MOLO! *Mutations: changing the genetic code* *Name:* _____

You will compare the effect of several different types of mutations in DNA, including nucleotide substitution, nucleotide insertion, and nucleotide deletion. Go to http://molo.concord.org/database/activities/102.html. Click the link that says, "Go To Activity." Hit OK. This will open Java. When prompted, select "run." The program may take a minute to open, have patience. **Note: you are following the directions provided on THIS sheet, not the ones posted on the website below the simulation.**

Page 1: introducing mutations. Read the information provided then hit the squiggly blue arrow at the bottom of the page.

Page 2: about the protein synthesis model.

1. Write the sequence of the antisense (bottom) strand of DNA.

2. Write the sequence of the mRNA.

3. "Translate mRNA to protein." Let the protein fully dislodge and form a globular shape. After the protein has formed hit the pause button (**II**). Draw the protein. Label and color code the amino acids. Be sure to include a key for hydrophilic and hydrophobic.

4. Use your proteins packet to look up the structure of the first two amino acids in the formed protein. Label and draw the structure of these two amino acids.

5. Explain why the hydrophobic amino acid(s) is hydrophobic and why the hydrophilic amino acid is hydrophilic.

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Page 3: Substitution mutations.

1. The second DNA triplet codes for phenylalanine. Find the second nucleotide of this triplet on the anti-sense strand (the second A). Hold down the control key and click on this nucleotide. Select a substitution mutation to change it from A to G. Write the sequence of the antisense strand of DNA. Highlight the mutated nucleotide.

2. Transcribe the mutant DNA. Write the sequence of the mRNA. Highlight the mutated nucleotide.

3. Translate the mRNA. Draw the resulting protein. Label and color code the amino acids. Be sure to include a key for hydrophilic and hydrophobic.

4. What is a substitution mutation and how are they caused?

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Page 4: Silent mutations.

1. Transcribe and translate an unmutated protein. Notice that there are three Leu's. These are three leucine amino acids. Each of the leucines is coded in this case by a different triplet in the DNA. Write the sequence of the antisense strand of DNA (note, the sequence is different than the ones above). Underline the three triplets that code for leucine.

2. These triplets are degenerate. What does “degenerate” mean in relation to the genetic code?

3. Make a substitution that replaces one nucleotide with another but keeps the amino acid sequence the same. You will want to change one of the leucine triplets into another. Write the sequence of the now mutated antisense strand of DNA. Highlight the mutated nucleotide.

4. Write the sequence of the mutated mRNA. Highlight the mutated nucleotide.

5. Synthesize your new protein with its silent mutation. Verify that there is still a leucine where you created your mutation. Draw the protein. Label the amino acids. Highlight the mutated leucine amino acid.

6. What is a silent mutation and how are they caused?

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Page 5: Stop codons.

1. Find a way to make ONE or TWO substation mutations of the antisense strand that will result in a stop codon and a partial protein structure. Write the sequence of the now mutated antisense strand of DNA. Highlight the mutated nucleotide(s).

2. Write the sequence of the mutated mRNA. Highlight the mutated nucleotide.

3. Transcribe and translate the DNA into a protein. Draw the protein. Label the amino acids.

4. Why do mutations that create a stop codon have a bigger effect on the protein than other mutations?

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Page 6: Insertions and Deletions.

1. What is a reading frame?

2. Write the sequence of the antisense strand of DNA (note, the sequence is different than previous pages). Underline each group of three DNA nucleotides to show the "reading frames."

3. Transcribe the DNA. Write the sequence of the mRNA.

4. Translate mRNA to protein. After the protein has formed hit the pause button (**II**). Draw the protein. Label and color code the amino acids.

5. Make an insertion mutation of your choosing somewhere in the first half of the sequence. Write the sequence of the now mutated antisense strand of DNA. Highlight the mutated nucleotide. Again, underline each group of three DNA nucleotides to show the "reading frames."

6. Why are insertions and deletions called frame shift mutations?

7. Transcribe the DNA. Write the sequence of the now mutated mRNA.

8. Translate mRNA to protein. After the protein has formed hit the pause button (**II**). Draw the protein. Label and color code the amino acids.

9. Why do frame shift mutations have a bigger effect on the protein than substitution mutations?

Analysis

1. Why did I keep having you write/draw the DNA sequence AND the RNA sequence AND the protein sequence? What relationship or point am I trying to emphasize? *The answer is not to cause torture, annoy or to give you busy work.*

2. Why do mutations of DNA affect the final 3-dimensional shape of a folded protein?

3. Why might mutations lead to disease? Use the word protein in your answer.