

DNA REPLICATION STUDY-GUIDE

DNA REPLICATION

01 ENZYMES

Replication involves an assembly of enzymes, among which DNA polymerase is the most important. It is a polymerase, which means it can build a polymer out of monomers.

- DNA polymerase** (DNA pol) is the enzyme that builds the double helix by transferring nucleotides to the growing strand.
- DNA helicase** (DNA helicase) is the enzyme that unwinds the double helix by breaking hydrogen bonds between the base pairs.
- DNA gyrase** (DNA gyrase) is the enzyme that relieves the torsional strain in the DNA molecule by cutting and rejoining the DNA strands.
- DNA topoisomerase** (DNA topoisomerase) is the enzyme that relieves the torsional strain in the DNA molecule by cutting and rejoining the DNA strands.
- DNA primase** (DNA primase) is the enzyme that synthesizes a short RNA primer to which DNA polymerase can add nucleotides.
- DNA ligase** (DNA ligase) is the enzyme that joins the Okazaki fragments on the lagging strand.

02 DIRECTIONALITY

Because DNA polymerase (DNA pol) can only add nucleotides to the 3' end, the two strands are synthesized in opposite directions. The leading strand is synthesized continuously towards the replication fork. The lagging strand is synthesized discontinuously as Okazaki fragments away from the replication fork.

03 PROOFREADING

DNA polymerase (DNA pol) has a proofreading function. It can detect and correct errors in the newly synthesized strand. If an error is detected, DNA pol will remove the incorrect nucleotide and replace it with the correct one.

04 NUCLEOTIDES

A nucleotide is the basic unit of DNA. It consists of a phosphate group, a deoxyribose sugar, and a nitrogenous base. The bases are adenine (A), thymine (T), guanine (G), and cytosine (C).

DNA REPLICATION

02 DNA BASE SEQUENCE

The order of bases in a DNA molecule is its base sequence. Each triplet of bases (codon) corresponds to a specific amino acid. The sequence of bases determines the structure and function of proteins.

03 SEMI-CONSERVATIVE

When a cell divides, DNA replication occurs. Each new DNA molecule consists of one original (parental) strand and one newly synthesized (daughter) strand. This is called semi-conservative replication.

05 KEY TERMS

Nucleotide
Basic unit of DNA, composed of a phosphate, deoxyribose sugar, and nitrogenous base.

Complementary base pairing
A base with T, A, and C bonds with G, A, and T, respectively.

Semi-conservative replication
Each new DNA molecule consists of one original strand.

Template strand
The original DNA strand used to synthesize a complementary copy.

Antiparallel
Strands run in opposite directions (5' to 3' and 3' to 5').

Helicase
Unwinds DNA.

DNA Polymerase
Synthesizes the daughter strand by adding nucleotides.

01 DNA STRUCTURE

DNA is a double-stranded molecule composed of nucleotides, each containing a phosphate group, a deoxyribose sugar, and a nitrogenous base.

The two strands run antiparallel (5' to 3' and 3' to 5') and twist into a double helix. Nucleotides are joined by hydrogen bonds between the bases, forming a complementary base pair. The sugar-phosphate backbone gives DNA structural stability and protects the genetic code stored in the base sequence.

Double helix structure

01 DNA STRUCTURE CONT.

Complementary base pairing

04 ENZYMES

Specialized enzymes help coordinate replication.

- Helicase**
Unwinds the double helix, creating the replication fork.
- DNA polymerase**
DNA polymerase adds nucleotides to the growing strand, checking for errors as it goes.

Other enzymes support strand separation and reconnection of fragments. These proteins also ensure accurate duplication of the genome.

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Carl S. Pike



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