Pre AP Biology 11

Concept 2: **Analyzing the processes of DNA Replication**

*You must know:*

* The structure of DNA.
* **The major steps to replication.**
* The differences between replication, transcription, and translation.
* How DNA is packaged into a chromosomes.
* *Refer to pg 117-122 in Holtzclaw, Ch 16 in Campbell*

***To Recap:***

1. What is the purpose of DNA replication? To make an**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** of DNA

2.When does it occur? Before **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

3. How does the new cell compared to the old cell? The **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**daughter cells have the exact same DNA as the **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**parent cell

4.  Where does DNA replication take place?  In the**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

Each strand is a **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**(parent) for the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_strand (daughter)

**Three steps of DNA Replication:**



DNA is considered ***Semiconservative***

What does that mean?

🡪 Each helix of DNA is made up of one parent (\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_) and one daughter (\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_)



**DNA Replication**

**Some Vocabulary:** Parent Strand, Daughter Strand, Leading Strand, Lagging Strand, Okazaki fragments, Replication Bubble, Replication Fork, 5’ to 3’, continuous synthesis, discontinuous synthesis, semi-conservation

**Enzymes:** helicase, topoisomerase, SSBP (single-stranded binding proteins), primase, DNA polymerase III, DNA polymerase I, DNA ligase

When it is time to replicate DNA (during S phase), proteins bind to the and separate the DNA strands, forming the replication bubble and a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_





At the **replication fork**, the enzyme **\_\_\_\_\_\_\_\_\_\_\_**unwinds and unzips the two DNA strands by breaking the hydrogen bonds between nitrogen bases.

*Helicase needs help!*

Single stranded binding proteins (SSBP) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_the DNA by “holding” the two separated parental strands from each other

Topoisomerase helps relieve the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_of the parent strands in front of the replication fork

At each replication fork, there are two daughter strands that need to be synthesized: the **leading strand** and the **lagging strand**. Both strands can only be synthesized in the **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**



The leading strand is synthesized in the 5’ to 3’ direction *continuously* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ the replication fork

The lagging strand is synthesized *discontinuously* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ the replication fork

Process is semi-conservative because each of the new DNA strands will contain one original parent strand and one new daughter strand

**Leading Strand:**

PRIMASE reads the DNA code and synthesizes an\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_: a short RNA chain (~10 nucleotides long).

DNA POLYMERASE III adds \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_to the primer in the 5’ to 3’ direction (towards the fork)

* Forms \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ between the nitrogen base on the parent strand and the complementary nitrogen base of the new daughter nucleotide
* Forms \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ between the 3’ end of the previous daughter nucleotide and the 5’ end of the new daughter nucleotide (hence 5’ to 3’ direction)

**Lagging Strand:**

A Primer is added to the lagging stand as well…but there are many of them here…not just one!

DNA POLYMERASE III adds DNA nucleotides to the primer in the 5’ to 3’ direction **(\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_)**

* Forms hydrogen bonds between the nitrogen base on the parent strand and the complementary nitrogen base of the new daughter nucleotide
* Forms covalent bonds between the 3’ end of the previous daughter nucleotide and the 5’ end of the new daughter nucleotide (hence 5’ to 3’ direction)

**DNA POLYMERASE III** keeps adding DNA nucleotides until it reaches the primer of the next**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**.

**DNA Polymerase I** takes over and keeps adding complimentary DNA nucleotides to the daughter strand in the 5’ to 3’ direction while \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_the RNA nucleotides of the primer on the next Okazaki fragment

**DNA LIGASE**  joins the two Okazaki fragments together



This process is very efficient!

DNA polymerases are good \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_… a mistake is made only in 1 of every 10 000 nucleotide pairings.

DNA polymerases needs help though… mismatch repair!

Ex: nucleotide excision repair in which the enzyme \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_cuts the damaged segment so that DNA replication “tries again.”