

# DNA → mRNA → amino acid → Protein

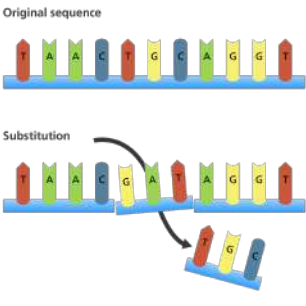
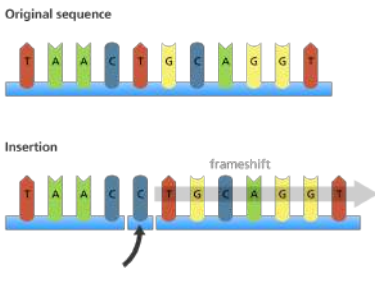
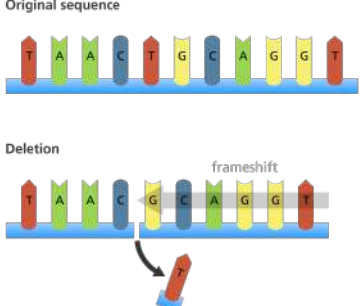
## Lesson 8: Wednesday, April 2, 2020. Biology MHS

### AIM: What are mutations, and do they always affect protein synthesis?

In genetics, a **mutation** is a *change in the base sequence of a gene*. Genes are segments of **DNA** that code for proteins. The specific sequence of DNA bases is transcribed into a single strand of **mRNA**. The mRNA message leaves the nucleus and goes to the **ribosome**, the organelle where proteins are synthesized as amino acids are attached together.

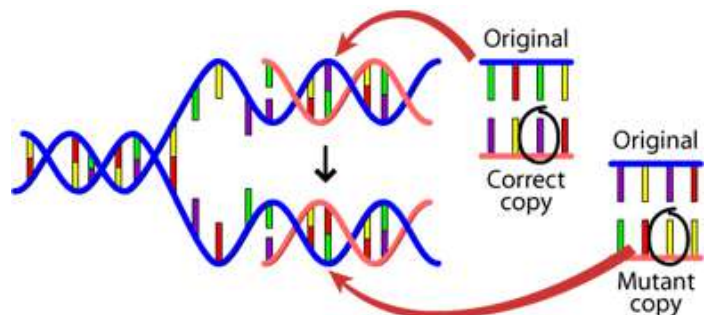
1. What is a mutation?
2. Which organelle stores the genetic information for protein synthesis?
3. Which organelle builds the protein?
4. What is the *direct* source of instruction used by the ribosome for making a protein?
5. What is the *indirect* source of instruction for making a protein?

There are three types of mutations that can occur. An **insertion** is when an extra base, or sequence of bases is **added** to the DNA code. This results in a DNA code that is *longer* than the original sequence. A **deletion** is when a base, or sequence of bases is **removed** from the DNA code. This results in a gene that is *shorter* than the original sequence. A **substitution** is when a base, or group of bases is **replaced** by different letters. This results in a gene sequence of the same length, but with different bases.

		
<p>This mutation is a <b>substitution</b>- 3 bases from the original sequence were replaced with different letter. The sequence remains the <i>same length</i>. Mutations happen during cell division.</p>	<p>This mutation is an <b>insertion</b>. An extra base was accidentally added during DNA replication. This makes the sequence <i>longer</i> than the original sequence.</p>	<p>This mutation represents a <b>deletion</b>. During DNA replication, the "T" was not copied properly. The mutated sequence is <i>shorter</i> than the original sequence.</p>

### When do mutations take place?

Mutations take place during **DNA replication of cell division**. Don't forget that DNA replication happens prior to cell division (both mitosis and meiosis). If the DNA is NOT copied properly, and there is *any* change from the original sequence, a **mutation** has taken place. Once again, this happens when extra bases are added, bases are deleted, or the wrong base pair is added to the new sequence.



**Questions:** Do ALL mutations affect the final protein product? How is it possible that a mutation in the DNA has NO effect on the final protein? ...

**Part 2- The effects of DNA mutation on protein production:**

- A sequence of DNA from a particular gene is shown below.
- Use the gene to form a single strand of mRNA. Be sure to bracket your codons (every **3** bases) This will help prevent any mistakes while you are coding.
- Then, use a *Universal Genetic Code Chart* to look up the sequence of amino acids in the protein.

**ORIGINAL SEQUENCE:**

Sequence of DNA in gene: TAC CAA CGA CTC CCG GGA

mRNA \_\_\_\_\_

Sequence of amino acids \_\_\_\_\_

**Mutation 1:** The '**C**' in the third codon was **deleted** during DNA replication. Notice how the deletion shifted all of your codons (groups of 3) after it took place!! The final "GA" will not code for an amino acid.

Sequence of DNA in gene: TAC CAA ~~CG~~AC TCC CGG GA

mRNA \_\_\_\_\_

Sequence of amino acids \_\_\_\_\_

**Did this mutation affect the final protein product? (Did the *sequence of amino acids* change??)**

**Mutation 2:** Two **substitutions** have taken place! A '**G**' has replaced a '**A**,' and a '**T**' has replaced a '**G**.' These mistakes happened during RNA replication.

Sequence of DNA in gene: TAC CAG CGA CTC CCT GGA

mRNA \_\_\_\_\_

Sequence of amino acids \_\_\_\_\_

**Did this mutation affect the final protein product? (Did the *sequence of amino acids* change??)**

**Conclusion:** Not all DNA mutations will affect final protein products. This is because each of the 20 amino acids is coded for by *multiple* mRNA sequences. Mistakes *can* happen during DNA replication, but this helps to protect us against any harmful effects on the final protein. Mutations only affect the final shape of the protein **if they change the amino acid sequence**. Mutation 1 **did** change the amino acid sequence. This mostly likely results in a protein *that can no longer function*. Mutation 2 **did not** affect the final protein. This means that even with a genetic mutation, the organism is still able to code for a functional protein.