Assignment 2: Quantum Information Processing and Genetic Engineering Assignment

585.729 Cell and Tissue Engineering

1. Please compare the structures and functions of DNA and RNA. Explain how the structures of these molecules facilitate their required functions within the cell. Also indicate how they are used in the DNA-protein paradigm.

2. You are interested in locating homologs of a human protein "W" in other species. You run a protein sequence similarity search and obtain the following results:

Human protein W vs.:		E Statistic Value (low indicating high similarity)
Human	Protein W	$<10^{-84}$
_____	Protein X	10^{-23}
_____	Protein Y	10^{-21}
_____	Protein Z	10^{-19}

All of these are statistically significant.
Assuming this is a housekeeping protein vital for cellular function and other proteins have been identified as demonstrating true homology, indicate the most likely species each match is from by filling in the table above with *C. Elegans*, **Chimpanzee or Dog.**

If you wanted to try to identify more distally related homologs perhaps in *E. Coli*, would a DNA similarity search be helpful? Briefly describe why or why not.

3. You ask a BME student is working in your lab to design an oligonucleotide to incorporate into a vector for the construction of a custom peptide. The student designs the following sequence. The student does NOT tell you if this is the coding or non-coding strand.

    5'   TGTTAACTTAGTTATCTCCTCTGCATGGCATGCCTTCA   3'

    Reminder – the coding strand corresponds to the codon sequence. A codon table is provided below and available in the slides from lecture 2.1.

    a. What is the RNA sequence of the longest reading frame that can be read. This is the desired sequence to translate on the ribosome (begin with the start codon and stop with the stop if any). Be sure to clearly indicate the 5' and 3' ends.

    b. Which sequence did the student give you? How do you know?

    c. What is the DNA sequence read by the RNA polymerase when assembling the portion of the transcription for part a. What direction does the RNA polymerase read in? Be sure to clearly indicate the 5' and 3' ends.

d. The student had some foresight so this sequence can be unidirectionally placed in a vector. This means upon proper construction of the vector and infection in an insect cell, transcription will only occur in the one direction, which produces the longest transcript you have identified by using a promotor upstream and terminator downstream. There is still a possibility that the ribosome could occasionally start translation at a downstream start codon in the same direction, yielding an additional and undesired protein product. How could you eliminate this possibility without impacting the amino acid sequence?
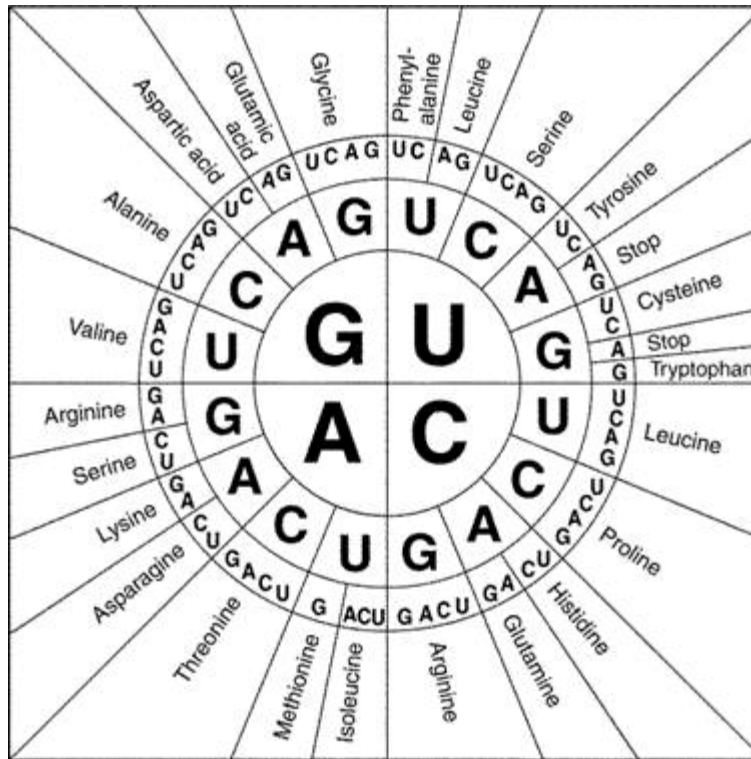
Assignment Rubric

Question	Component	Total Point Value
1	Short answer	6
2	Fill ins	3
	Short answers	3
3	A	5
	B	5
	C	4
	D	4

Total Point Value = 30