Molecular Workbench Worksheet

Name:____________________________

Teacher:___________________________

Date:______________________________

This worksheet is for use with the Concord Consortium MIT Museum Activity: "From DNA to Proteins and Protein Folding." (http://workbench.concord.org/database/activities/324.html)

Directions: *Click through each page of the activity online.*
Read the instructions below that go with each page and answer the questions.

Screen Page 1: Examine the 3D model of DNA. Use the buttons below the model to highlight different features of the DNA. In addition, you can rotate the model by placing the cursor on the DNA and holding down the left mouse button and dragging it.

Which bases pair together? Bonus question: How many hydrogen bonds do you see between the pairs?

Screen Page 2: Examine the 3D model of DNA. We have transformed the 3D helix model into a 2D model with a straightened backbone. This makes it easier to learn about the sequence of nucleotides and how this sequence contains the information for creating proteins in the cell. Click on a letter to highlight that nucleotide in the 3D molecule.

Which two bases are bigger?

Screen Page 3: Watch the animation of the transcription process. You will see the DNA molecule opening up so an RNA copy of the information can be made, called messenger RNA. In the blue window, you can see a 2D version of DNA. Using the 2D version, you will see a simplified version of transcription. Click either the "Step by step" button or the "Transcribe" button.

How is the messenger RNA different from the DNA?

Screen Page 4: Watch the animation of the translation process. You will see the messenger RNA travel to the ribosome. The sequences of nucleotides in the RNA are read by transfer RNA molecules, which drop off the correct amino acids to create a protein sequence. In the blue window, you can see a 2D version of DNA. Using the 2D version, you will see a simplified version of translation. Click the "Transcribe" button and then the "Translate" button.

What is the sequence of amino acids in the protein?

Screen Page 5: In the blue window, you see a 2D version of DNA. Click on "Edit the DNA string" and change the DNA sequence however you choose. Click the "Transcribe" button and then the "Translate" button.

What is the sequence of amino acids in the protein you created? Bonus question: Did you have a STOP codon in your mRNA sequence?

Screen Page 6: Read the summary of Sickle Cell Anemia**.**

What happens to mutated hemoglobin molecules? What happens to the red blood cells in someone with this disease?

Screen Page 7: Read about hydrophobic and hydrophilic molecules. Under the model window, pull the slider all the way to the right, so that the blue molecules act like water molecules, then click "run."

What happens to the purple hydrophobic molecules? Why?

Screen Page 8: In the blue window, choose either hydrophobic or hydrophilic amino acids for the protein chain, set the solvent to be either water or oil, and then click "run" to see how that protein will behave in that environment. Try all four combinations.

How do hydrophobic amino acids behave in oil? In water?

Screen Page 9: Now investigate the effect of changing just one amino acid in the chain. Run Model A and watch it fold. It will stop on its own after a fixed amount of time. Change just one amino acid in Model B by holding down the "alt" key on your keyboard and clicking one of the amino acids. Run Model B. Repeat this process more than once. Change a different amino acid each time.

Can a single amino acid change cause a change in the shape of the folded protein?

Screen Page 10: Click on the grey boxes to take a tour of a normal hemoglobin molecule, and see the location where the single amino acid substitution occurs in sickle cell anemia.

What is the original amino acid on the beta chain at position 6?

Screen Page 11: Click on the grey boxes to see why mutant hemoglobin molecules stick together.

Is position 6 in the beta chain changed to a hydrophobic or hydrophilic amino acid? Why is this important?