**Mutations: How do they affect organisms?**

**Purpose**

A mutation is any change to the genetic code of an organism. Everyone has about 6 mutations in each cell in their body! However having a mutation does not mean you will see a physical change or that it will affect the function of that gene.

Mutations can be

* harmful and can cause a cell to die, malfunction, or multiply uncontrollably.
* Beneficial
* Have no effect

The purpose of this activity is to explore what happens when a mutation happens to the DNA in your cells and what types of mutations can occur.

**Background**

[**Watch the following video on Transcription and Translation before completing this activity**](https://www.youtube.com/watch?v=oefAI2x2CQM)

Our DNA codes for every protein that makes up our cells, tissues, organs, and ultimately us. It uses 4 bases, represented by A, T, C and G, to code all the information contained in our DNA. There are several steps to breaking the code.

**DNA** is stuck in the nucleus; therefore, it first needs to be written into a form, called **RNA**, which can be read outside the nucleus. This step is called **transcription**. RNA is made using DNA as the template. Complementary bases are matched to the strand of DNA to form the strand of RNA as shown in the example below (T pairs with A, A pairs with U, C pairs with G, G pairs with C). Thymine is not a base in RNA, it is replaced by Uracil (U). Look at the following example:

DNA: TACAGTCTTACT

RNA: AUGUCAGAAUGA

The RNA strand then leaves the nucleus and makes its way to a ribosome, where it is read to make proteins. This is called **translation**. The code is read in 3 letter segments (**codons**) which correspond to amino acids, the smallest part of **proteins**. There are start and stop codons found in the instructions to determine when the protein starts and stops being made.

RNA: 5’ AUG – UCA – GAA – UGA 3’

Amino Acids: Methionine – Serine – Glutamic Acid - Stop

**Protein Synthesis: The Making of Proteins**

1. How many different kinds of bases can be found on DNA
2. What base is found on RNA but not on DNA?
3. How many bases are in a codon? How many letters are “read”
4. How many amino acids are brought in to match each codon?
5. Where does Transcription occur?
6. Where does Translation occur?
7. The process of making RNA from DNA is called
8. The process of assembling a protein from RNA is called
9. Describe two ways in which RNA differs from DNA:

Sometimes mutations occur in the DNA. These are permanent changes to the DNA sequence and may have different effects on the organism. There are three major kinds of mutations:

**Substitution** - Usually one base is changed. The sequence around the change is the same.

**Insertion** - Extra bases are added. The surrounding sequence is the same after the insertion ends.

**Deletion** - Some bases are removed. The surrounding sequence is the same after the insertion ends.

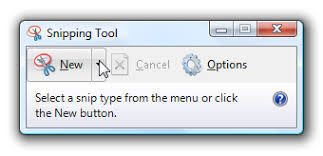
An example of each kind of mutation follows.

Original: AMY GOT HER RED HAT

Substitution: AMY GOT HER R**O**D HAT

Insertion: AMY GOT H**IS** ERR EDH AT

Deletion: AMY OTH ERR EDH AT



Using the following link: <https://www.biologycorner.com/worksheets/DNA-sim.html> Complete the following

1. Without changing the DNA (Regular Protein)
   1. Click on Transcribe
   2. Click on Translate
   3. Click show protein
      1. What does your protein look like? Shape, size, colour, amino acids present? (If you know how, use the “snip tool” on your computer to capture an image.
2. Hit RESET
   1. Choose an insertion mutation
   2. Click on Transcribe
   3. Click on Translate
   4. Click show protein
      1. What does your protein look like? Shape, colour, amino acids present? (If you know how, use the “snip tool” on your computer to capture an image)
3. Hit RESET
   1. Choose a deletion mutation
   2. Click on Transcribe
   3. Click on Translate
   4. Click show protein
      1. What does your protein look like? Shape, size, colour, amino acids present? (If you know how, use the “snip tool” on your computer to capture an image)
4. Hit RESET
   1. Choose an substitution mutation
   2. Click on Transcribe
   3. Click on Translate
   4. Click show protein
      1. What does your protein look like? Shape, colour, size, amino acids present? (If you know how, use the “snip tool” on your computer to capture an image)

**Discussion Questions (4 Questions)**

1. What type of mutation had the greatest effect? Least effect? Why is this the case? Think about how the “code” is “read”

1. A proteins function is related to its shape and order of amino acids. What happened to your protein after a mutation occurred? What effect could this have on how it functions?
2. Complete some research to identify a mutation that has been beneficial to an organism and identify a mutation that has been harmful. Identify how they have affected the organism. For example, a mutation in fur pigment in northern bears allowed them to be able to camouflage and have a better chance at survival.
3. What determines whether the mutation is harmful, beneficial or no effect on the individual?