DNA Mutations Worksheet

Name: _____

Period: _____ **Date:** _____

DNA Mutation Worksheet

A mutation is a permanent change of the nucleotide sequence of the genome of an organism, virus, or extra chromosomal DNA or other genetic elements. Only gamete cells (sperm & eggs) will pass on mutations. Mutations are a common natural process occurring in DNA sequences.

Think of mutations as "typos" in the DNA code. These "typos" happen about every 100,000 nucleotides. When a human cell is copied and transmitted the exact same sequence of 3 billion nucleotides to its daughter cells. This means there are about 120,000 errors in an average human cell each time it divides.

Three ways DNA can be altered when a mutation (change in DNA sequence) occurs.

1. **Point Mutation** or **Substitution —** mutation causing replacement of a single base nucleotide with another nucleotide of the genetic material, DNA or RNA. In other words, one base-pair is replace by 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.

   G → C or A → G CGTC
2. **Insertion —** One or more base pairs is added to a sequence.

   DNA: CGA TGG → CGA ATG G

   mRNA: GCT ACC → GCT TAC C
3. **Deletion —** one or more base pairs is lost from a sequence

   DNA: CGA TGG → CAT GG

   mRNA: GCT ACC → GTA CC

There are five possible results

1. **Silent mutations —** When a base pair is substituted but the change still codes for the same amino acid in the sequence.

   TCT and TCC both code for the same amino acid, Serine
2. **Substitution —** When a base is substituted and the new codon codes for a different amino acid.

   TCT codes for Serine and CCT 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.

   DNA: GTG GTC CGA AAC ACC → GTG GTC TGA AAC ACC

   mRNA: GUG GUC CGA AAC ACC → GUG GUC UGA AAC ACC

   Val-Val-Pro-Asn-Thr → Val-Val-STOP
4. **Codon Deletion or Insertion —** When a whole new amino acid is added or one is missing from the mutant protein.

   DNA: GTG GTC CGA AAC ACC → GTG GTC TGC CGA AAC ACC

   mRNA: GUG GUC CGA AAC ACC → GUG GUC UGC CGA AAC ACC

   Val-Val-Pro-Ans-Thr →Val-Val-Cys-Pro-Asn-Thr
5. **Frame Shift —** When a deletion or insertion results in a different base pair being the beginning of the next codon, shifting it over, changing the whole sequence of amino acids. Meaning the reading "frame" changes, changing the amino acid sequence.

   DNA: GTG GTC CGA AAC ACC → GTG GTC GAA ACA CCT

   mRNA: GUG GUC CGA AAC ACC → GUG GUC GAA ACA CCT

   Val-Val-Pro-Ans-Thr → Val-Val-Glu-Thr-Pro

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Conclusions

1. Which type of mutation is responsible for new variations (alleles) 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?

2. A geneticist found that a particular mutation had no effect on the protein coded by a gene. What do you think is the most likely type of mutation in this gene? Why?

4. Examine your genetic code chart. Name one amino acid that has more than one codon. Name an amino acid that has only one codon.

5. 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?

6. Given the following three mRNA sequences, determine which two code for the same protein. Circle them.

	mRNA #1	**mRNA #2**	**mRNA #3**
Transcript	AGU UUA GCA ACG AGA UCA	UCG CUA GCG ACC AGU UCA	AGC CUC GCC ACU CGU AGU
Translate			

Bonus: You have a DNA sequence that codes for a protein and is 105 nucleotides long. A frameshift mutation occurs at the 85th base - how many amino acids will be correct in this protein? **Show your work.**