DNA's Instructions for Insulin

Introduction:

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 the production of a protein. 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.

Materials: The materials used in this experiment were:

1. Paper
2. Pencil
3. Codon table

Procedure: The procedures used in this experiment were:

1. Using the DNA sequence given in table 1, make a complimentary RNA strand for the human.
2. Write the RNA directly below the DNA strand [remember to substitute U's for T's in RNA].
3. Repeat step 1 for the cow. Write the RNA directly below the DNA strand in table 2.
4. Use the codon table in your book/notes 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.

Data:

Table 1

Sequence 1 Human	
DNA	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	
Amino Acids	

Table 2

Sequence 1 Cow	
DNA	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	
Amino Acids	

Analysis:

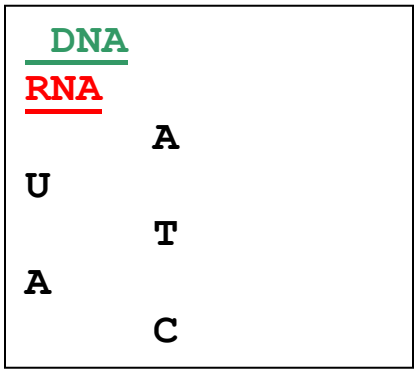
1. The DNA sequence is different for the cow and the human, but the amino acid chain produced by the sequence is almost the same. How can this happen?
2. Diabetes is a disease characterized by the inability to break down sugars. Often a person with diabetes has a defective DNA sequence that codes for the making of the insulin protein. Suppose a person has a mutation in their DNA, and the first triplet for the gene coding for insulin is C C C [instead of C C A].

    a. Determine what amino acid the new DNA triplet codes for.
    b. Will this person be diabetic?

3. Would the person be diabetic if the first triplet was C A A?
4. How is it that a code consisting of only four letters, as in DNA [A, T, G, C] can specify all the different parts of an organism and account for all the diversity of organisms on this planet?
5. DNA sequences are often used to determine relationships between organisms. DNA sequences that code for a particular gene can vary widely. Organisms that are closely related will have sequences that are similar. Below is a list of sequences for a few organisms:

Human	**CCA TAG CAC CTA**
Pig	**CCA TGG AAA CGA**
Chimpanzee	**CCA TAA CAC CTA**
Cricket	**CCT AAA GGG ACG**

5. Based on the sequences, which two organisms are most closely related?
6. An unknown organism is found in the forest, and the gene is sequenced, and found to be: **C C A T G G A A T C G A**, What kind of animal do you think this is?



Second Position

First Position (5' end)	U	C	A	G	Third Position (3' end)
U	UUU Phe UUC Phe UUA Leu UUG Leu	UCU Ser UCC Ser UCA Ser UCG Ser	UAU Tyr UAC Tyr UAA *Stop* UAG *Stop*	UGU Cys UGC Cys UGA *Stop* UGG Trp	U C A G
C	CUU Leu CUC Leu CUA Leu CUG Leu	CCU Pro CCC Pro CCA Pro CCG Pro	CAU His CAC His CAA Gln CAG Gln	CGU Arg CGC Arg CGA Arg CGG Arg	U C A G
A	AUU Ile AUC Ile AUA Ile AUG Met	ACU Thr ACC Thr ACA Thr ACG Thr	AAU Asn AAC Asn AAA Lys AAG Lys	AGU Ser AGC Ser AGA Arg AGG Arg	U C A G
G	GUU Val GUC Val GUA Val GUG Val	GCU Ala GCC Ala GCA Ala GCG Ala	GAU Asp GAC Asp GAA Glu GAG Glu	GGU Gly GGC Gly GGA Gly GGG Gly	U C A G