# *Worksheet: Mutations Practice*

*There are three ways that DNA can be altered when a mutation (change in DNA sequence) occurs.*

1. **Substitution** – one base-pairs is replaced by another:
   *Example:*     G to **C** or A to **G**
                  C **G** T **C**
2. **Insertion** – one or more base pairs is added to a sequence:
   *Example:*     CGATGG — CGA**A**TGG
                  GC**T**ACC GCT**T**ACC
3. **Deletion** – one or more base pairs is lost from a sequence:
   *Example:*     C**G**ATGG — CATGG
                  G**C**TACC GTACC

*There are five possible results of a mutation.*

   1. **Silent mutation**: When a base pair is substituted but the change still codes for the same amino acid in the sequence:
      *Example:* TC**T** and TC**C** both code for the amino acid Serine
   2. **Substitution**: When a base pair is substituted and the new codon codes for a different amino acid:
      *Example:* **T**CT codes for Serine and **C**CT codes for Proline
   3. **Premature Stop**: When a substitution results in the formation of a STOP codon before all of the codons have been read and translated by the ribosome.
      *Example:*     GTGGTC**C**GAAACACC — GTGGTC**T**GAAACACC
                     Val-Val-Pro-Asn-Thr Val-Val-STOP
   4. **Codon Deletion or Insertion**: A whole new amino acid is added, or one is missing from the mutant protein:
      *Example:*     GTGGTCCGAAACACC — GTGGTC**TGC**CGAAACACC
                     Val-Val-Pro-Asn-Thr Val-Val-Cys-Pro-Asn-Thr
   5. **Frame Shift**: When a deletion or insertion results in a different base pait being the beginning of the next codon, changing the whole sequence of amino acids
      *Example:*     GTGGTC**C**GAAACACCT — GTGGTCGAAACACCT
                     Val-Val-Pro-Asn-Thr Val-Val-Glu-Thr-Pro

1. Below is the base sequence for the normal protein for normal hemoglobin and the base sequence for the sickle cell hemoglobin.
   **Normal:      GGG CTT CTT TTT**
   **Sickle:      GGG CAT CTT TTT**
   a. <u>Transcribe</u> and <u>translate</u> the normal and sickle cell DNA.


   b. Identify this as a point or frameshift mutation. <u>Explain</u>.


   c. If the base sequence read GGG CTT CTT AAA instead, would this result in sickle cell hemoglobin? <u>Explain</u>.


2. Name one amino acid that has more than one codon. Name an amino acid that has only one codon


3. Look at the following sequence: THE FAT CAT ATE THE RAT. Delete the first H and regroup the letters in groups of three- write out the new groups of three. Does the sentence still make sense? What type of mutation is this an example of?

4. You have a DNA sequence that codes for a protein and is 105 nucleotides long. A frameshift mutation occurs at the 85$^{th}$ base- how many amino acids will be correct in this protein?

5. Given the following three mRNA sequences, 2 code for the same protein. Which two?
#1. AGU UUA GCA ACG AGA UCA
#2 UCG CUA GCG ACC AGU UCA
#3 AGC CUC GCC ACU CGU AGU

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*There are three main types of mutations: point missense mutations, point nonsense mutations, and frameshift mutations. In each of the following DNA sequences, you will use the mRNA and amino acid sequences to identify the mutation that occurred and the effects of each on, if any. Look and analyze carefully!*

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| **Original DNA Sequence**:    T A C A C C T T G G C G A C G A C T |
| **mRNA Sequence:** |
| **Amino Acid Sequence:** |

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| 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? (Circle the change) |
| What will be the amino acid sequence? |
| Will there likely be effects? |
| What kind of mutation is this? |

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| 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? (Circle the change) |
| What will be the amino acid sequence? |
| Will there likely be effects? |
| What kind of mutation is this? |

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| 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? (Circle the change) |
| What will be the amino acid sequence? |
| Will there likely be effects? |
| What kind of mutation is this? |

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| 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? (Circle the change) |
| What will be the amino acid sequence? |
| Will there likely be effects? |
| What kind of mutation is this? |

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| Mutated DNA Sequence #1:    **T A C A C C T T G G G A C G A C T** |
| What will be the corresponding mRNA sequence? |
| What will be the amino acid sequence? |
| Will there likely be effects? |
| What kind of mutation is this? |

1. Which type of mutation is responsible for new variations of a trait? _____
2. Which type of mutation results in abnormal amino acid sequence? _____
3. Which type of mutation stops the translation of the mRNA? _____