



Objectives

- ✿ Summarize the process of DNA replication.
- ✿ Identify the role of enzymes in DNA replication.
- ✿ Explain the importance of complimentary base pairing in DNA replication.
- ✿ Evaluate what can occur if there is an error during replication.



The Life Cycle of a Cell (Preview)

- ✿ There are 2 major stages of life for any cell:
 - ✿ Interphase
 - ✿ Cell Division
- ✿ Interphase is divided into 3 sub-phases.
 - ✿ G_1
 - ✿ S
 - ✿ G_2
- ✿ In the “S-Phase” of interphase, the cell copies DNA to prepare for cell division.
- ✿ Without this phase it would not be possible to pass on genetic information from one cell to the next.



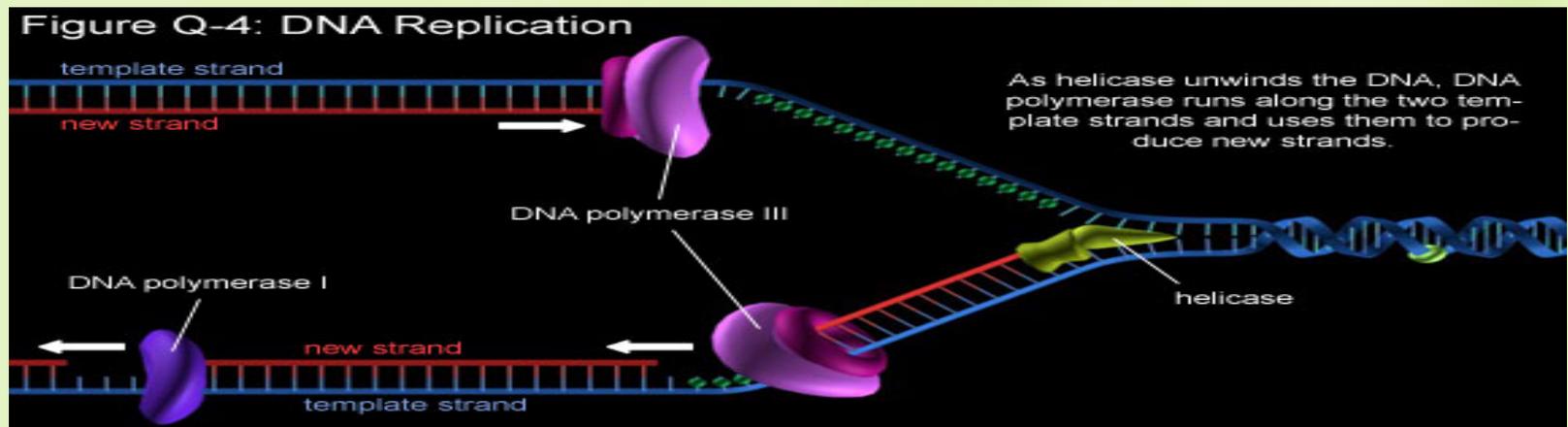
DNA Replication (An Overview)

- ✿ **DNA Replication** is the process by which DNA is copied in the nucleus of a cell.
- ✿ Enzymes unravel the DNA and then “unzip” the molecule to expose the nitrogenous bases.
- ✿ The nitrogenous bases make up the code that determine everything in the cell, and therefore the body.
- ✿ The process creates 2 strands of DNA, each with half of a strand from the original strand.



DNA Replication (The Process)

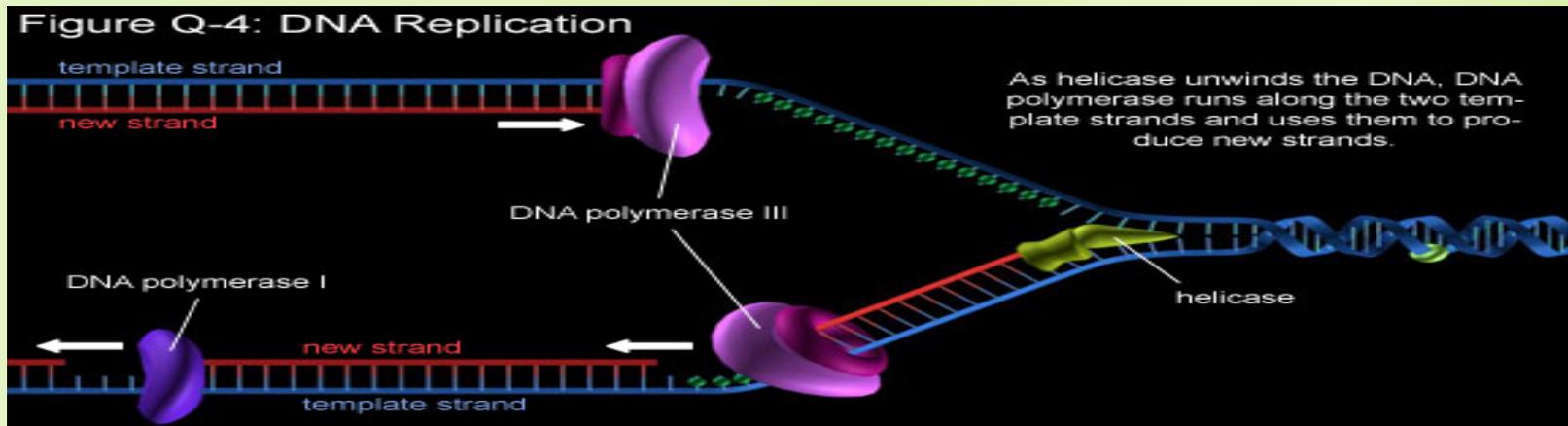
- ✿ An enzyme called **helicase** opens the DNA molecule by untwisting, and separating it at the N.B. creating a **replication fork**.
- ✿ An additional enzyme called **DNA Polymerase** attaches to each half of the separated DNA molecule.

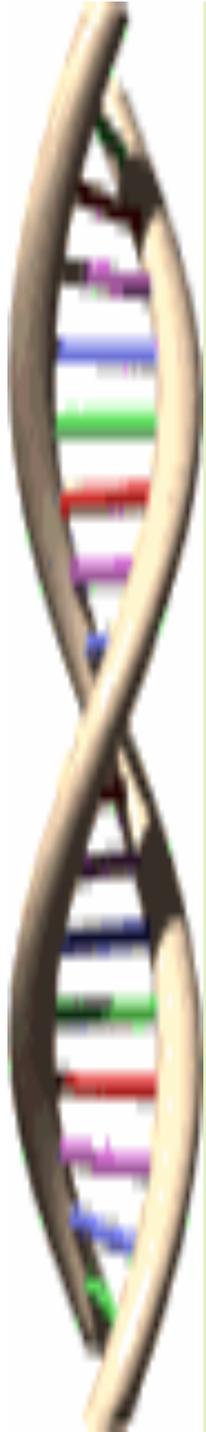




DNA Replication (The Process)

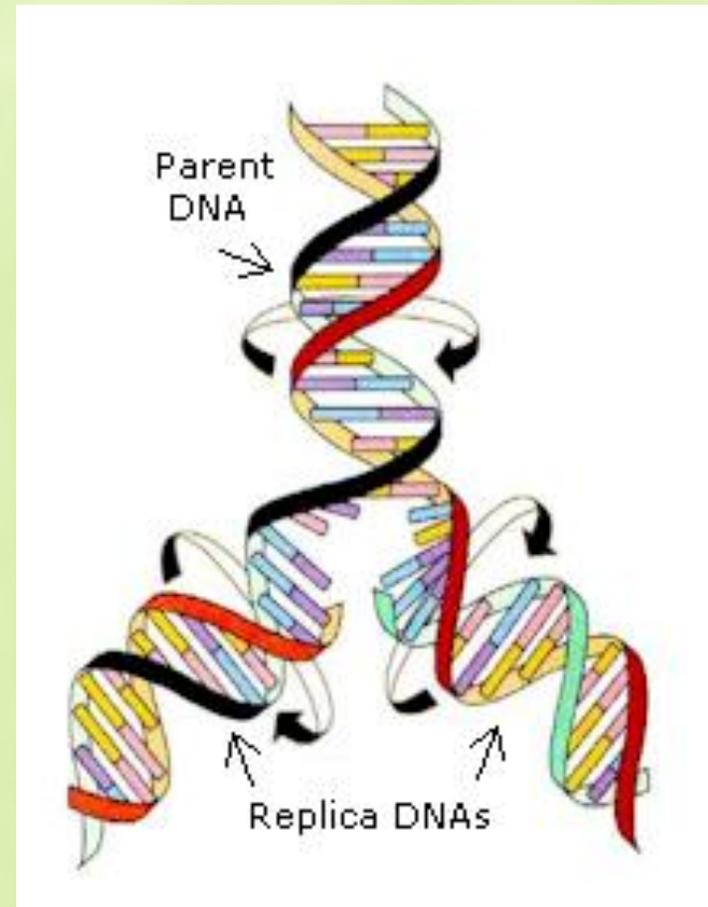
- ✿ The DNA polymerases travel up the strands in a 5' to 3' direction and place complimentary nucleotides to the existing bases on the original strand.
- ✿ The strand that runs 5' to 3' is called the **leading strand**, and the other is called the **lagging strand**.
- ✿ Once the polymerases are finished they fall off the end of the 2 new DNA strands.





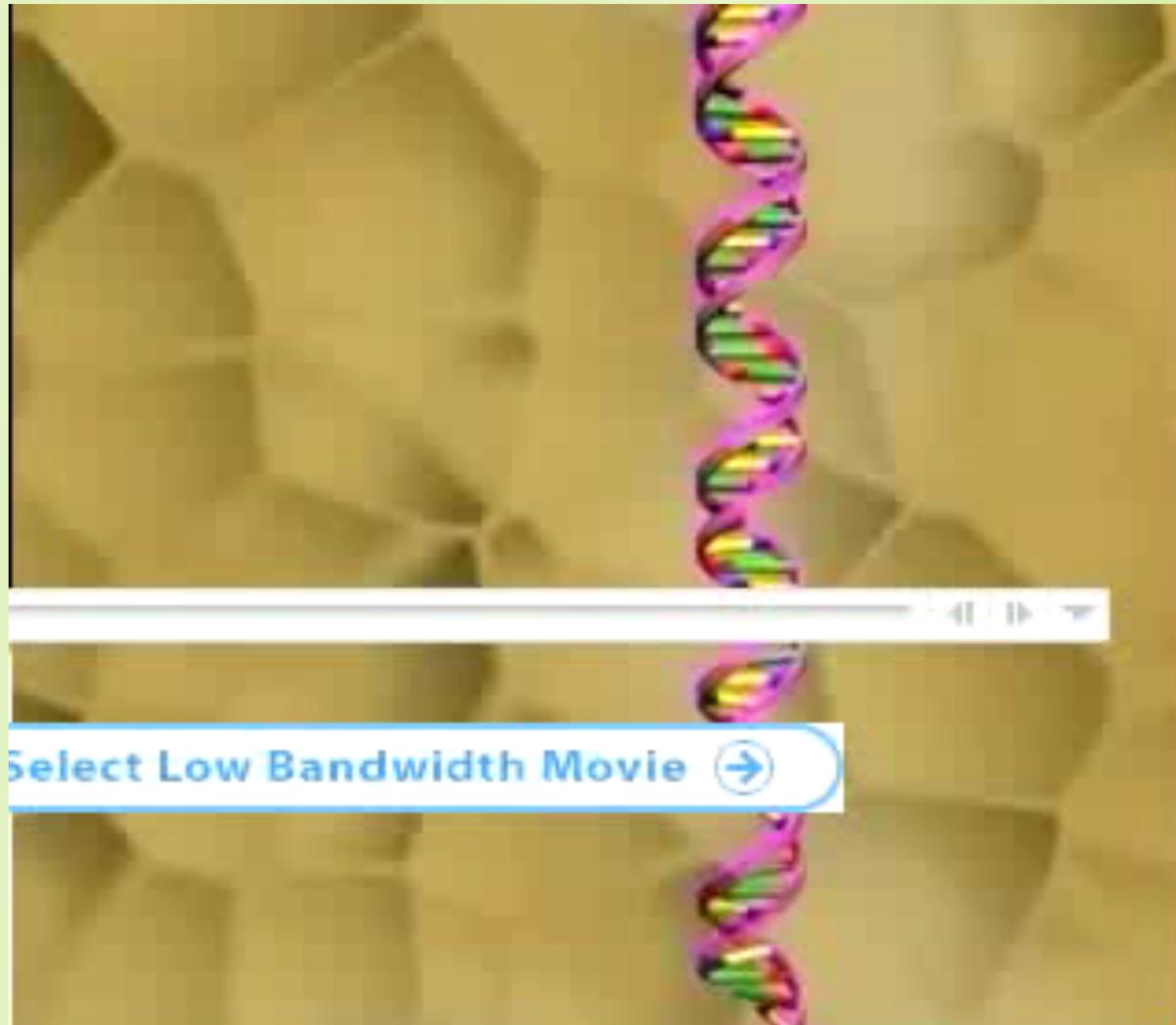
DNA Replication (The Result)

- ✿ The result of DNA replication is 2 identical stands of DNA that are exact copies of the original strand.
- ✿ Each strand is composed of half of a strand from the original DNA molecule and half of a strand of new DNA.
- ✿ This is referred to as **semi-conservative replication** (because part of the original DNA is conserved in each molecule.)





DNA Replication at a Glance





Replication Gone Wrong

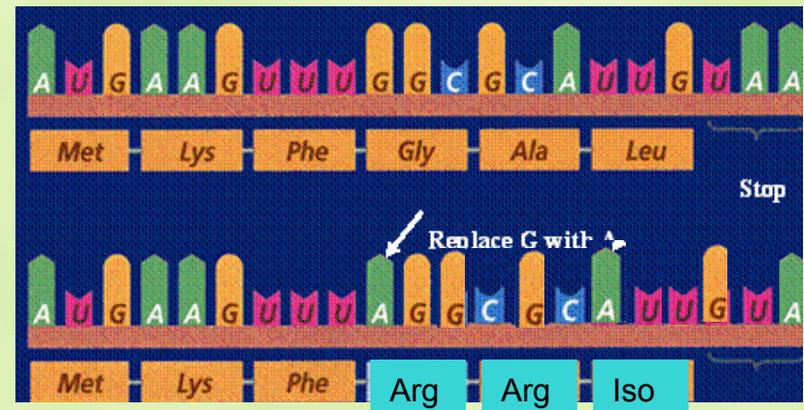
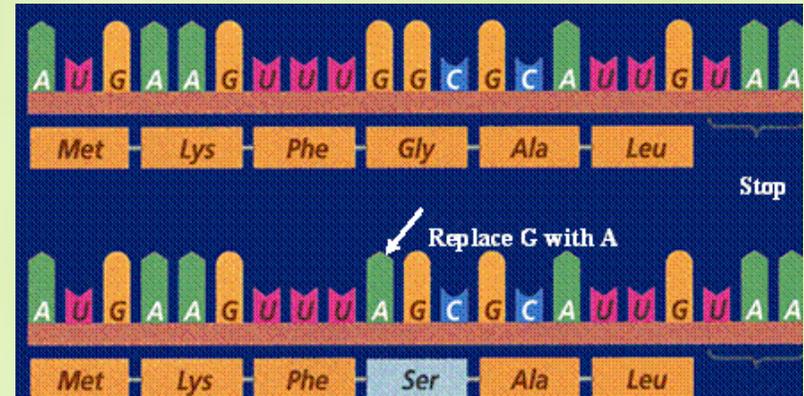
- ✿ Rarely, errors can occur in the DNA replication process.
- ✿ This can result in **mutations**.
- ✿ A mutation is a *CHANGE* in the nucleotide sequence of a DNA molecule.
- ✿ Most mutations are harmless and are hardly noticeable; however, some can be beneficial and others can be deadly.



Mutations

✿ There are 2 types of mutations:

- ✿ **Point Mutation:** A mutation at a single point of a DNA strand as a result of substitution of a specific base affecting a single amino acid.
- ✿ **Frameshift Mutation:** A mutation as a result of insertion or deletion of a base that affects all of the amino acids that follow the mutation.





Causes of Mutations

- ✿ Some mutations occur simply because there is a mistake in the DNA replication.
- ✿ Radiation can knock a particular nucleotide out of a DNA sequence.
- ✿ Certain chemical agents, or **carcinogens**, can also cause mutations.
- ✿ Virus can introduce new genetic information leading to mutation.
- ✿ Scientists can, in some cases, intentionally cause a mutation called a directed mutation.



Results of Mutations

- ✿ Some mutations of DNA can result in a change of the way a cell functions (most go undetected).
- ✿ Some mutations lead to an increase and uncontrolled division of cells, or **cancer**.
- ✿ Other mutations can lead to the production of beneficial traits like resistance to certain conditions or diseases.
- ✿ Since the mutated DNA is replicated when the cell divides, it is possible for the mutation to be passed on to the off spring if it occurs in the gametes.

The Reality of Comic Books



✿ Possible (But how likely?):

- ✿ Increased healing time (Wolverine.)
- ✿ Absorb/change genetic traits (Rogue, toad & Mystique.)
- ✿ Increased strength (Beast.)
- ✿ Increased life span.

✿ Impossible:

- ✿ Control weather (Storm.)
- ✿ Laser vision (Cyclops.)
- ✿ Telepathy/telekinesis (Dr. Xavier & Jean Gray)
- ✿ Others?



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