Name: _____
Hour: _____

How Can a Mutation in DNA Affect an Organism?

Sometimes the DNA code that makes up a gene has an error in it. This error is called a mutation. When the DNA contains an error, the mRNA that is made will copy that error. When mRNA contains an error, it will code for incorrect tRNAs and produce an incorrect protein.

Sickle-cell anemia is a disorder that receives its name from the shape of the red blood cell. A normal red blood cell is disc-shaped and looks like doughnuts without holes in the middle. "Sickled-shaped" means that the red blood cells are shaped like a crescent. The sickled red blood cells are caused by a mutation in the hemoglobin of the person with the disorder. Hemoglobin is the main protein in red blood cells that carries oxygen from the lungs to other parts of the body.

Objectives:

I will…

- Examine the coding errors produced in mRNA and tRNA when there is a mutation in the DNA
- Examine the effect of a mutation in the gene that codes for blood hemoglobin.

Keywords:

Define the following keywords:

1. Gene: _____

_____

2. Hemoglobin: _____

_____

3. Mutation: _____

_____

4. Sickle-cell Anemia: _____

_____

Materials:

Colored Pencil

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Procedure:

1. Examine Table 1. The two columns show a section of normal DNA and a section of DNA that has a mutation in it. The mutation is called *Sickle Hemoglobin*.

2. In Table 1, in the row marked "*mRNA code*" write in the correct letters that will match with the nitrogen base letters of DNA given in the row above. Do this for both columns (normal hemoglobin & sickled hemoglobin). Remember A matches with U, T matches with A, C matches with C, and G matches with C.

3. Examine Table 2. This table shows which protein parts are coded for by specific sets of nitrogen bases (3 per set) of the mRNA molecule. For example, the mRNA sequence CCC codes for protein part of the amino acid called proline.

4. In table 1, in the row marked "*Order of Protein Parts*", write in the correct order of protein parts coded for by the mRNA. DO this for both normal and sickle hemoglobin.

5. In the row marked "*Shape of Blood Cells*", draw in what you think will be the correct shape of the blood cells for the kind of protein found in the row above. Use the diagrams in Figure 1 for reference.

6. In the column marked "*This Section Codes for Sickle Hemoglobin*", locate the TWO nitrogen bases that are different in DNA and mRNA from those in the column for normal hemoglobin. Color those bases that are mutations with the colored pencil.

Figure 1. Shapes of Blood Cells

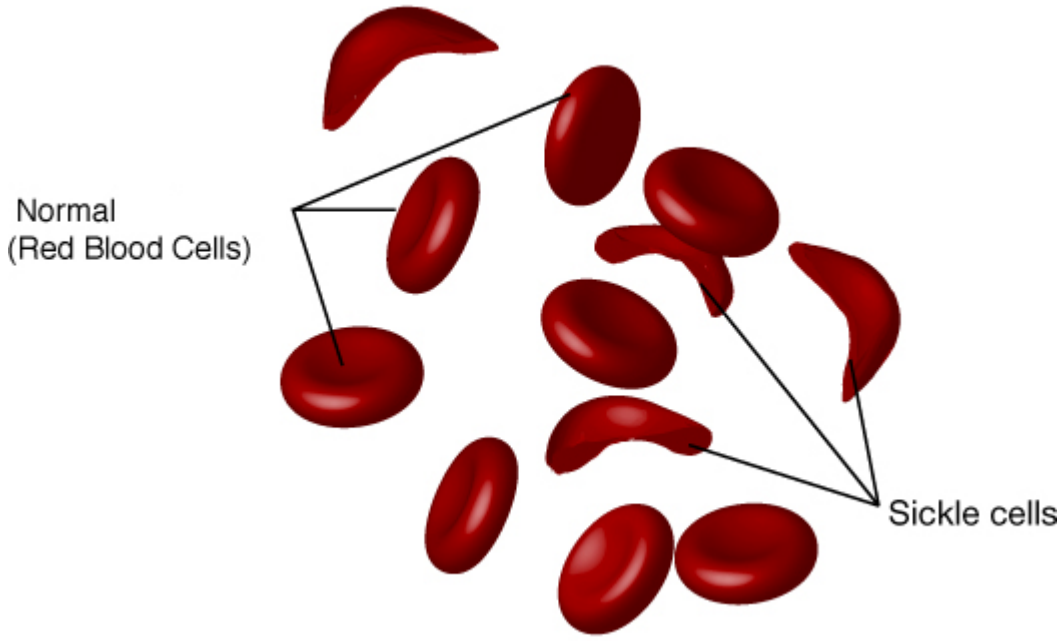

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Table 1. Comparing Normal with Sickle DNA Mutation

	This Section Codes for Normal Hemoglobin	This Section Codes for "Sickle" Hemoglobin
DNA Code		
mRNA Code		
Order of Protein Parts (Amino Acids)		
Shape of Blood Cells		

Table 2. Nitrogen Bases of Protein Parts

Protein Part (Amino Acid)	mRNA
Proline	CCC
Glutamic Acid	GAA
Lysine	AAA
Valine	GUU

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1. Look at the 2 DNA molecules in Table 1. What nitrogen bases in the sickle mutation DNA are different from those of normal DNA? _____

2. If every 3 nitrogen bases on DNA represents a codon/ amino acid, how many codons/amino acids are shown on:
    a. A normal section of DNA? _____
    b. The section of sickle hemoglobin DNA? _____

3. List the nitrogen bases examined in the DNA code in Table 1. For:
    a. The normal section of DNA _____
    b. The sickle cell section of DNA _____

4. How many **bases** are different in sickle hemoglobin DNA compared with normal hemoglobin DNA? _____

5. How many **codons** are different in sickle hemoglobin compared with normal hemoglobin? _____

6. Define the word mutation:
    a. Using the word gene
    _____
    b. Using the word DNA Code
    _____

7. It is possible to move DNA from one molecule of DNA to another. A normal gene could be put in the place of a gene with a mutation.
    a. If the DNA with a mutation were corrected in this way, what would happen to the mRNA that the DNA makes?
    _____
    b. What would happen to the protein formed by the mRNA?
    _____

8. Conclusion: Using your own words, describe the mutation that has taken place in the sickle cell gene AND describe the effect that this mutation has on the final protein product.