

DNA Replication

by Sophia



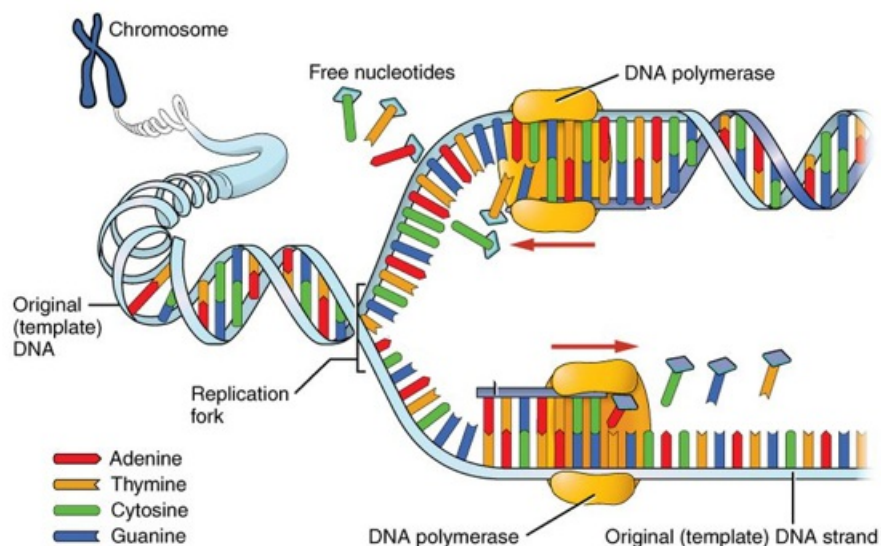
WHAT'S COVERED

In this lesson, you will learn to understand the process of DNA replication. Specifically, this lesson will cover:

1. DNA Replication

Recall that before a cell divides (via mitosis or meiosis I), the cell undergoes interphase, in which it prepares for division. Part of the preparation of interphase is Synthesis (S phase), where the DNA copies itself. This makes it possible for both daughter cells to receive all the necessary genetic information. This process of copying DNA is called **DNA replication**.

DNA molecules are copied so that traits can be passed from parents to offspring. **DNA polymerase** is an enzyme that assists in DNA replication. This enzyme unwinds a DNA molecule and then separates the DNA so that new DNA molecules can be produced using the old DNA molecules as a template.



Recall that DNA is in the shape of a "twisting ladder", where each "side rail" is a strand of DNA (hence, DNA is double-stranded), and each "rung" of the ladder is made up of one nucleotide from each strand (either an A matched to a T, or a C matched to a G).

During DNA replication, DNA polymerase will unwind and separate those DNA strands. Then, the old strands of DNA are used as a template in order to build new strands of DNA.

The new bases pair up using the rules of base pairing (A to T, C to G) to create a molecule that is half old and half new. These two strands will be identical to the original strand and each other. This is called **semiconservative replication**, and this is how DNA is replicated so that the traits can be passed from parents to offspring.



TERMS TO KNOW

DNA Replication

The process of copying (replicating) DNA.

DNA Polymerases

An enzyme that assists in the process of DNA replication.

Semiconservative Replication

When a stretch of double-stranded DNA is replicated into two copies, each copy contains one strand from the original copy and one strand that is new; the new strands used the original strands as templates.

2. DNA Repair

DNA polymerase, in addition to playing a role in DNA replication, also helps with DNA repair. Sometimes, during the process of DNA replication, DNA can change in a way that will change a gene, so a **gene mutation** can occur.

A mutation is a change to a nucleotide sequence. There are various types of mutations, but one type is a **base-pair substitution**. A base-pair substitution is when the wrong nucleotide pairs with a base during replication. These mutations can occur and affect how a gene is produced or functions.

➔ **EXAMPLE** If thymine paired with guanine instead of adenine.

All DNA polymerases have some ability to proofread; if they create a base-pair substitution, they can back up (removing a couple of nucleotides), and try again.

How do DNA repair enzymes know which strand is the "old", correct strand and which strand is the "new", erroneous one? Before DNA replication, both strands of the DNA are methylated—marked as the original strands. Thus, when they are copied, the strand that isn't methylated is recognized by DNA repair enzymes as the new strand. It is the new strand that is more likely to have the mistake, and that is the strand that is edited if there's a base-pair substitution, for example.}}

Beyond base-pair substitution, there are many kinds of DNA damage, and specific enzymes to deal with each kind of damage. This is important for cancer therapies, for example. The mutations that make cancer cells able to ignore signals to stop dividing uncontrollably also make cancer cells struggle to repair DNA damage. Radiation therapy deliberately introduces double-strand breaks (breaks that cut all the way through both strands of the "twisting ladder") to the site of the tumor. Healthy cells will be able to repair these breaks within 24 hours, but cancerous cells won't be to fix the breaks so quickly. Often radiation therapy involves treatments over several days, so healthy cells have time to repair, but cancer cells don't. Eventually, the cancer cells have so much DNA damage they cannot function, and they die.



TERMS TO KNOW

Gene Mutation

A change in the sequence of nucleotides in a gene.

Base-Pair Substitution

A type of gene mutation in which the wrong nucleotide is paired with a base during the process of DNA replication; the effects can range from none at all to life-threatening.



SUMMARY

DNA polymerase plays an important role in **DNA Replication**. It is the signal for DNA to unwind and separate. This allows new bases to come in a pair with the unwound strands. This is semiconservative replication because the new copies each contain one original strand and one new strand. Two copies of the DNA are created that are identical to the original. DNA polymerase also plays a role in **DNA repair** when mutations like base pair substitutions occur.

Keep up the learning and have a great day!

Source: This work is adapted from Sophia Author Amanda Soderlind



ATTRIBUTIONS

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