Sometimes even mother nature can it wrong!!
When that happens, we get mutations!!

Look at the following sentence and pretend it represents a protein molecule:

**The shinbone is a device for finding furniture in a dark room.**

Let’s say the gene coding this protein-sentence looks like this:

**TAC**
**T**
**G**
**C**
**A**
**T**
**G**
**G**
**A**
**T**
**A**
**T**
**G**
**A**
**T**

If DNA replication occurred without any problems, then we should always get the same sequence for the gene and the exact same protein-sentence. But ask yourself, what would happen if something went wrong? What could go wrong? A lot!!

Mutations can occur at the chromosomal level or at the genetic level.

<table>
<thead>
<tr>
<th>chromosome</th>
<th>gene</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deletion</td>
<td>Point mutation</td>
</tr>
<tr>
<td>Inversion</td>
<td>Substitution</td>
</tr>
<tr>
<td>Translocation</td>
<td>Frameshift</td>
</tr>
<tr>
<td>Nondisjunction</td>
<td>Insertion</td>
</tr>
</tbody>
</table>

**Mutation Time!!——Insertion**

Look at the DNA sequence now. Somewhere one or more nucleotides have been added to the gene. Figure out what the protein-sentence will say by using the Genetic “Word” Code. Remember you will have to transcribe the DNA sequence first.

**TAC**
**T**
**G**
**C**
**A**
**T**
**G**
**G**
**A**
**T**
**A**
**T**
**G**
**A**
**T**
**G**
**C**
**A**
**T**

mRNA:

New protein-sentence:

Does this sentence still make sense? If this was a protein, what do you think could happen to the cell that made it? To the person?
Make It A Mutation!!

Mutation Time!!—substitution
One of the nucleotides of the original gene has been substituted with another. Figure out what the protein-sentence says now by using the Genetic “Word” Code.

**TACTTTCACTGAGATATGAATCTGTCGGCGATGTGTGCAC**

New protein-sentence:

Does this sentence still make sense?

Some mutations are called “silent” mutations because they do not impact the protein being made. Explain how the mutation above is an example of a silent mutation.

Mutation Time!!—frameshift
Several nucleotides have been deleted from the original gene causing incorrect grouping of the following nucleotides. Determine the new protein-sentence.

**mRNA:**

**TACTTGCACTGAGATATGAATGTCTGGCGATGTGTGCAC**

New protein-sentence:

Not all mutations are bad. Can you think of an example where a mutation could be good or helpful?
**Make It A Mutation!!**

Name:

Sometimes even mother-nature can it wrong!!
When that happens, we get mutations!!

Look at the following sentence and pretend is represents a protein molecule:

**The shinbone is a device for finding furniture in a dark room.**

Let’s say the gene coding this protein-sentence looks like this:

```
TAC  TTG  CAC  TGA  GAT  ATG  ATCT  GTG  TCT  GGC  GAT  GTG  GTG  CACT
```

If DNA replication occurred without any problems, then we should always get the same sequence for the gene and the exact same protein-sentence. But ask yourself, what would happen if something went wrong? What could go wrong? A lot!!

Mutations can occur at the chromosomal level or at the genetic level.

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**Mutation Time!!——Insertion**

Look at the DNA sequence now. Somewhere one or more nucleotides have been added to the gene. Figure out what the protein-sentence will say by using the Genetic “Word” Code. Remember you will have to **transcribe** the DNA sequence first.

```
TACTTGCACTGAGATATGAATCTGCTCTGGCGATGTGTGCACT
```

New protein-sentence:

**START-THE SHINBONE IS A WINNING FOR FINDING CATS RIGHT BUT RIGHT DARK SHINBONE**

Does this sentence still make sense? If this was a protein, what do you think could happen to the cell that made it? To the person?

**NO. THE NEW PROTEIN WOULD BE COMPLETELY THAN THE ORIGINAL, DESIRED PROTEIN. THIS COULD HAVE NO EFFECT OR BE DETERMENTAL TO**
**Make It A Mutation!!**

Name: 

**THE CELL. IT COULD CREATE AN ILLNESS OR DISEASE PROCESS IN THE PERSON.**

---

**Mutation Time!—substitution**

One of the nucleotides of the original gene has been substituted with another. Figure out what the protein-sentence says now by using the Genetic “Word” Code.

**TACTTTTCACTGAGATATGAATCTGCTGGCGATGTGGGCACT**

AUG-AAA-GUG-ACU-CUA-UAC-UUA-GAC-AGA-CCG-CUA-CAC-ACG-UGA

New protein-sentence:

**START THE SHINBONE IS A DEVICE FOR FINDING FURNITURE IN A DARK ROOM.**

Does this sentence still make sense? **YES**

Some mutations are called “silent” mutations because they do not impact the protein being made. Explain how the mutation above is an example of a silent mutation.

**EVEN THOUGH THERE WAS A CHANGE IN NUCLEOTIDES, THE MUTATION ITSELF DID NOT EFFECT THE RESULTING PROTEIN-SENTENCE. THEREFORE, THE MUTATION IS CONSIDERED SILENT AS IT DOESN’T EXPRESS ANY CHANGES.**

---

**Mutation Time!—frameshift**

Several nucleotides have been deleted from the original gene causing incorrect grouping of the following nucleotides. Determine the new protein-sentence.

**TACTTTGCATCGAGATATGAATGCTGGCGATGTGGCACT**

**mRNA:**

**AUG-AAC-GUG-ACU-CUA-UAC-UUA-GAC-ACC-GCU-ACA-CAC-GUG-A**

New protein-sentence:

**START- THE SHINBONE IS A DEVICE FOR ALWAYS RIGHT BUT RIGHT DARK**

Not all mutations are bad. Can you think of an example where a mutation could be good or helpful?
**Make It A Mutation!!**

Name:

Mutations help increase our genetic diversity which increase our overall chance for surviving as a species.

---

**Genetic “Word” Code**

<table>
<thead>
<tr>
<th>SECOND</th>
<th>BASE</th>
</tr>
</thead>
<tbody>
<tr>
<td>U</td>
<td>C</td>
</tr>
<tr>
<td>UUU-if</td>
<td>UCU-keep</td>
</tr>
<tr>
<td>UUC-bird</td>
<td>UCC-then</td>
</tr>
<tr>
<td>UUA-for</td>
<td>UCA-score</td>
</tr>
<tr>
<td>UUG-isn’t</td>
<td>UCG-dogs</td>
</tr>
<tr>
<td>CUU-when</td>
<td>CCU-they</td>
</tr>
<tr>
<td>CUC-do</td>
<td>CCC-goes</td>
</tr>
<tr>
<td>CUA- a</td>
<td>CCA-who</td>
</tr>
<tr>
<td>UCG-a</td>
<td>CCG-in</td>
</tr>
<tr>
<td>AUU-didn’t</td>
<td>ACU-is</td>
</tr>
<tr>
<td>AUC-winning</td>
<td>ACC-right</td>
</tr>
<tr>
<td>AUA-go</td>
<td>ACA-right</td>
</tr>
<tr>
<td>AUG-start</td>
<td>ACG-room</td>
</tr>
<tr>
<td>GUU-worm</td>
<td>GCU-but</td>
</tr>
<tr>
<td>GUC-customer</td>
<td>GCC-but</td>
</tr>
<tr>
<td>GUA-staff</td>
<td>GCA-joke</td>
</tr>
<tr>
<td>GUG-shinbone</td>
<td>GCG-get</td>
</tr>
</tbody>
</table>