How DNA Controls the Workings of the Cell

Name _____

Below are two partial sequences of DNA bases (shown for only one strand of DNA) Sequence 1 is from a human and sequence 2 is from a cow. In both humans and cows, this sequence is part of a set of instructions for controlling a bodily function. In this case, the sequence contains the gene to make the protein insulin. Insulin is necessary for the uptake of sugar from the blood. Without insulin, a person cannot use digest sugars the same way others can, and they have a disease called diabetes.

Instructions:

1. Using the DNA sequence, make a complimentary RNA strand from both the human and the cow. Write the RNA directly below the DNA strand (remember to substitute U's for T's in RNA)

2. Use the codon table in your book (page 298) to determine what amino acids are assembled to make the insulin protein in both the cow and the human. Write your amino acid chain directly below the RNA sequence.

Example:

Sequence　　　　　*T T A C G G C T T A G T T A T*

RNA Sequence　　*A A U G C C G A A U C A A U A*

mRNA codon　　　　　*AAU/GCC/GAA/UCA/AUA*

Amino Acids　　　　　*Asparagine/ Alanine/Glutamate/Serine/Isoleucine*

Sequence 1 - Human

　　　　　　　　C C A T A G C A C G T T A C A A C G T G A A G G T A A

RNA sequence:

mRNA Codon

Amino Acids:

Sequence 2 - Cow

　　　　　　　　C C G T A G C A T G T T A C A A C G C G A A G G C A C

RNA sequence:

mRNA Codon

Amino Acids:

Analysis

1. Comparing the human gene to the cow gene, how many of the mRNA codons are exactly the same?

2. How many of the amino acids in the sequence are exactly the same?

3. Could two humans (or two cows) have some differences in their DNA sequences for insulin, yet still make the exact same insulin proteins? Explain.

4. Find ALL of the codons that can code for the amino acid leucine and list them.

5. Diabetes is a disease characterized by the inability to break down sugars. Often a person with diabetes has a defective DNA sequence that codes for the making of the insulin protein.

   Suppose a person has a mutation in their DNA and the first triplet for the insulin gene reads T A T. The normal gene reads T A G. What amino acid does the mutant DNA and the normal DNA code for and will the person with this mutation be diabetic?

6. Another mutation changes the insulin gene to read T C T (instead of the normal T A G). Will this person be diabetic? Explain.

7. DNA sequences are often used to determine relationships between organisms. DNA sequences that code for a particular gene can vary, though organisms that are closely related will have very similar sequences. This table shows the amino acid sequences of 4 organisms.

Human: C C A T A G C A C C T A   Chimpanzee: C C A T A A C A C C T A
Pig: C C A T G T A A A C G A   Cricket: C C T A A A G G G A C G

Based on these sequences, which two organisms are most closely related? How do you know?

8. An unknown organism is found in the forest and the gene is sequenced as follows:

Unknown: C C A T G G A A T C G A

What kind of an animal do you think this is? Why?