Genetics and Inheritance (9744)

DNA REPLICATION

- 1. Before DNA replication, free deoxyribonucleoside triphosphates are manufactured in the cytoplasm and transported into the nucleoplasm via nuclear pores.
- 2. DNA replication occurs at S phase of interphase.

UNZIPPING OF PARENTAL STRAND

- 3. Replication begins at specific points of the DNA molecule each of which is known as an origin of replication (ori).
- Helicase binds to origin of replication. It disrupts hydrogen bonds between complementary base pairs, causing parental strands to unzip and separate.
- Single-strand binding proteins keep the strands apart so that they can serve as templates for the synthesis of new strands.
- Topoisomerase relieves "overwinding" strain ahead of replication forks by breaking, swiveling and rejoining DNA strands.

ADDITION OF PRIMER

- 7. RNA primer is added to each template (parental) strand by the enzyme primase.
- 8. RNA primer provides a **free 3' OH** end for **DNA polymerase** to recognise and start DNA synthesis of the complementary daughter strand.
- DNA polymerase can only add deoxyribonucleotides (DNA nucleotides) to a pre-existing 3'OH end of a nucleotide.

SYNTHESIS OF DAUGHTER STRANDS

- 10. DNA polymerase uses the parental strand as a template and aligns the free activated deoxyribonucleoside triphosphates (dNTPs) in a sequence complementary to that of the parental strand.
- 11. Adenine base pairs with Thymine and vice versa. Guanine base pairs with Cytosine and vice versa.
- 12. DNA polymerase catalyses the formation of phosphodiester bonds between adjacent daughter DNA nucleotides of the newly synthesised strand.
- 13. Removal of the pyrophosphate (PPi) from the deoxyribonucleoside triphosphate (dNTP) and the subsequent hydrolysis of PPi provides the energy to drive the polymerization reaction.
- 14. As DNA polymerase moves along the template, it proof reads the previous region for proper base pairing. Any incorrect deoxyribonucleotide is removed and replaced by the correct one.
- The leading strand is synthesized <u>continuously</u> in the 5' to 3' direction.
- 16. The lagging strand is synthesized <u>discontinuously</u>. Its synthesis is similar to leading strand, except that the lagging strand is synthesised in fragments known as Okazaki fragments. Each fragment is initiated by an RNA primer before the addition of DNA nucleotides.
- 17. A different DNA polymerase then removes the RNA primer and replaces it with deoxyribonucleotides.
- 18. DNA ligase seals the nicks by forming phosphodiester bonds between adjacent nucleotides of the each of the DNA fragments on the new strand.

END OF REPLICATION

- **19.** Complementary parental and daughter strands **rewind** into a double helix.
- 20. Each resultant helix consists of one parental strand and one daughter strand. Hence this is called semiconservative DNA replication.



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