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DNA Replication Study Guide

**DNA Replication Process**

**Initiation**: is the point where the splitting starts and is called the “origin of replication,” creating the replication fork.

On Leading Strand 5”-3” (replication is continuous)

1. DNA helix is unwounded by **helicase** by breaking the hydrogen bonds between the two strands (The splitting happens in places of the chains which are rich in A-T).
2. Binding of **RNA primase add RNA primer** for DNA polymerase to start replication.
3. **Single-binding proteins** keep strands separated
4. **Topoisermerase** relieves strain caused by the DNA unwinding

**Elongation**: adding of nucleotides

1. **DNA polymerase** moves along DNA strand joining new nucleotides on 3”(OH group)end and proofreads.

On lagging strands 3”-5” (replication occurs from multiple primers)

\*cannot be read by DNA poly.

1. Nucleotides are added to the 3” end of the okazaki fragments (small fragments).
2. Primers continuously laid down
3. DNA ligase connects the fragments together



**Termination**: This is when the DNA polymerase stops when it reaches a section it has already replicated. At the end of the chromosome (telomere), replication is impossible because they have non-coding genes.

**Things to know:**

* In eukaryotic cells-multiple origins of replication
* In prokaryotes-one origin of replication
* Telemores are not passed on by parents because they are too short.

Why does DNA Replication occur? So that the new nucleus can pass on our DNA to the daughter cells

**Multiple Choice Questions**

1. **DNA synthesis continue**
2. in the 3’ to 5’ direction
3. in the 5’ to 3’ direction.
4. Both directions
5. **Which one of the following is incorrect about DNA replication?**
6. The end of a DNA strand that has a phosphate group attached to the number 5 carbon is the 5 prime end.
7. DNA polymerase can only move along the DNA strand in both direction.
8. DNA semi-conservative replication produce one original strand and one new strand.
9. DNA polymerase III doesn’t have to synthesize the new DNA on the leading strand.
10. **If topoisomerase was not present what will happen:**
11. It would disrupt the strand and prevent binding and the other enzymes from doing their job and stop the replication process.
12. Mutations would occur
13. Helicase would not unwind double helix
14. **What is the complementary sequence for GCTAAAGTC**
15. AAGCCCAGA
16. CGATTTCAG
17. AAGCCCTGA
18. GGATTTCAG
19. **Replication origins are essentially easy to open. Why is this?**
20. The origins has mass amount of A and T nucleotides.
21. The origins has mass amount of G and C nucleotides.
22. The origins has mass amount of A and U nucleotides.
23. The origins have the same amount of A,T,G, and C nucleotides.

**Essay Questions**

1. **Describe the order in which DNA replication occurs. Including the different enzymes in their respective order. Then, compare and contrast DNA replication to the PCR process.**

**Answer should include:**

1. Strand is separated by **helicase** at the replication origin and unwinds the DNA helix breaking the hydrogen bonds between the nucleotides. While this is happening the RNA primase is right behind the helicase to create a primer for replication to start. The **topoisermerase** is the enzyme that relieves the strain. The **single-strand binding proteins** attach to the DNA to prevent it from annealing.
2. DNA Polymerase adds new DNA nucleotides to the 3’ to 5’ direction but the DNA is growing to the 5’ to 3’ direction. On the lagging strand, DNA form short fragments called **Okazaki fragments**. Once again, RNA primers are laid down and are later extended by DNA polymerase III. RNA primers replaced by DNA and the fragments are connected by **DNA ligase**.

Enzymes that are used: helicase, topoisomerase, RNA primase, DNA polymerase III, DNA ligase.

**Compare and Contrast (Answer may vary)**

In PCR, the temperature of 95 degrees or so unwinds the two DNA template (Denaturation), which mimics the helicase. In the annealing stage, the DNA is quickly cooled to anneal primers. This mimics the single-binding protein, which refrain the strands from attaching again. Then, Taq polymerase extends the DNA strands by attaching to 3” end of the sequence-specific primers.

In PCR, only a segment of DNA is amplified. Unlike in DNA replication the whole DNA is replicated. In PCR, the nucleotides are called d ATP, d GTP, d CTP, and d TTP. In the PCR process, the ddNTP binds to the A and allows the process to stop, while in DNA replication, the stop codon halts process.

 **2. Can replication begin at any region of a chromosome? Explain**

**Answer should include:**

DNA replication cannot begin at any region because (1) it has to be A-T rich, (2) DNA polymerase requires a segment of DNA or RNA to bind to so that it can start synthesis, (3) Though it eukaryotes there are multiple regions of replication, it needs a specific sequence on the origins of replication (4)it cannot start at the telomere because that is a non-coding region.