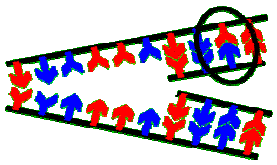
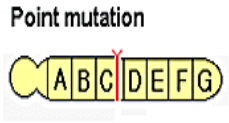
BIOLOGY



LAB: How can a MUTATION in DNA affect An Organism?

INTRODUCTION: 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 it makes will copy that error. When the mRNA contains an error, it will code for incorrect tRNAs and produce an incorrect protein. There are several types of mutations: ***Gene mutations and Chromosomal mutations.***



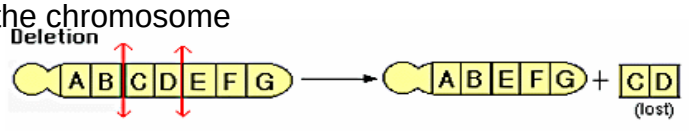
1) Gene mutations = mutation to a **single gene**: Gene mutations involving changes in one or a few nucleotides (also known as **point mutations**: they occur at a single point in the DNA sequence.

These include: a) **substitutions** = when one base is changed to another

b) **insertions & deletions** = when a base is inserted or removed from the DNA sequence--also called **frameshift mutations** (they shift the "reading frame" of the genetic message.

2) Chromosomal mutations = changes in the number or structure of chromosomes

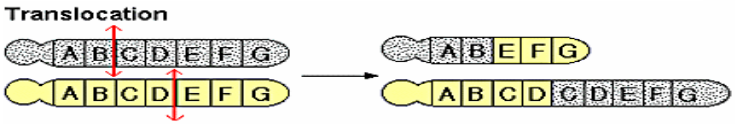
These include: **a) *Deletions*** – **loss** of part of the chromosome



b) Duplications – **extra** copies of part of the chromosome are made

c) Inversions – **reverse** the direction of some of the chromosome

d) Translocations – part of the chromosome breaks off and **attaches** to another chromosome



3) Polyploidy mutations = when an organisms has extra sets of chromosomes

EX: lethal or harmful to animals Ex: Down's Syndrome and

Polyploidy plants are often larger & stronger Ex: bananas & citrus fruits

Sickle-cell anemia is a disorder that gets its name from the sickle shape of the red blood cells. The sickled red blood cells are caused by a **mutation** in the hemoglobin of the person with the disorder *(one base is changed for another)* Hemoglobin is the main protein in red blood cells. Each hemoglobin molecule carries oxygen from the lungs to all other parts of the body.

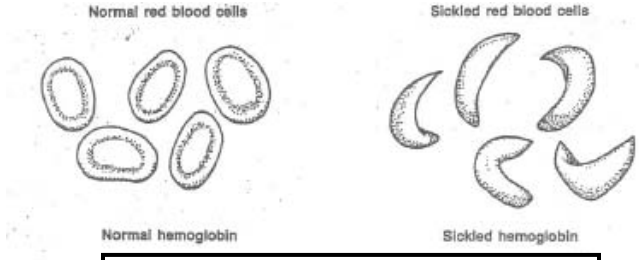


Figure 1: shapes of blood cells

OBJECTIVES:

- 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.

MATERIALS: colored pencils

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.
   Remember: A matches with U, T matches with A; C matches with G, and G matches with C.

3. In the row marked ***tRNA code***, write in the correct letters that will match with the nitrogen base letters of **mRNA** in the row above. Remember: A = U, U =A; C=G, G=C

4. 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 A.

Table 2. Nitrogen Bases of Protein parts

Protein part	mRNA
A	CCC
B	GAA
C	AAA
X	GUU

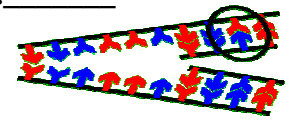
5. In Table 1, in the row marked ***Order of protein Parts,*** write in the correct order of protein parts coded for by the mRNA. Do this for both normal and sickle hemoglobin.

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

7. In the column marked *This section codes for sickle hemoglobin,* locate the two nitrogen bases that are different in DNA, mRNA, and tRNA from those in the column for normal hemoglobin, Color those bases that are mutations with the colored pencil.

BIOLOGY **Name_____TABLE #_____**

LAB: How can a MUTATION in DNA Affect An Organism? **Date_____Per._____**



QUESTIONS and OBSERVATIONS:

1. Define: gene:_____
   hemoglobin:_____
   mutation:_____
   sickle-cell anemia:_____

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

3. If every 3 nitrogen bases on DNA represent a gene, how many genes are shown on:
   a. the section of normal DNA?_____
   b. the section of sickle hemoglobin DNA?_____

4. List the nitrogen bases (in Table 1) for:
   a. normal genes of hemoglobin: _____
   b. sickle hemoglobin genes:_____

5. How many genes are different in sickle hemoglobin DNA compared with normal hemoglobin DNA?_____

6. How many protein parts are different in sickle hemoglobin compared with normal hemoglobin?_____

7. How many genes are needed to code one protein part into a protein such as hemoglobin?_____

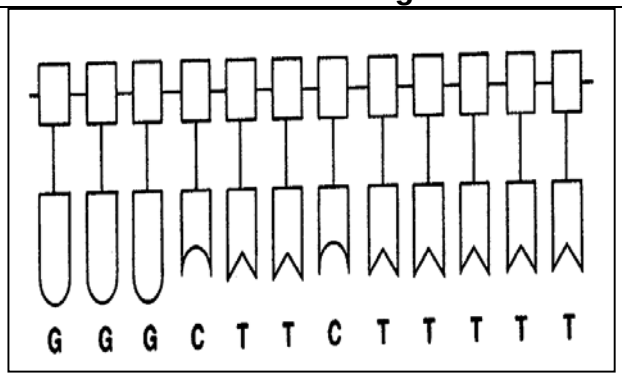
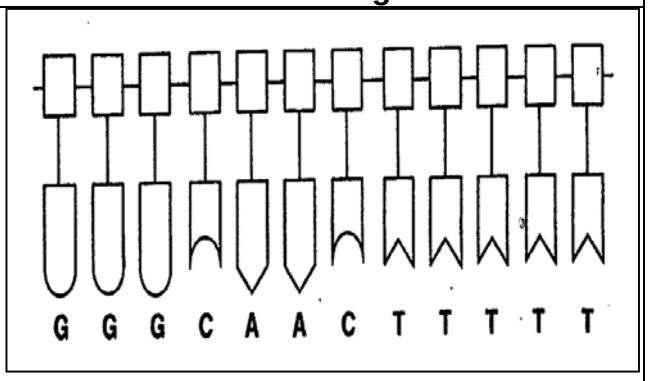
8. What type of mutation is the sickle hemoglobin? _____
   How do you know:_____

9. Define the word ***mutation***:
   a. by using the word **"gene."**_____
   b. by using phrase **"DNA code**."_____

10. It is possible to move genes 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 DNA makes?_____
    b. What would happen to the protein by this mRNA?_____
    _____

CONCLUSION: (Answer the question *How can a mutation in DNA affect an Organism?*)

Table 1. COMPARING NORMAL WITH SICKLE MUTATION DNA

	This section codes for "normal" hemoglobin	This section codes for "sickle" hemoglobin
DNA code		
mRNA code		
tRNA code		
Order of protein parts		
shape of blood cells		

Professor Arnbuckle debates the wisdom of releasing a mutation that has the appetite of a piranha and the social mores of a paparrazzi.