

What do you remember about mutations?

For the following, place an "X" if it is true statement.

- | | |
|---|--|
| <input type="checkbox"/> Mutations are random. | <input type="checkbox"/> Mutations are mostly beneficial and useful for an organism. |
| <input type="checkbox"/> Mutations can occur in both DNA and RNA. | <input type="checkbox"/> Mutations can only occur during interphase. |
| <input type="checkbox"/> Not all DNA codes for proteins. | <input type="checkbox"/> Not all genes are "turned on" or activated. |
| <input type="checkbox"/> Substitution mutations typically result in frameshift. | <input type="checkbox"/> Mutations can be genetically inherited. |

Illustrate That Chromosome Mutation

Sketch your own cartoon for the following chromosome mutations. Creativity is encouraged!

<p style="text-align: center;">Duplication</p>	<p style="text-align: center;">Deletion</p>
<p style="text-align: center;">Inversion</p>	<p style="text-align: center;">Translocation</p>



Amoeba Sisters LLC

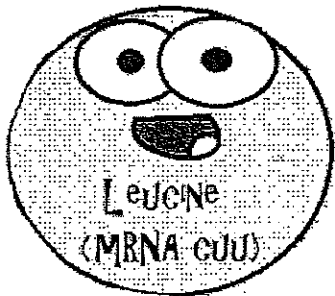
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Amoeba Sisters Video Recap of Mutations: The Potential Power of a Small Change

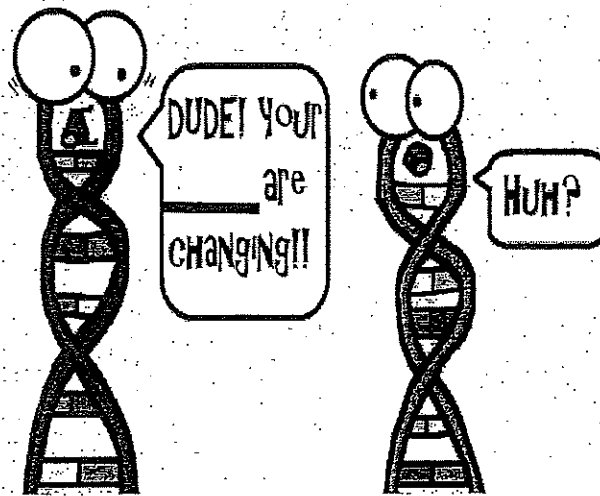
Note: You will need an mRNA chart for many of these questions. If you don't have one, they are easy to find online with your favorite search engine.

1. Mutations can be **harmful**, **helpful** (unlikely), or **neutral** in their effect. Often a neutral mutation will not change the amino acid that it codes for. Using your mRNA chart, give another mRNA codon that this CUU could mutate to and still code for Leucine.

The mRNA codon CUU could mutate to C_____ and still code for Leucine, which could be a neutral mutation.



2. It is important to understand that in mutations, a specific part of a **nucleic acid** experiences the mutation. In the below cartoon, fill in the blank that describes the part of the DNA molecule that is experiencing the mutation. Then label where that part is found on the DNA in the picture below.



3. Even a **gene mutation** that is a **point mutation**, meaning it affects one nucleotide base, can still make a major change. Sickle Cell Anemia is caused by a point mutation known as a **substitution**. Complete the following example of a substitution:

If the following is for normal hemoglobin:

PORTION OF HEMOGLOBIN DNA	GGA CTC CTC
MRNA	CCU GAG GAG
AMINO ACIDS	Proline-Glutamic Acid-Glutamic Acid

Show what would occur if the first T ("thymine") DNA base in the portion shown above mutated to an A ("adenine"). Sickle Cell Hemoglobin:

Portion of mutated hemoglobin DNA: _____

mRNA: _____

Amino Acids: _____

4. An insertion or deletion can result in a **frameshift mutation**. To demonstrate this, complete the following:

Normal Strand:

DNA: GCA ATG CAC

mRNA: _____

Amino Acids: _____

Deletion (causing a frameshift):

Taking out the first "G" in the original DNA above results in:

DNA: CAA TGC AC

mRNA: _____

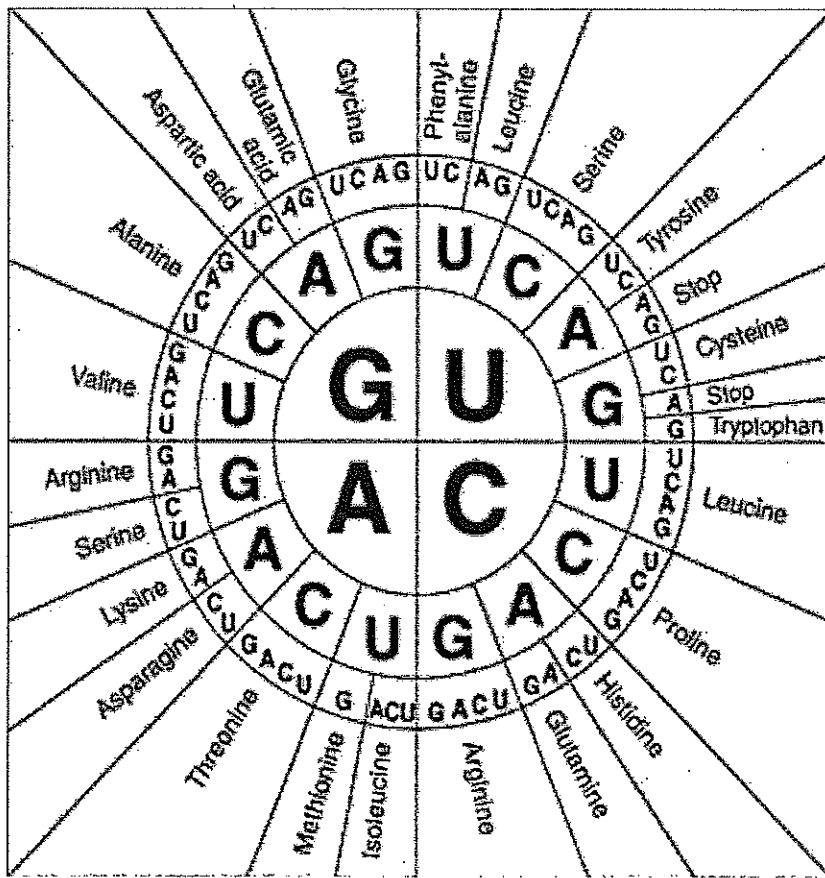
Amino Acids: _____

How did the frameshift change the amino acids that were coded?



Codon Chart and Codon Wheel

		Second base				
		U	C	A	G	
First base	U	UUU } PHE UUC } UUA } LEU UUG }	UCU } UCC } SER UCA } UCG }	UAU } TYR UAC } UAA } STOP UAG }	UGU } CYS UGC } UGA } STOP UGG } TRP	U C A G
	C	CUU } CUC } LEU CUA } CUG }	CCU } CCC } PRO CCA } CCG }	CAU } HIS CAC } CAA } GLN CAG }	CGU } CGC } ARG CGA } CGG }	U C A G
	A	AUU } AUC } ILE AUA } AUG } MET or START	ACU } ACC } THR ACA } ACG }	AAU } ASN AAC } AAA } LYS AAG }	AGU } SER AGC } AGA } ARG AGG }	U C A G
	G	GUU } GUC } VAL GUA } GUG }	GCU } GCC } ALA GCA } GCG }	GAU } ASP GAC } GAA } GLU GAG }	GGU } GGC } GLY GGA } GGG }	U C A G



DNA Mutations Practice Worksheet

DIRECTIONS: Transcribe and translate the original DNA sequence. Then, do the same for each mutated DNA sequence. Then, determine the consequence, if any, for each mutation, by circling your choice for each question. You will need a Genetic Code Chart.

Original DNA sequence:	TAC ACC TTG GCG ACG ACT
mRNA transcript:	
amino acids:	

Mutated DNA sequence #1:	TAC ATC TTG GCG ACG ACT					
mRNA transcript: <i>(Circle any changes)</i>						
amino acids:						
Type of mutation (Circle one.)	Point Substitution			Frameshift Insertion or Deletion		
How did the mutation affect the amino acid sequence (protein)? (Circle one.)	No change	1 amino acid changed	Premature stop signal	No stop signal	1 amino acid added/ deleted	All the amino acids changed after the point of mutation

Mutated DNA sequence #2:	TAC GAC CTT GGC GAC GAC T					
mRNA transcript: <i>(Circle any changes)</i>						
amino acids:						
Type of mutation (Circle one.)	Point Substitution			Frameshift Insertion or Deletion		
How did the mutation affect the amino acid sequence (protein)? (Circle one.)	No change	1 amino acid changed	Premature stop signal	No stop signal	1 amino acid added/ deleted	All the amino acids changed after the point of mutation

Mutated DNA sequence #3:		TAC ACC TTA GCG ACG ACT					
mRNA transcript: <i>(Circle any changes)</i>							
amino acids:							
Type of mutation (Circle one.)	Point	Substitution		Frameshift	Insertion	or	Deletion
How did the mutation affect the amino acid sequence (protein)? (Circle one.)	No change	1 amino acid changed	Premature stop signal	No stop signal	1 amino acid added/ deleted		All the amino acids changed after the point of mutation

Mutated DNA sequence #4:		TAC ACC TTG GCG ACT ACT					
mRNA transcript: <i>(Circle any changes)</i>							
amino acids:							
Type of mutation (Circle one.)	Point ⇒	Substitution		Frameshift ⇒	Insertion	or	Deletion
How did the mutation affect the amino acid sequence (protein)? (Circle one.)	No change	1 amino acid changed	Premature stop signal	No stop signal	1 amino acid added/ deleted		All the amino acids changed after the point of mutation

Mutated DNA sequence #5:		TAC ACC TTG GGA CGA CT					
mRNA transcript: <i>(Circle any changes)</i>							
amino acids:							
Type of mutation (Circle one.)	Point	Substitution		Frameshift	Insertion	or	Deletion
How did the mutation affect the amino acid sequence (protein)? (Circle one.)	No change	1 amino acid changed	Premature stop signal	No stop signal	1 amino acid added/ deleted		All the amino acids changed after the point of mutation

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? (assume all shifted sequences code for a different A.A.) **SHOW YOUR WORK.**