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Biology Study Guide

**DNA Replication**

DNA replication involves use of an existing strand of DNA as a template for the synthesis of a new, identical strand. It occurs during S phase.

This process of DNA replication begins at the***origin of replication***. DNA replication is divided into 3 major stages: unwinding, primer synthesis and elongation.

* + - * 1. **Unwinding**
  + ***Helicase*** separates the complementary strands by breaking the hydrogen bonds that join the nucleotide bases to each other. THINK HELICOPTER; separates DNA much like the rotator blades of a helicopter.
  + In order to keep the new single strands separated, ***binding proteins*** keep the single strands stable until elongation begins.
  + Another group of proteins, the ***topoisomerases,*** reduce some the strain caused by the unwinding of the double helix.
  + Replication proceeds along the two single strands at the same time but in opposite directions. This forms two replication forks that move along the DNA.

**B. Primer Synthesis**

* + Primer synthesis marks the beginning of DNA replication.
  + Primers are short bands of nucleotides that are synthesized by an RNA polymerase enzyme called ***primase.***
  + Primers are required for DNA polymerase because DNA polymerases can only add deoxy-nucleotides to the 3’-OH group at the end of a chain.

**C. Elongation**

* + Elongation is the addition of nucleotides to the new DNA strand.
  + Synthesis of the growing strand involves adding nucleotides in a specific order to match the original strand of DNA.
  + Since DNA is synthesized in the 5’-3’ direction, nucleotides are always added to the 3’ end.
  + ***DNA polymerase III*** does most of the elongation work.
  + After elongation is complete the RNA primers are removed by ***DNA polymerase I.***
  + Once these enzymes finish, there is a gap that is left behind between the primer and the elongated section of the DNA. ***DNA ligase*** then seals the bond between the two adjacent nucleotides.

**DNA Polymerase**

* + DNA polymerase can only move in one direction.
  + The 5’ end remains unaltered because DNA polymerase can only add to the 3’ end.
  + The strand going in the 3’ end is known leading strand. Synthesis proceeds immediately along this strand and is known as continuous replication.
  + The other strand is known as the lagging strand and replication along this strand is known as discontinuous replication.
  + Replication along the lagging strand can only proceed in short, discontinuous spurts known as ***Okazaki fragments.***

**Telomeres and Telomerase**

* + Telomeres are ends of linear chromosomes that are lost with each cell division.

-every time DNA gets replicated it gets shorter.

-ends of lagging strands do not get replicated

* + Telomerase-elongates the ends; found in gametes and cancers
  + Telomerase solves end-replication problem.
  + Telomerase has DNA polymerase activity and also contains an RNA sequence that provides a template for the synthesis of telomeric repeat DNA.
  + A piece of the RNA sequence hybridizes with the single stranded overhang on the DNA strand leaving a single stranded overhanging RNA sequence.
  + The DNA polymerase function of telomerase then synthesizes the DNA strand complimentary to the RNA found in telomerase and translocates to the end of the newly synthesized strand. This cycle repeats itself.
  + Once this cycle is completed, DNA primes synthesizes an RNA primer near the 3’ end and DNA fills in the empty region. However, a short region at the 3’ end will remain single stranded.