Engage: Replication Relay Race

INSTRUCTOR:
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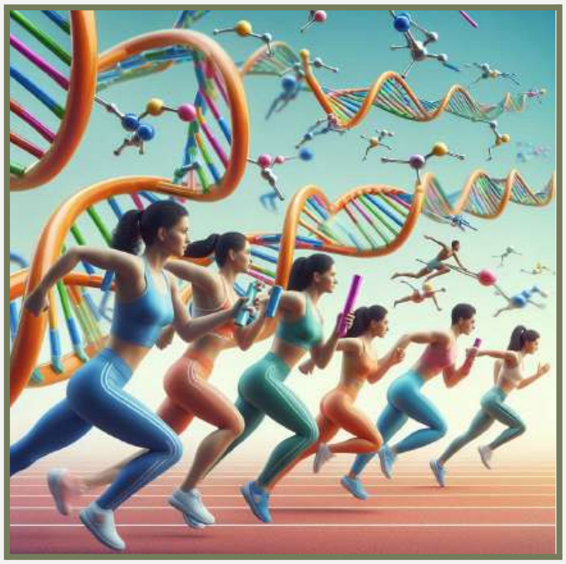
***Objective*:**

To learn the steps of DNA replication by arranging them in the correct order on a whiteboard.



Materials Needed:

- Whiteboard and markers
- Index cards or sticky notes with steps of DNA replication written on them
- Magnets or tape to attach cards to the whiteboard
- Timer
- Sheets with a summary of the DNA replication steps

Sequencing Activity (20 minutes):

- When your teacher says "Go!", your team will race to put the DNA replication steps in the correct order on the whiteboard.
- Work together with your teammates to decide the correct sequence.
- The first team to correctly sequence all steps wins.
- The timer will track how long it takes.

Background on DNA Replication

DNA replication is how a cell makes an exact copy of its DNA. This is important because each new cell needs a full set of instructions to work properly. DNA replication happens in several steps to make sure everything is copied accurately.

First, the twisted ladder shape of the DNA unwinds with the help of an enzyme called helicase, making two single strands. Then, the enzyme, topoisomerase, helps relieve the tension created by the unwinding. The bonds between the base pairs break, separating the two strands, and single-stranded binding proteins (SSBs) are added to keep the strands apart. An enzyme called *primase makes an RNA primer to start the replication process. DNA polymerase then adds new nucleotides to the template strands, matching up with the complementary bases.*

The leading strand of DNA is made continuously in the same direction as the replication fork by DNA polymerase. Meanwhile, the lagging strand is made in short pieces called Okazaki fragments, also by DNA polymerase, in the opposite direction of the replication fork. After these fragments are created, the RNA primers are removed and replaced with DNA nucleotides by another type of DNA polymerase. Finally, the gaps left by the removed primers are filled with DNA, and the enzyme DNA ligase joins the Okazaki fragments together to form a continuous strand. Each step is crucial to ensure the DNA is copied accurately, so the new cells can function properly..

Reflection (10 minutes):

- Write a short reflection on what you learned using the sentence stems provided.
- Hand in your reflection to your teacher for feedback.

Sentence Stems for Reflection:

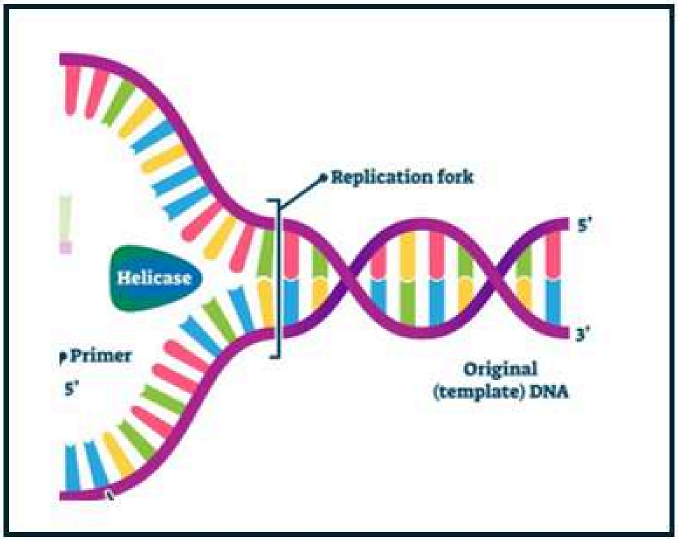
- *"During the activity, I learned that the step of ________ is important because ________."*
- *"One challenge my team faced was ________. We overcame it by ________."*
- *"The step I found most interesting was ________ because ________."*
- *"I helped my team by ________ and ________."*
- *"I now understand that DNA replication is important for ________ because ________."*
- *"A question I still have about DNA replication is ________."*

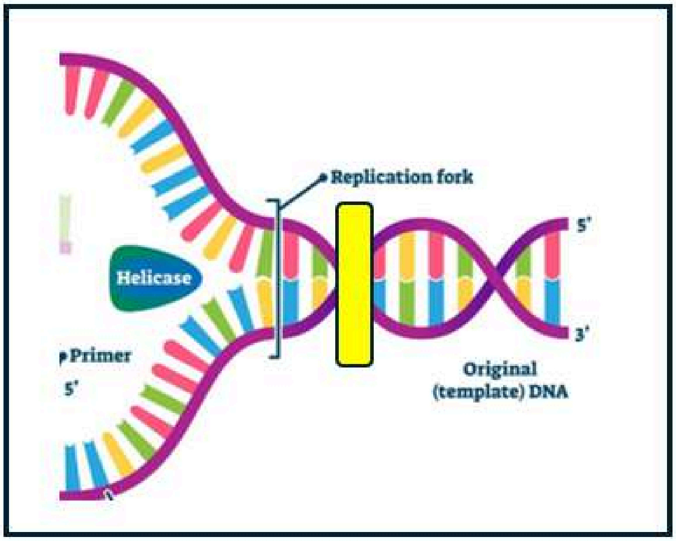
Name: ______________________________ Date: __________

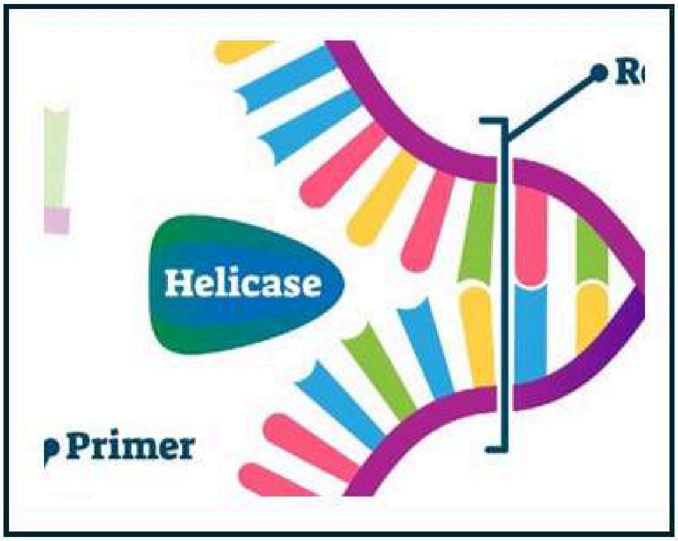
Sequencing Cards:

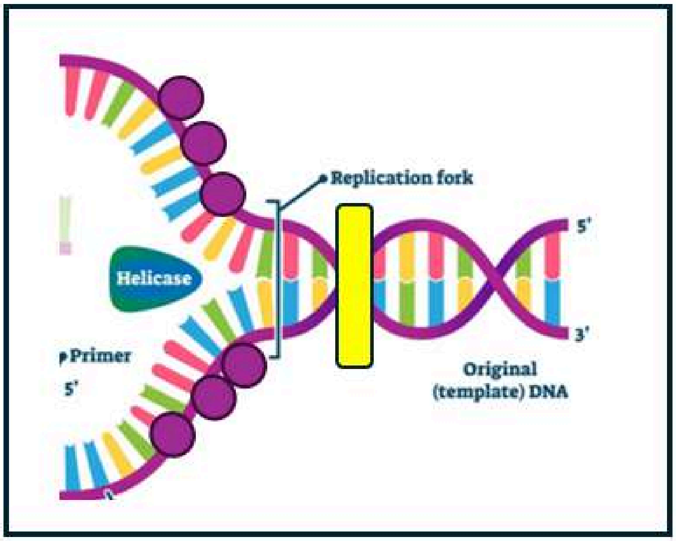
Unwinding the DNA helix: The enzyme helicase unwinds the twisted ladder shape of the DNA.	**Relieving tension**: Topoisomerase helps relieve the tension created by the unwinding.
Separating the strands: Helicase breaks the bonds between the base pairs, separating the two strands.	**Stabilizing the strands**: Single-stranded binding proteins (SSBs) bind to the separated strands to keep them apart.
Creating an RNA primer: The enzyme primase makes an RNA primer to start the replication process.	**Adding nucleotides to the leading strand**: DNA polymerase adds new nucleotides to the leading strand, which is made continuously in the same direction as the replication fork.

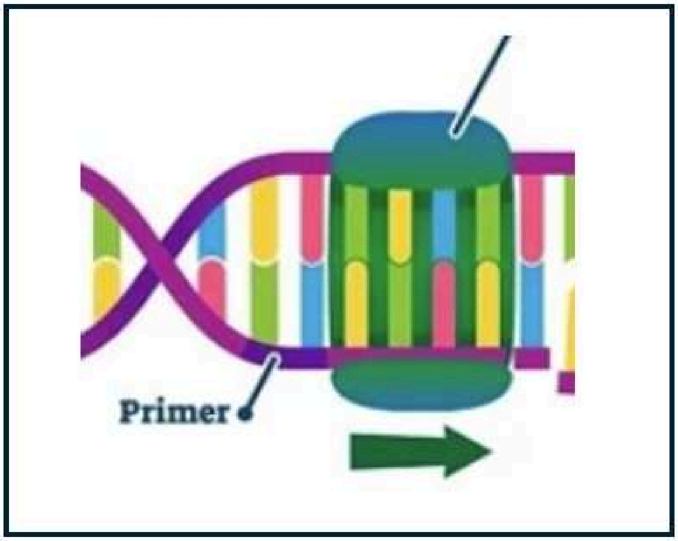
Name: ____ Date: ____________

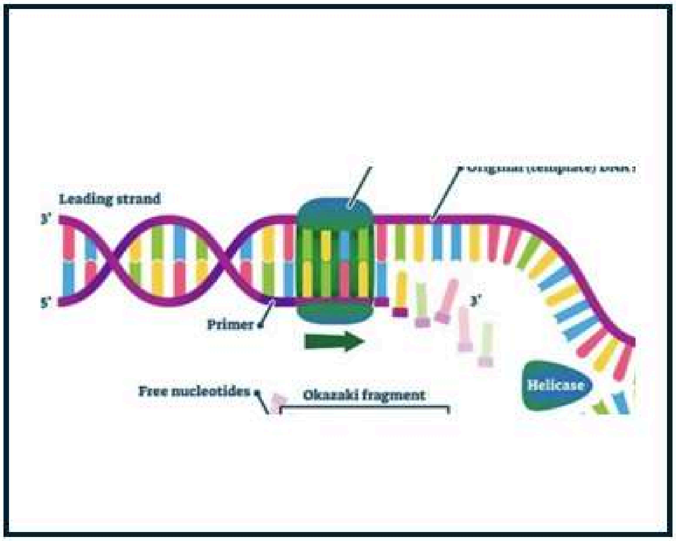

Replication fork
5'
Helicase
3'
Primer
5'
Original
(template) DNA


Replication fork
5'
Helicase
3'
Primer
5'
Original
(template) DNA


Helicase
Primer


Replication fork
5'
Helicase
3'
Primer
5'
Original
(template) DNA


Primer


Leading strand
3'
5'
Primer
3'
Helicase
Free nucleotides
Okazaki fragment

Name: ______________________________ Date: __________

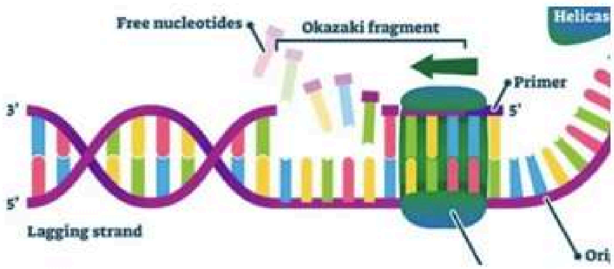
Adding nucleotides to the lagging strand: DNA polymerase adds nucleotides to the lagging strand in short pieces called Okazaki fragments, in the opposite direction of the replication fork.

Removing RNA primers: Another type of DNA polymerase removes the RNA primers from the newly synthesized DNA.

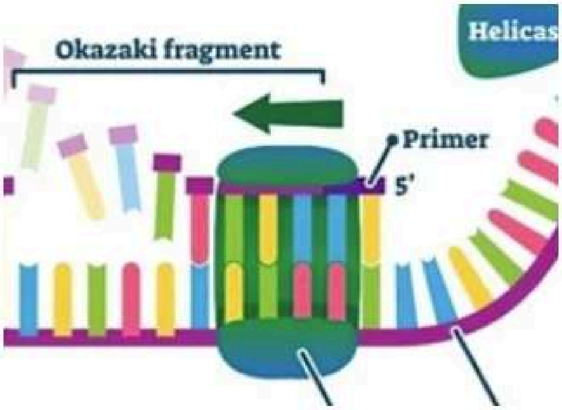
Replacing RNA with DNA: DNA polymerase replaces the RNA primers with DNA nucleotides.

Joining Okazaki fragments: The enzyme DNA ligase joins the Okazaki fragments together to form a continuous strand.

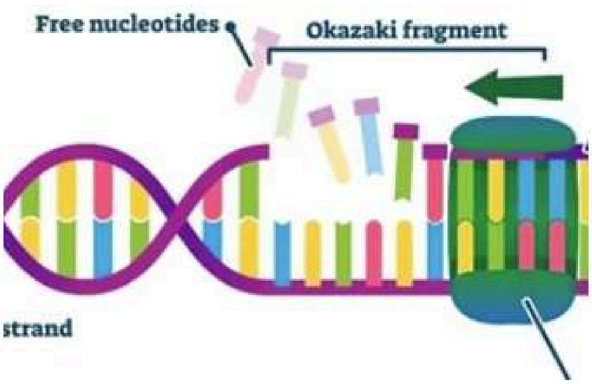
Name: ____ Date: ___________



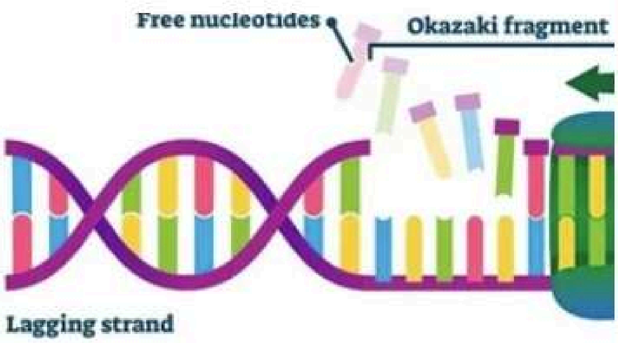
Free nucleotides
Okazaki fragment
Helicas
Primer
3'
5'
5'
Lagging strand



Okazaki fragment
Helicas
Primer
5'



Free nucleotides
Okazaki fragment
strand



Free nucleotides
Okazaki fragment
Lagging strand