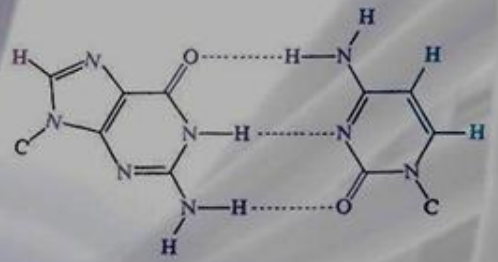
DNA

Replcation



deoxyribonucleic acid

WJ

What is DNA replication?

DNA replication is the process by which DNA makes a copy of itself during cell division.

- 1-The first step in DNA replication is to unbind the double helix structure of the DNA molecule.
- 2-This is carried out by an enzyme called helicase which breaks the hydrogen bonds? holding the complementary bases of DNA together (A with T, C with G).

•3- The separation of the two single strands of DNA creates a 'Y' shape called a replication 'fork'. The two separated strands will act as templates for making the new strands of DNA.
•4-One of the strands is oriented in the 3' to 5' direction (towards the replication fork), this is the leading strand?. The other strand is oriented in the 5' to 3' direction (away from the replication fork), this is the lagging strand?. As a result of their different orientations, the two strands are replicated differently:

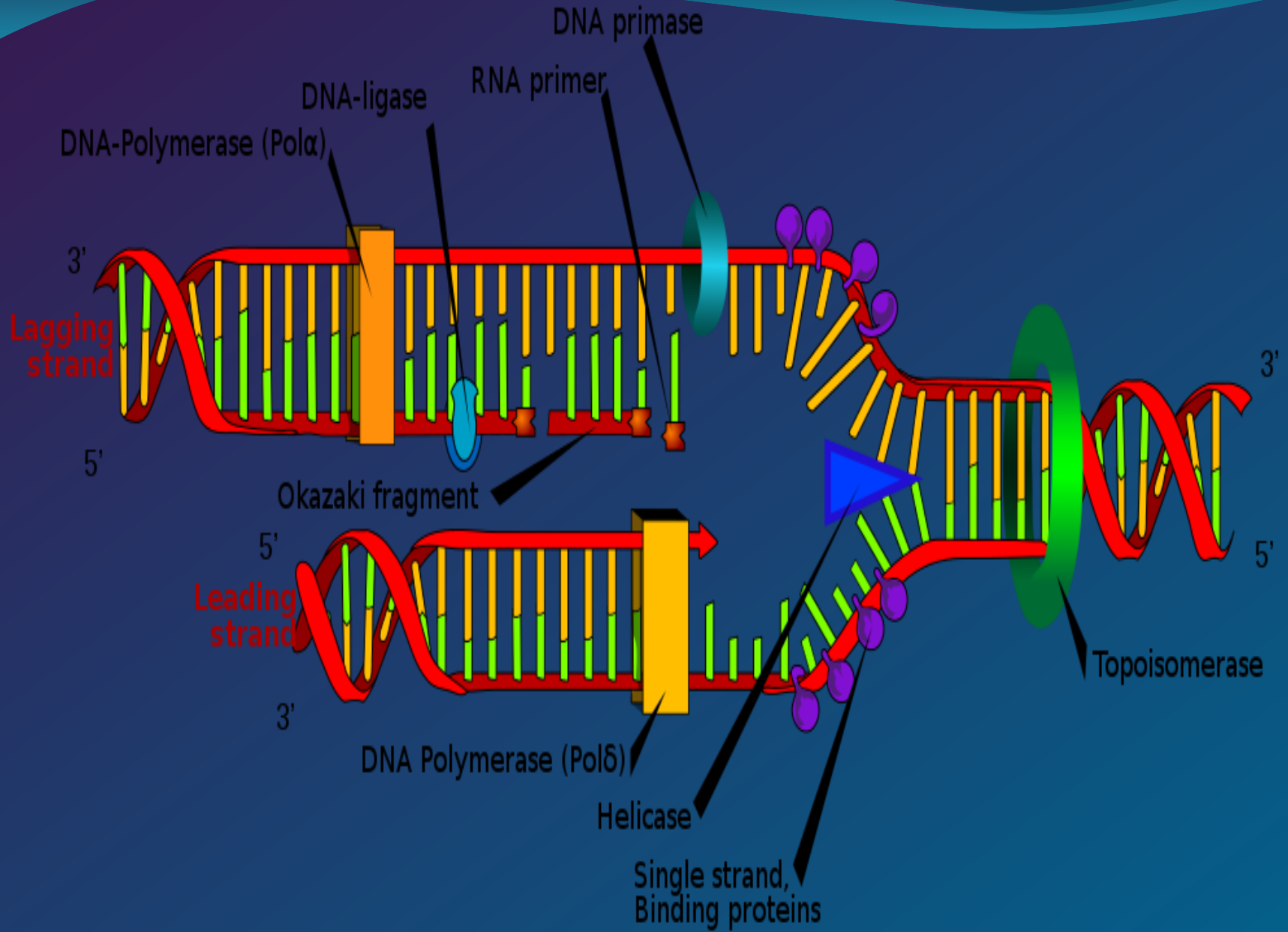
•5-A short piece of RNA called a primer (produced by an enzyme called primase) comes along and binds to the end of the leading strand. The primer acts as the starting point for DNA synthesis.
•6- DNA polymerase binds to the leading strand and then ‘walks’ along it, adding
new complementary nucleotide bases (A, C, G and T) to the strand of DNA in the 5’ to 3’ direction.
•7- This sort of replication is called continuous.

•8- Lagging strand:

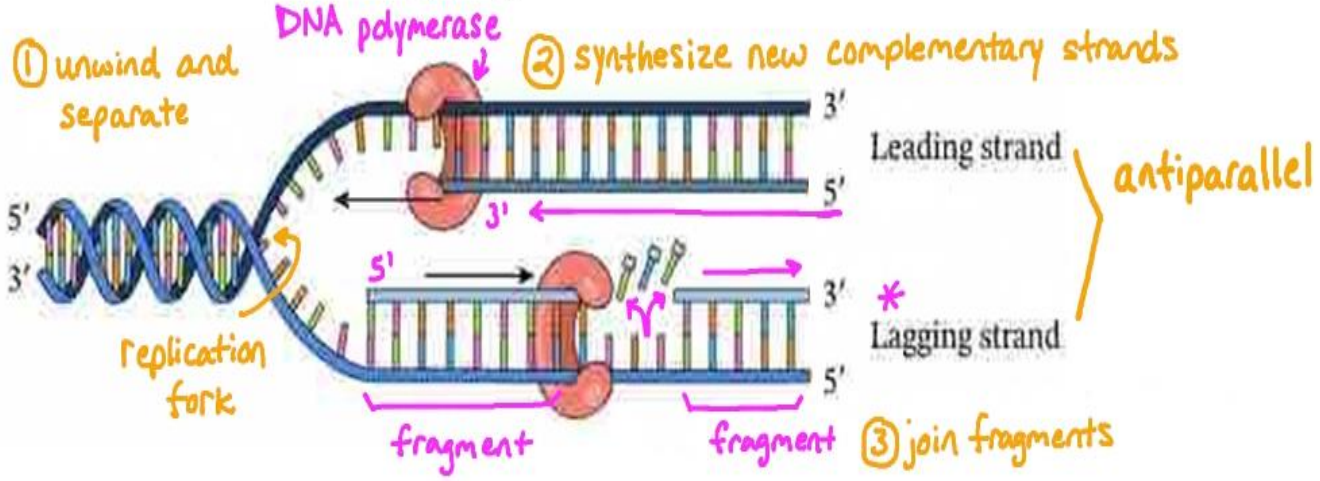
•Numerous RNA primers are made by the primase enzyme and bind at various points along the lagging strand.

• 9- Chunks of DNA, called Okazaki fragments, are then added to the lagging strand also in the 5’ to 3’ direction.

• 10-This type of replication is called discontinuous as the Okazaki fragments will need to be joined up later.


DNA primase
RNA primer
DNA-ligase
DNA-Polymerase (Polα)
3'
Lagging strand
5'
Okazaki fragment
5'
Leading strand
3'
DNA Polymerase (Polδ)
Helicase
Single strand, Binding proteins
Topoisomerase
3'
5'

The diagram provided shows a simplified outline of how DNA is replicated on the leading strand and the lagging strand.



Which enzyme joins the fragments that are formed during the replication of the lagging strand? DNA ligase

DNA Replication

Step 1: unwind and separated strands makes bases accessible
Enzyme: DNA helicase breaks H bonds

Step 2: form new complemetary strands
DNA polymerase adds nucleotides

Step 3: join (ligate) the fragments
DNA ligase forms phosphodiester bonds

- 11- Once all of the bases are matched up (A with T, C with G), an enzyme called exonuclease strips away the primer(s). The gaps where the primer(s) were are then filled by yet more complementary nucleotides.
- 12-The new strand is proofread to make sure there are no mistakes in the new DNA sequence.
- 13- Finally, an enzyme called DNA ligase? seals up the sequence of DNA into two continuous double strands.

•14- The result of DNA replication is two DNA molecules consisting of one new and one old chain of nucleotides. This is why DNA replication is described as semi-conservative, half of the chain is part of the original DNA molecule, half is brand new.
Following replication the new DNA automatically winds up into a double helix

* DNA replication occurs in the cytoplasm of prokaryotes and in the nucleus of eukaryotes

*Cells must replicate their DNA before they can divide. This ensures that each daughter cell gets a copy of the genome, and therefore, successful inheritance of genetic traits. DNA replication is an essential process and the basic mechanism is conserved in all organisms.

* Daughter strand

Refers to the newly synthesized strand of DNA that is copied via the addition of complementary nucleotides from one strand of pre-existing DNA during DNA replication.

What is recombinant DNA technology and give examples?

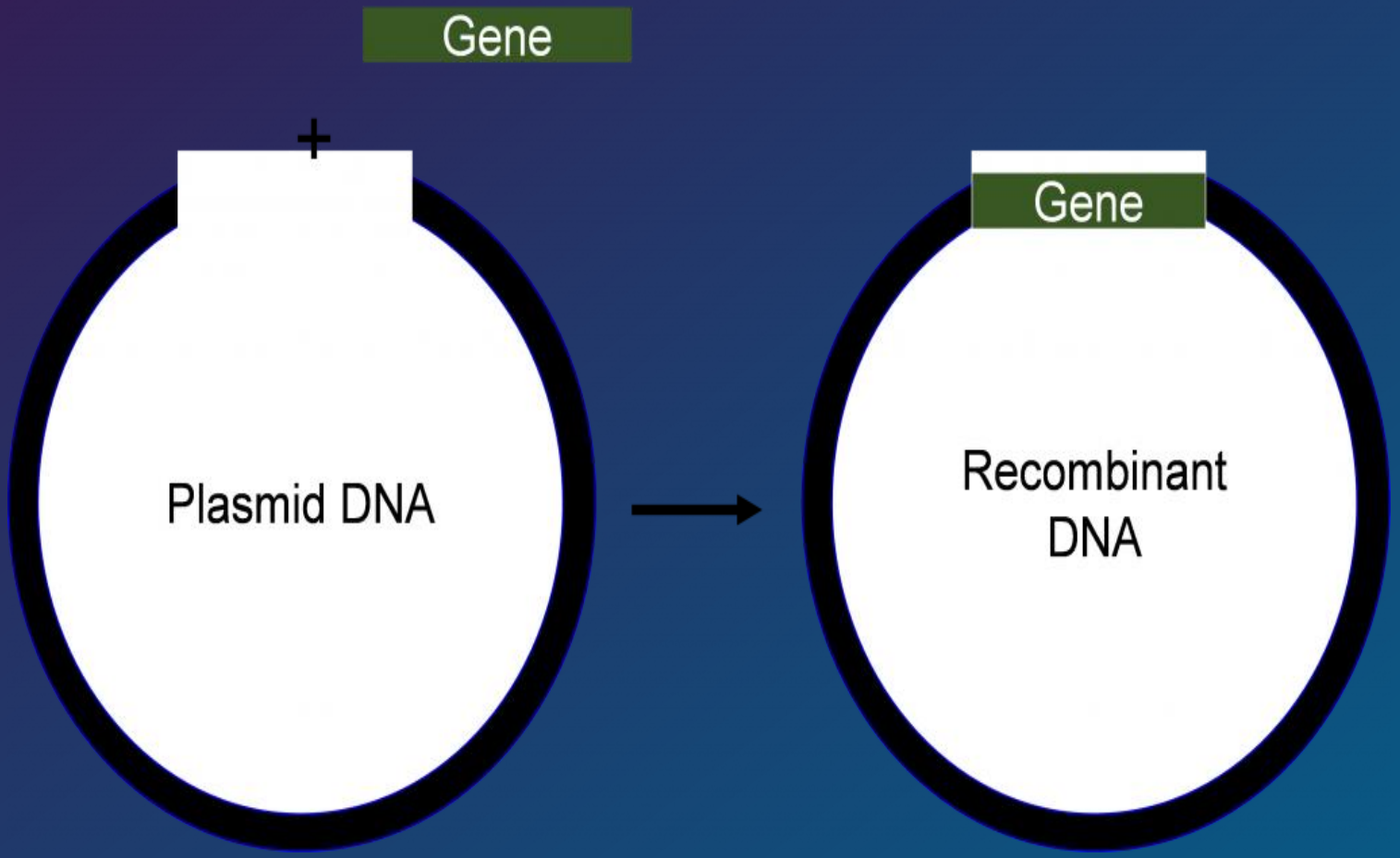
Recombined DNA technology

is the joining together of DNA molecules from two different species. The recombined DNA molecule is inserted into a host organism to produce new genetic combinations that are of value to science,
medicine, agriculture, and industry.

For example, insulin is regularly produced by means of recombinant DNA within bacteria. A human insulin gene is introduced into a plasmid, which is then introduced to a bacterial cell.

In agriculture, recombinant DNA has improved plant growth by increasing nitrogen fixation efficiencies, **by cloning bacterial genes, and inserting them into plant cells**. Other plants have been engineered to be resistant to caterpillar, pests, and viruses by inserting resistant genes into plant genomes.

Recombinant rDNA technology involves procedures for analyzing or combining DNA fragments from one or several organisms (Figure 1) including the introduction of the rDNA molecule into a cell for its replication, or integration into the genome of the target cell.


Gene
+
Plasmid DNA
Gene
Recombinant
DNA