

NAME _____ **KEY**

Mutations Worksheet - Deletion, Insertion & Substitution



There are several types of mutations:

- **DELETION** (a base is lost/deleted)
- **INSERTION** (an extra base is added/inserted)
 - Deletion & insertion may cause what's called a **FRAMESHIFT** mutation, meaning the **reading "frame"** changes, thus changing the amino acid sequence from this point forward
- **SUBSTITUTION** (one base is substituted for another)
 - If a substitution **changes** the amino acid, it's called a **MISSENSE** mutation
 - If a substitution **does not change** the amino acid, it's called a **SILENT** mutation
 - If a substitution **changes the amino acid to a "stop,"** it's called a **NONSENSE** mutation



Complete the boxes below. Classify each as **Deletion**, **Insertion** or **Substitution** **AND** as either **frameshift**, **missense**, **silent** or **nonsense** (**Hint**: Deletion & Insertion will always be frameshift).

Original DNA Sequence: T A C A C C T T G G C G A C G A C T ...
mRNA Sequence: A U G / U G G / A A C / C G C / U G C / U G A
Amino Acid Sequence: Methionine-Tryptophan-Asparagine-Arginine-Cysteine-Stop

Mutated DNA **Sequence #1** T A C A T C T T G G C G A C G A C T ...
What's the **mRNA** sequence? A U G / U **(A)** G / A A C / C G C / U G C / U G A (*Circle the change*)
What will be the **amino acid** sequence? **Methionine-Stop**
Will there likely be effects? **Yes!** What type of mutation is this? **Nonsense**

Mutated DNA **Sequence #2** T A C G A C C T T G G C G A C G A C T ...
What's the **mRNA** sequence? A U G / **(C)** U G / G A A / C C G / C U G / C U G / A (*Circle the change*)
What will be the **amino acid** sequence? **Methionine-Leucine-Glutamic Acid-Proline-Leucine-Leucine-**
Will there likely be effects? **Yes!** What type of mutation is this? **Insertion**

Mutated DNA **Sequence #3** T A C A C C T T A G C G A C G A C T ...
What's the **mRNA** sequence? A U G / U G G / A A **(U)** C G C / U G C / U G A (*Circle the change*)
What will be the **amino acid** sequence? **Methionine-Tryptophan-Asparagine-Arginine-Cysteine-Stop**
Will there likely be effects? **No!** What type of mutation is this? **Silent**

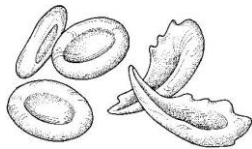
Mutated DNA **Sequence #4** T A C A C C T T G G C G A C T A C T ...
What's the **mRNA** sequence? A U G / U G G / A A C / C G C / U G **(A)** U G A (*Circle the change*)
What will be the **amino acid** sequence? **Methionine-Tryptophan-Asparagine-Arginine-Stop**
Will there likely be effects? **Yes!** What type of mutation is this? **Nonsense**

Original DNA Sequence: T A C A C C T T G G C G A C G A C T ...
mRNA Sequence: A U G / U G G / A A C / C G C / U G C / U G A
Amino Acid Sequence: Methionine-Tryptophan-Asparagine-Arginine-Cysteine-Stop

Mutated DNA Sequence #5 T A C A C C T T G G G A C G A C T ...
 What's the **mRNA** sequence? A U G / U G G / A A C / C C U / G C U / G A (Circle the change)
 What will be the **amino acid** sequence? Methionine-Tryptophan-Asparagine-Proline-Alanine-
 Will there likely be effects? Yes! What type of mutation is this? Deletion

1. Which type of mutation is responsible for **new variations** of a trait? Missense Mutations
2. Which type of mutation does **not** result in an abnormal amino acid sequence? Silent Mutation
3. Which type of mutation stops the **translation** of an mRNA molecule? Nonsense Mutation

Sickle Cell Anemia



Sickle cell anemia is the result of a type of mutation in the gene that codes for part of the **hemoglobin** molecule. Recall that hemoglobin carries **oxygen** in your **red bloods cells**. The mutation causes these red blood cells to become stiff & sickle-shaped when they release their oxygen. The sickled cells tend to get stuck in blood vessels, causing pain and increased risk of stroke, blindness, damage to the heart & lungs, and other conditions.

--- Analyze the DNA strands below to determine what amino acid is changed **AND** what type of mutation occurred

Normal hemoglobin DNA C A C G T A G A C T G A G G A C T C ...

Normal hemoglobin mRNA G U G / C A U / C U G / A C U / C C U / G A G

Normal hemoglobin AA sequence Valine-Histidine-Leucine-Threonine-Proline-Glutamic Acid

Sickle cell hemoglobin DNA C A C G T A G A C T G A G G A C A C ...

Sickle cell hemoglobin mRNA G U G / C A U / C U G / A C U / C C U / G U G

Sickle cell hemoglobin AA sequence Valine-Histidine-Leucine-Threonine-Proline-Valine

4. What type of mutation is this? Please explain why.
 This is a substitution-missense mutation because one base changes and it changes the amino acid sequence.