**Types of Mutations Jigsaw**

There are many different ways that DNA can be changed, resulting in different types of mutation.

On Page 73, take notes on the following types of mutations:

* Substitution
* Insertion
* Deletion
* Frameshift

Roles:

* Reader- read over your mutation
* Note taker- write a summary (in your own words!) of this type of mutation
* Artist- create a visual representation of the mutation
* Teacher- stay where you are and teach the next group

Instructions:

1. Take 10 minutes to discuss your type of mutation and create a teaching tool for the next group.
2. Teacher stays where you are. The rest of the group will switch to the next table.
3. You have 5 minutes to take notes on and understand this type of mutation.
4. Switch!

**Types of Mutations**

There are many different ways that DNA can be changed, resulting in different types of mutation. Here is a quick summary of a few of these:

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| --- | --- | --- |
| Substitution | http://evolution.berkeley.edu/evolibrary/images/dot_clear.gif | **Substitution Mutation** A substitution is a mutation that exchanges one base for another (i.e., a change in a single "chemical letter" such as switching an A to a G). Such a substitution could:   1. change a codon to one that encodes a different amino acid and cause a small change in the protein produced. For example, [sickle cell anemia](http://evolution.berkeley.edu/evolibrary/glossary/glossary_popup.php?word=sickle+cell+anemia) is caused by a substitution in the beta-hemoglobin gene, which alters a single amino acid in the protein produced. 2. change a codon to one that encodes the same amino acid and causes no change in the protein produced. These are called silent mutations. 3. change an amino-acid-coding codon to a single "stop" codon and cause an incomplete protein. This can have serious effects since the incomplete protein probably won't function. |
| http://evolution.berkeley.edu/evolibrary/images/dot_clear.gif | | |
| insertion | http://evolution.berkeley.edu/evolibrary/images/dot_clear.gif | **Insertion Mutation** Insertions are mutations in which extra base pairs are inserted into a new place in the DNA. |
| http://evolution.berkeley.edu/evolibrary/images/dot_clear.gif | | |
| deletion | http://evolution.berkeley.edu/evolibrary/images/dot_clear.gif | **Deletion Mutation** Deletions are mutations in which a section of DNA is lost, or deleted. |
| http://evolution.berkeley.edu/evolibrary/images/dot_clear.gif | | |
| frameshift | http://evolution.berkeley.edu/evolibrary/images/dot_clear.gif | **Frameshift Mutation** Since protein-coding DNA is divided into codons three bases long, insertions and deletions can alter a gene so that its message is no longer correctly parsed. These changes are called frameshifts.  For example, consider the sentence, "The fat cat sat." Each word represents a codon. If we delete the first letter and parse the sentence in the same way, it doesn't make sense.  In frameshifts, a similar error occurs at the DNA level, causing the codons to be parsed incorrectly. This usually generates truncated proteins that are as useless as "hef atc ats at" is uninformative. |
| |  |  |  |  | | --- | --- | --- | --- | | |  | | --- | | http://evolution.berkeley.edu/evolibrary/images/dot_clear.gif | | [print](http://evolution.berkeley.edu/evolibrary/print/printable_template.php?article_id=mutations_04&context=%3C?%20echo%20$baseURL;%20?%3E) [print](http://evolution.berkeley.edu/evolibrary/print/printable_template.php?article_id=mutations_04&context=%3C?%20echo%20$baseURL;%20?%3E) |   [DNA and Mutations](http://evolution.berkeley.edu/evolibrary/article/mutations_01) :  **The causes of mutations**  Mutations happen for several reasons.  **1. DNA fails to copy accurately** Most of the mutations that we think matter to evolution are "naturally-occurring." For example, when a cell divides, it makes a copy of its DNA — and sometimes the copy is not quite perfect. That small difference from the original DNA sequence is a mutation.  Following cell division, the copied DNA is imperfect   |  | | --- | | **2. External influences can create mutations** Mutations can also be caused by exposure to specific chemicals or radiation. These agents cause the DNA to break down. This is not necessarily unnatural — even in the most isolated and pristine environments, DNA breaks down. Nevertheless, when the cell repairs the DNA, it might not do a perfect job of the repair. So the cell would end up with DNA slightly different than the original DNA and hence, a mutation. | | | | |

**Tipos de mutaciones**

Hay muchas maneras diferentes que puede cambiarse ADN, dando lugar a diferentes tipos de mutación. Aquí está un breve resumen de algunos de estos:

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| --- | --- | --- |
| Substitution |  | **Mutación de la substitución** Una sustitución es una mutación que cambia una base por otra (es decir, un cambio en una sola "letra química" como cambiar una A a G). Tal SUSTITUCIÓN puede:  1. cambiar un codón que codifica un aminoácido diferente y causar un pequeño cambio en la proteína producida. Por ejemplo, [anemia de células falciformes](https://ssl.translatoruser.net/bv.aspx?from=en&to=es&a=http%3A%2F%2Fevolution.berkeley.edu%2Fevolibrary%2Fglossary%2Fglossary_popup.php%3Fword%3Dsickle%2Bcell%2Banemia) es causada por una substitución en el gene beta de la hemoglobina, que altera un único aminoácido en la proteína producida.  2. cambio un codón a uno que codifica el mismo aminoácido y ningún cambio en la proteína producida. Estas son las llamadas mutaciones silenciosas.  3. cambian un codón codificante de ácido amino a un codón de "parada" y causar una proteína incompleta. Esto puede tener efectos graves ya que la proteína incompleta probablemente no funciona. |
|  | | |
| insertion |  | **Mutación de la inserción** Las inserciones son mutaciones en el que más pares de bases se insertan en un nuevo lugar en el ADN. |
|  | | |
| deletion |  | **Mutación de la canceladura** Eliminaciones son mutaciones en las que una sección de la DNA es perdida o borrada. |
|  | | |
| frameshift |  | **Mutación del mutágeno ' frameshift '** Desde ADN codificante de proteínas se divide en codones tres bases largas, inserciones y eliminaciones pueden alterar un gen para que su mensaje se analiza ya no correctamente. Estos cambios se llaman mutágeno ' frameshift '.  Por ejemplo, consideremos la frase, "el Gato gordo sentado." Cada palabra representa un codón. Si eliminar la primera letra y analizar la frase de la misma manera, no tiene sentido.  En mutágeno ' frameshift ', se produce un error similar en el nivel de ADN, haciendo que los codones que hubiera analizado incorrectamente. Generalmente, esto genera proteínas truncadas que son tan inútiles como "hef atc ats en" es poco informativo. |
| |  |  |  |  | | --- | --- | --- | --- | | |  | | --- | |  | | [imprimir](https://ssl.translatoruser.net/bv.aspx?from=en&to=es&a=http%3A%2F%2Fevolution.berkeley.edu%2Fevolibrary%2Fprint%2Fprintable_template.php%3Farticle_id%3Dmutations_04%26context%3D%253C%3F%2520echo%2520%24baseURL%3B%2520%3F%253E) |   [ADN y mutaciones](https://ssl.translatoruser.net/bv.aspx?from=en&to=es&a=http%3A%2F%2Fevolution.berkeley.edu%2Fevolibrary%2Farticle%2Fmutations_01) :  **Las causas de las mutaciones**  Las mutaciones ocurren por varias razones.  **1. el ADN es incapaz de copiar con precisión** La mayoría de las mutaciones que pensamos respecto a la evolución son "natural." Por ejemplo, cuando una célula se divide, hace una copia de su ADN, y a veces la copia no es absolutamente perfecta. Esa pequeña diferencia de la secuencia de ADN original es una mutación.  Following cell division, the copied DNA is imperfect   |  | | --- | | **2. externas influencias pueden crear mutaciones** Mutaciones también pueden ser causadas por la exposición a agentes químicos o radiación. Estos agentes causan el ADN romper. Esto no es necesariamente antinatural — incluso en los ambientes más prístinos y aislados, descompone el ADN. Sin embargo, cuando la célula repara el ADN, no podría hacer un trabajo perfecto de la reparación. Así terminaría la célula con la DNA ligeramente diferente que la DNA original y por lo tanto, una mutación. | | | | |