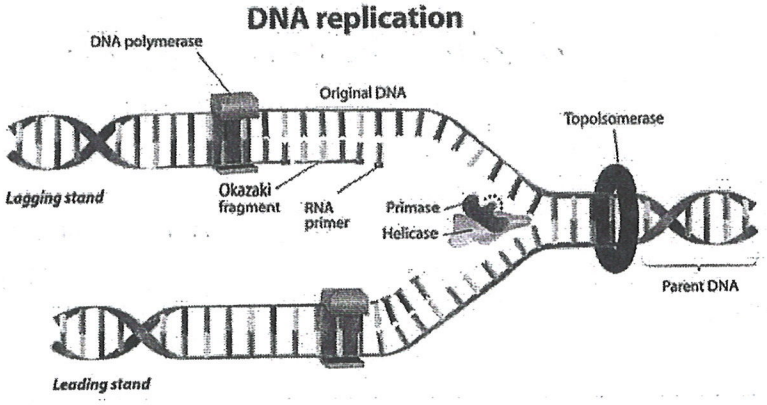
OPHS Biology
Unit 6 Notes

Name: _____
DNA/RNA/Protein Synthesis

Unit 6, Topic 2: DNA Replication

By the end of this topic, you should be able to...

1. *Identify the purpose of DNA replication*
2. *Identify and order the steps involved in DNA replication*
3. *Explain the purpose of molecules (enzymes) used in DNA replication*

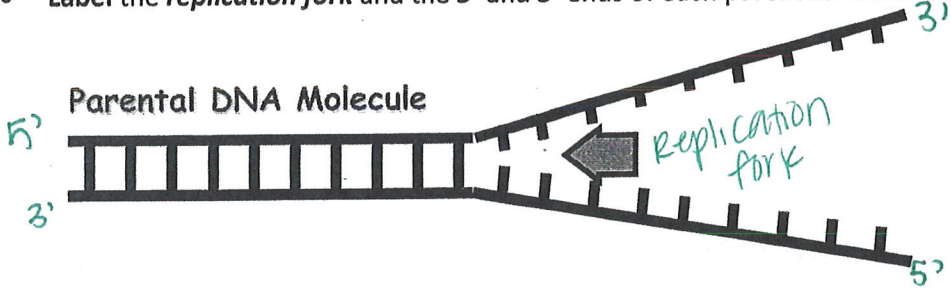


DNA REPLICATION

- Cells must copy their DNA before they do what? Divide (mitosis, Binary Fission, etc.)
  - Explain why: The cells produced (daughter cells) must contain complete genomes
- DNA is copied during the S or synthesis phase of interphase
- Where does DNA replication take place in eukaryotes? Nucleus
  (remember, DNA cannot leave this location! It's too big)
- Replication of DNA begins at points called origins of replication
- The two strands open at origins of replication forming Y-shaped areas called Replication fork.

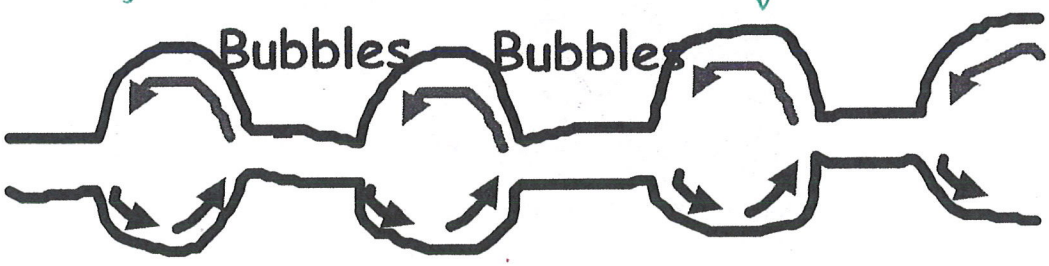
New strands of DNA grow here

- **Label** the ***replication fork*** and the ***5'*** and ***3'*** ends of each parent strand on the picture below.



Recall: Why are the 5' and 3' ends arranged like this?
The two strands are antiparallel (opposite). One runs 5'→3' and the other runs 3'→5'.

- *As the two strands open at the origins of replication, replication* bubbles *form.*
  - Prokaryotes *(bacteria) have a single bubble.*
  - Eukaryotes *chromosomes have many bubbles.*



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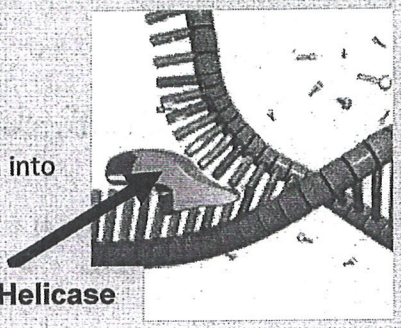
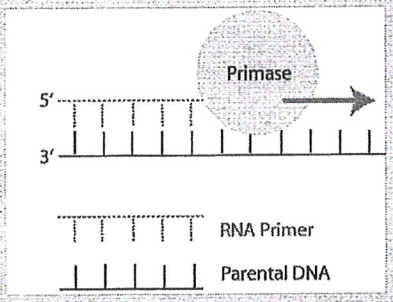
Steps of DNA Replication

- The enzyme HELICASE unwinds and separates the 2 DNA strands by breaking the weak Hydrogen bonds between bases.
  - It "unzips" the double helix.
- Primase gathers nucleotides and brings them into the replication fork.
  - A primer (start) is created to start the new strand.


Helicase

- The enzyme DNA Polymerase (polymer now being built) matches free nucleotides with the correct base pairs on the template (parent) strands.

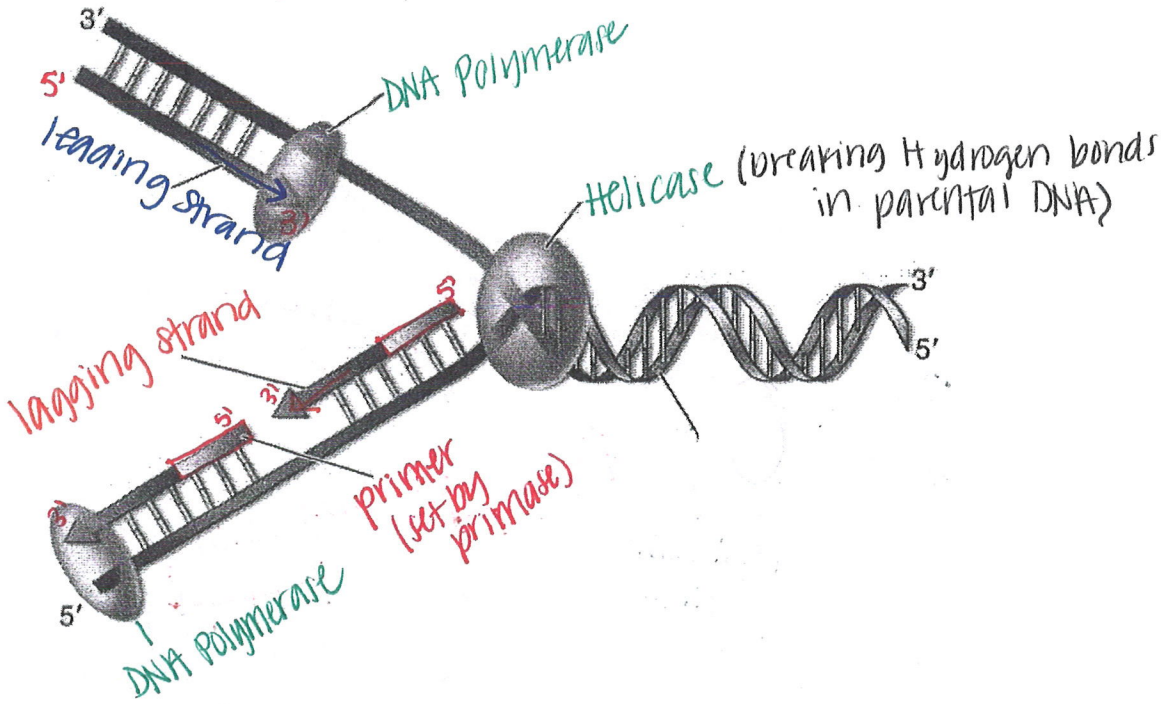


- The enzyme ligase -- connects any "breaks" in the new strands, and the 2 identical strands rewind back together.

  - ***The Big Question:*** *Why are their breaks in the new strands at all?*
    - DNA polymerase can only add nucleotides to the 3' end of the DNA.
    - This causes the new DNA to be built in a 5' to 3' direction.
    - The leading strand is built into the replication fork.
    - The lagging strand is built in short sections in the opposite direction (out of the fork). This causes the breaks in the strand.

- **Label** the ***leading strand, lagging strand, DNA polymerase, helicase, and primer*** in the picture below.

built INTO fork built out of fork



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Proofreading New DNA:

- DNA polymerase makes about 1 in 10,000 base pairing errors.
- Enzymes proofread and correct these mistakes → new error rate of 1 in 1 billion.
  - **How does the DNA get damaged?**
    - Chemicals and UV radiation damage the DNA in our body cells.
  - **Types of DNA repair**
    - Excision repair - when a repair enzyme removes damaged DNA.
    - DNA Polymerase and Ligase work together to replace and bond new nucleotides together.

[[Language Target for Topic 2: I can explain the purpose of DNA replication; I can sequence the steps in DNA replication; I can provide the name of the enzyme involved in each step of DNA replication]]

1. Number the steps of DNA replication in the correct order (1, 2, 3):

   _____ Daughter strands are formed using complementary base pairing.
   _____ DNA unwinds
   _____ The DNA of the daughter strands winds with together with its parent strand.

2. Why is DNA replication called "semi-conservative"?

3. What enzyme unwinds or unzips the parent strand?

4. What enzyme connects the new bases to the old bases in the DNA template?

5. What enzyme connects the new nucleotides together and proofreads them?

Using the DNA provided, complete the following:

1. Label the 3' and 5' end of each strand (you decide which is which)
2. Label the replication fork
3. Draw and label helicase
4. Label the overall direction of DNA replication
5. Draw and label the leading strand
6. Draw and label DNA polymerase
7. Draw and label the lagging strands