DNA Replication

Semi-conservative replication

- Parental DNA strands separate through breakage of hydrogen bonds and each act as a <u>template</u> for the synthesis of a new <u>complementary</u> DNA strand
- Each daughter DNA molecule formed is a hybrid consisting of one original strand and one newly synthesised strand

When: Occurs during S phase of interphase Where: Nucleus

HSTPCD5PAOL Start

- Helicase binds to <u>origin of replication</u> on parental DNA molecule and <u>unzips</u> and separates parental strands by <u>breaking hydrogen bonds</u> between complementary base pairs
- **Single-strand binding proteins** bind to single DNA strands, keeping them apart and preventing them from reannealing so that they can serve as **templates** for replication
- **Topoisomerase** <u>relieves overwinding strain</u> by breaking, swivelling and rejoining DNA strands

Synthesis

- **Primase** catalyses synthesis of **RNA primer** which provides a free 3' OH end required by DNA polymerase to initiate DNA synthesis
- **Complementary base pairing** occurs between parental DNA (template) strand and free incoming deoxyribosenucleoside triphosphates
 - Adenine forms 2 hydrogen bonds with Thymine and Cytosine forms 3 hydrogen bonds with Guanine
- DNA polymerase catalyses the formation of phosphoidester bonds linking DNA nucleotides
- New DNA strand synthesised in 5' to 3' direction



- A different **DNA polymerase** removes the **RNA primers** and replaces it with DNA nucleotides
- Due to **anti-parallel** nature of DNA molecule, there is a **leading strand** that is synthesised continuously towards replication fork
- And a **lagging strand** that is synthesised <u>discontinuously</u> away from replication fork giving rise to **Okazaki fragments**
- **DNA ligase** catalyses formation of <u>phosphodiester bond</u> between Okazaki fragments, <u>sealing the nicks</u>

<u>End</u>

- Process is **semi-conservative** where original strands of DNA molecule separate acting as **templates** for the synthesis of two new strands
 - Each of the 2 daughter DNA molecules consist of one original strand and one newly synthesised strand

<u>Extra</u>

- Pre-replication
 - Free deoxyribonucleoside triphosphate (dNTP) manufactured in cytoplasm and transported into nucleoplasm
- Replication forks form and spread, creating a replication bubble
- Active site of DNA polymerase complementary to free 3' OH group attached to end of growing DNA strand

- DNA polymerase has proof-reading function, ensuring proper base pairing and replacing the wrong ones
 - Ensures fidelity of the DNA
 - Incorrect DNA nucleotides removed and replaced with correct one
- Eukaryotes can have multiple origins of replication with more DNA polymerases working simultaneously
 - Speeds up replication process