

DNA Protein Mutation Lab

1. What do you know about DNA?

2. What is a mutation?

3. What things can happen if you have a mutation?

4. From reading the background section, what are the three different types of mutations that can occur in DNA? Explain each mutation and give an example of each using the sequence CAT.

_____ -

_____ -

_____ -

5. Of the three types of mutations, which is least likely to change the entire DNA sequence? Why?

6. Fill out table 1. Then, follow the instructions on the instruction pages and perform the lab, being sure to fill out table 2.

Table1: Various proteins and associated DNA sequences

Protein	DNA Bases That Code for Making the Protein	Is there a mutation?	What kind of mutation is it?	Do you think the protein will work the same as the normal?	Is there a change in protein function (from looking at the pictures)
Normal	A C G C G A T C G C G T A C A G T C				
Mutant A	A C G C G A T A C G C G T A C A G T C				
Mutant B	A C G C G A T C G C G T C C A G T C				
Mutant C	A G G C G A T C G C G T A C A G T C				
Mutant D	A C G C A T C G C G T A C A G T C				

7. Which mutant do you think will work the most like the normal protein, why?

8. Which mutant do you think will be the most successful (transfer the most water) and which mutant will be the least successful (transfer the least amount of water)?

Table 2: the effects of Mutations on Protein Function

Amount of water transferred (mL)	Normal Protein	Mutant A	Mutant B	Mutant C	Mutant D
Trial 1					
Trial 2					
Average					

Analysis questions:

1. Did all of the mutations result in different proteins being made?
2. Explain which mutation would you rather have if you:
 - a. Lived in water, why?
 - b. Lived in a very hot place, why?

Conclusion questions:

1. What did you learn about the relationship between DNA, mutations and changes in protein structure and function?
2. The function of this protein is to transport water; the more transported, the better. Compare the function of each mutant protein with the normal protein. Which proteins were better? Which were worse? Why?
3. In your cell cycle lab, you saw how cells divide. What might be the results of a mutation in the gene that regulates the rate (speed) in which cells divide.
4. A mutation in a single gene may cause a major change in the body of a fruit fly, such as an extra pair of legs or wings. Mutations can occur when an organism is still developing, or when they reach adulthood. When might mutations have the biggest effect on an organism?
5. Mutations can end up having three outcomes. Looking back at the lab, what are these three outcomes?

DNA Protein Mutation Lab Instructions

Background

DNA (deoxyribonucleic acid) is a long molecule made up of chemical building blocks called **nucleotides**. Nucleotides consist of a sugar molecule, a phosphate molecule and a nitrogenous base. Nucleotides in DNA can contain one of four different bases: adenine (A), thymine (T), cytosine (C), or guanine (G). Different combinations of these four bases make each organism's DNA unique.

A segment of DNA is called a **gene**. Genes may be composed of thousands of bases in order to contain the information needed to make *one protein*. The DNA within a gene provides the instructions that ribosomes use when assembling a protein. **Proteins** are large molecules that carry out almost all cell functions. Proteins are built by ribosomes piece-by-piece. We call the pieces (or building blocks) that make up one protein, **amino acids**. Because DNA directs the composition of proteins, changes in DNA can have effects on proteins that are made. **Mutations** are changes in the nucleotide sequence of DNA. **Substitution** mutations occur when a single nucleotide is exchanged for a different nucleotide. **Insertion** mutations occur when a nucleotide is added into the original sequence. **Deletion** mutations occur when a nucleotide is removed from the original sequence. The order of the bases is very important. In the cell, ribosomes read the bases in order and put together proteins that perform various jobs. If the bases are not in the correct order (caused by a mutation) then the protein may be altered. **Changes in a DNA sequence may alter the way that ribosomes read the DNA strand, and therefore change the order of amino acids (and ultimately the construction of the protein).**

Lab Instructions:

1. One student will model the protein and the other student will count number of water transfers, making sure that the student transferring the water stops after 20 times and that the student does not change the structure of the protein or spill water outside of the containers.
2. Place the model normal protein in the container with water. Using the protein model, the student will continuously transfer water from the container with water to the other container for 20 times. Be sure not to change the structure of the protein or to spill water outside the containers.
3. Measure the amount of water transferred by pouring the water from the second container into a graduated cylinder.
4. **Record:** Write the volume of water transferred by the normal protein in the table next to "Trial 1."
5. Pour the water back into the first container. Add additional water if water level has significantly decreased and wipe up excess water spilled if needed.
6. Repeat the experiment two more times for the normal protein.
7. **Record:** Write the volume transferred in Trial 2 and Trial 3
8. **Calculate:** Find the average of the volume transferred.
9. Now, repeat the experiment in the same way for mutant proteins A, B and D.
10. **Record:** Write your results for each mutant protein.

Table B: Modeling Water Transportation Protein

Protein	Type of DNA Mutation (Insertion/Deletion/Substitution)	Instructions	Image
Normal	None	Use your non-writing hand, and lay it flat on the table with your palm up. Place all of your fingers together and your thumb against your hand. DO NOT CUP YOUR HAND!	
Mutant A		Use you non-writing hand and lay it flat on the table with the palm up. Place a marble between each of your fingers and between your thumb and your hand. Do not cup your hand! If the marbles fall out of your hand you must stop, and put them back while the timer continues to run.	
Mutant B		Use your non-writing hand and lay it flat on the table with the palm up. Place all your fingers together. Put a RUBBER BAND around your hand. DO NOT CUP YOUR HAND!	
Mutant C		Use your non-writing hand and lay it flat on the table with the palm up. Place all of your fingers together and your thumb against your hand. DO NOT CUP YOUR HAND!	
Mutant D		Use your non-writing hand and lay it flat on the table with the palm up. Put a weigh dish in your palm and cup your hand around it to hold the weigh dish in place.	

Table B: Modeling Water Transportation Protein

Protein	Type of DNA Mutation (Insertion/Deletion/Substitution)	Instructions	Image
Normal	<u>None</u>	Use your non-writing hand, and lay it flat on the table with your palm up. Place all of your fingers together and your thumb against your hand. DO NOT CUP YOUR HAND!	
Mutant A	<u>Insertion</u>	Use you non-writing hand and lay it flat on the table with the palm up. Place a marble between each of your fingers and between your thumb and your hand. Do not cup your hand! If the marbles fall out of your hand you must stop, and put them back while the timer continues to run.	
Mutant B	<u>Substitution</u>	Use your non-writing hand and lay it flat on the table with the palm up. Place all your fingers together. Put a RUBBER BAND around your hand. DO NOT CUP YOUR HAND!	
Mutant C	<u>Substitution</u>	Use your non-writing hand and lay it flat on the table with the palm up. Place all of your fingers together and your thumb against your hand. DO NOT CUP YOUR HAND!	
Mutant D	<u>Deletion</u>	Use your non-writing hand and lay it flat on the table with the palm up. Put a weigh dish in your palm and cup your hand around it to hold the weigh dish in place.	