

Unit V: Activity 4

MUTATIONS WORKSHEET (student)

A mutation is a change in the nucleotide sequence of DNA. Mutations can involve large regions of the DNA or just a single nucleotide. How can small changes, such as altering a single nucleotide in the DNA sequence, cause such big changes in the phenotype, as the disease of Sickle Cell Anemia? In this activity we will be exploring several kinds of mutations.

A. Substitutions

1. Open and run the *Molecular Workbench* model: **Mutations: Substitutions and Deletions**.

1. From your browser. Click the link below.:

* [Molecular Workbench: Mutations](http://xeon.concord.org:8080/modeler/webstart/protein/mutations.jnlp)

[<http://xeon.concord.org:8080/modeler/webstart/protein/mutations.jnlp>]

2. By going through the *Molecular Workbench* application on your computer (workbench.jar). Then you should click the following links: Student Pages, Protein Folding, Mutations or Hemoglobin.

It may take a short while to launch the *Molecular Workbench* the first time.

2. Run the model and note the "flying bird" pattern

(Arg-Ser-Gly-Gly-Gly-Ala-Gly-Gly-Gly-Arg-Gly-Gly-Gly-Ser-gly-Ala-Gly-Gly-Ala-Glu, which also can be written as:

R-S-G-G-G-A-G-G-G-R-G-G-G-S-G-A-G-G-A-E) because scientists recently began using a one letter code for amino acids. So Arginine (or Arg) can be also coded with letter R; Serine with letter S, or Glycine with letter G, etc.

3. "Mutate" the genetic code for the bird-like protein. Go to the DNA section below the model, where the nucleotides are arranged in groups of three. Count over three codons. Substitute the G of the third codon (GGA) in DNA to A, making the codon AGA. * Remember to make the mutation by changing the DNA, not the amino acids.

Click "Run." Describe what happens, if anything, to the shape of the bird.

4. Now make three changes in the sequence of DNA by randomly substituting (replacing) any of the nucleotides with another. (The last codon is an interesting one to change.) Record what nucleotide you changed (for example, "In the fifth codon, I substituted the first nucleotide A to the nucleotide T") and describe below how the replacement affected, if at all, the shape of the protein.

a.

b.

c.

5. Explain why some substitutions of nucleotides in the DNA appear to have no effect on the protein and some have great effect.

B. Deletions.

1. Scroll to the bottom of the page.

2. Click the link to the Deletion Challenge.

3. Change the same sequence of DNA by deleting the whole third nucleotide. Click "Run."

4. Describe what happens to the shape of the protein.

5. The following is a list of the original amino acid sequence.

Arg-Ser-Gly-Gly-Gly-Ala-Gly-Gly-Gly-Arg-Gly-Gly-Gly-ser-Gly-Arg-Gly-Gly-Arg-Glu

(R-S-G-G-G-A-G-G-G-R-G-G-G-S-R-G-G-A-E)

Record the new protein sequence below.

6. Describe how the DNA code changed after you deleted the third nucleotide?
(You may want to reset the model by clicking the "reload page" button in the menu bar.)

C. Comparison of Mutations.

Which type of mutation has the greater effect, substituting a nucleotide or deleting one? What might explain this difference?

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