

Three-letter codons of messenger RNA and the amino acids specified by the codons			
AAU } Asparagine AAC }	CAU } Histidine CAC }	GAU } Aspartic acid GAC }	UAU } Tyrosine UAC }
AAA } Lysine AAG }	CAA } Glutamine CAG }	GAA } Glutamate GAG }	UAA } Stop UAG }
ACU } Threonine ACC ACA ACG }	CCU } Proline CCC CCA CCG }	GCU } Alanine GCC GCA GCG }	UCU } Serine UCC UCA UCG }
AGU } Serine AGC }	CGU } Arginine CGC CGA CGG }	GGU } Glycine GGC GGA GGG }	UGU } Cysteine UGC }
AGA } Arginine AGG }			UGA - Stop UGG - Tryptophan
AUU } Isoleucine AUC AUA }	CUU } Leucine CUC CUA CUG }	GUU } Valine GUC GUA GUG }	UUU } Phenylalanine UUC }
AUG - Methionine			UUA } Leucine UUG }

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. Transcribe and translate the normal and sickle cell DNA.

Normal    CCC GAA GAA AAA  
            Pro Glut Glut Lys

sickle    CCC GUA GAA AAA  
            Pro Val Glut Lys

b. Identify this as a point or frameshift mutation. Explain.

point

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

CCC GAA GAA AAA  
Pro Glut Glut Phenyl

yes - another amino acid has changed

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?

point mutation in the last base of a triplet → it still codes for the same amino acid

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?

TEF ATC ATA TETHER AT (doesn't make sense)  
= frameshift

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

28 will be correct

5. Given the following three mRNA sequences, 2 code for the same protein. Which two?

#1 AGU UUA GCA ACG AGA UCA

Ser Leu, Ala, Threo Arg. Ser \*

#2 UCG CUA GCG ACC AGU UCA

Ser Leu, Ala, Threo Ser Ser

#3 AGC CUC GCC ACU CGU AGU

Ser Leu Ala Threo Arg. Ser \*

1+3

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: meth Trypt Asp Arg Cys 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? (Circle the change) A U G (U A G) A A C C G C U G C U G A

What will be the amino acid sequence? stop.

Will there likely be effects? yes

What kind of mutation is this? point - shorter protein premature stop

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) A U G C U G G A A C C G C C U G C U G A

What will be the amino acid sequence? meth Leuc Glut. Pro. Leuc Leuc

Will there likely be effects? yes

What kind of mutation is this? insertion -> frameshift.

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) A U G U G G A A A C C G C U G C U G A

What will be the amino acid sequence? meth trypt (Arg) Arg Cys stop

Will there likely be effects? no

What kind of mutation is this? substitution: neutral (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? (Circle the change) A U G U G G A A C C G C (U G A) U G A

What will be the amino acid sequence? stop

Will there likely be effects? yes

What kind of mutation is this? shorter premature stop.

Mutated DNA Sequence #5: T A C / A C C / T T G / G G A / C G A / C T

What will be the corresponding mRNA sequence? A U G U G G A A C C C U G C U G A

What will be the amino acid sequence? meth Trypt Asp Pro Ala

Will there likely be effects? yes

What kind of mutation is this? frame shift due to deletion.