rate of certain mRNA is 1 molecule/min and its half life is 10 mins. The translation rate of the protein per mRNA is 1 molecule/min and its half life is 30 mins. Calculate the number of mRNA and protein at steady state. Also estimate the concentrations (in nM=n mol/l) of the mRNA and protein if the cell has 1 micron radius.

Q3. For the given DNA sequence GTGGATGAGCCGTCGTCCGTCTTAAAGTAG write the transcribed mRNA sequence. Identify start and stop codon, write the translated protein sequence. Introduce a frameshift mutation by adding "A" at the 2nd position eg. GATGGAT to the above sequence. Write the corresponding mRNA and protein sequences.

Q4. Briefly describe the role of activator and repressor in the regulation of Lac operon to achieve the sugar preference in bacteria.

Q5. As found in the previous assignment, the number of protein molecules in a bacterial cell is around 10^7 . Calculate the number of ATP consumed to produce all the protein molecules for division in 30 min.

If the glucose consumption rate is $2 \text{ mili mol g}^{-1} \text{ hour}^{-1}$, calculate the total ATP produced per cell during 30 min. What is the percentage of ATP used in protein production.

(Assume that around 30 molecules of ATP are produced through metabolism of one glucose molecule).