



Aim :How are the mistakes that occur during DNA replication repaired?






Mechanisms for DNA repair

- **Mutations are random changes in the DNA of genes.**
 - **They often do more damage than good.**
 - **They need to be repaired.**
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- **Mistakes during the initial pairing of template nucleotides and complementary nucleotides occurs at a rate of one error per 10,000 base pairs.**
 - **DNA polymerase proofreads each new nucleotide against the template nucleotide as soon as it is added.**
 - **If there is an incorrect pairing, the enzyme removes the wrong nucleotide and then resumes synthesis.**
 - **The final error rate is only one per billion nucleotides.**
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Repair Enzymes

- **Repair enzymes recognize faulty or damaged areas because of the change in patterns of spacing and polarity.**
 - **They loosen damaged bonds or strengthen weak ones.**
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Repair during replication

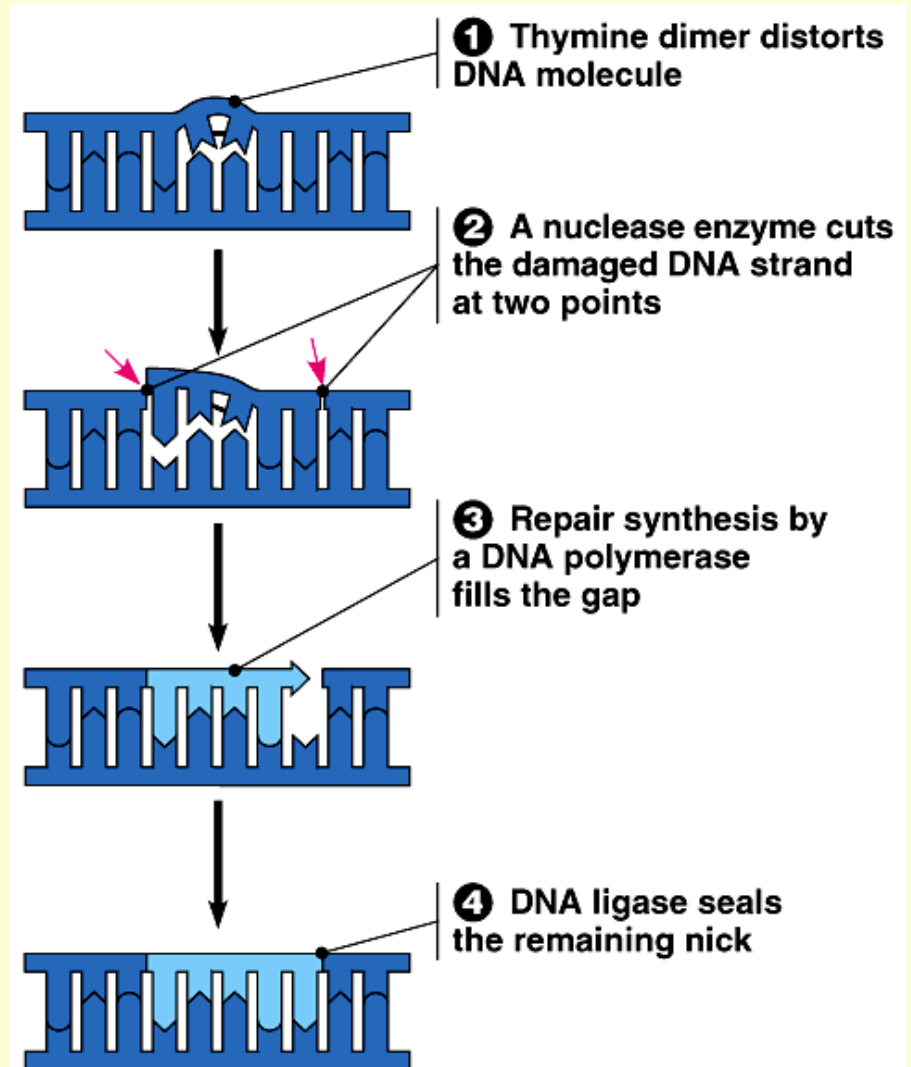
- 1) In bacteria, the DNA polymerase enzyme itself can repair mismatches between nucleotides.
 - 2) In eukaryotes, a DNA polymerase complex has many enzymes:
 - A) Type A enzymes proof read unzipped DNA and remove faulty base pairs. (excision repair)
 - B) Type B enzymes read complimentary strands and replace clipped faulty bases, replacing them with true bases.
 - C) DNA polymerase III creates the corrected strand after Type A & B have done their job.
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- In mismatch repair, special enzymes fix incorrectly paired nucleotides.

- A hereditary defect in one of these enzymes is associated with a form of colon cancer.


- In nucleotide excision repair, a nuclease cuts out a segment of a damaged strand.

- The gap is filled in by DNA polymerase and ligase.






Repair of other mutations

- 1) mutations may occur when induced by heat, radiation, and various chemical agents.
 - A) heat – breaks bonds that hold purines to deoxyribose (5000 per day) or changes cytosine into uracil (100 per day)
 - B) UV radiation causes 2 adjacent thymine molecules on a DNA molecule to fuse (bond with themselves) rather than with their compliments (adenine).
 - This makes DNA unstable and leads to skin cancer.
 - These thymine dimers must be excised and the mutation repaired.
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Repair of other mutations

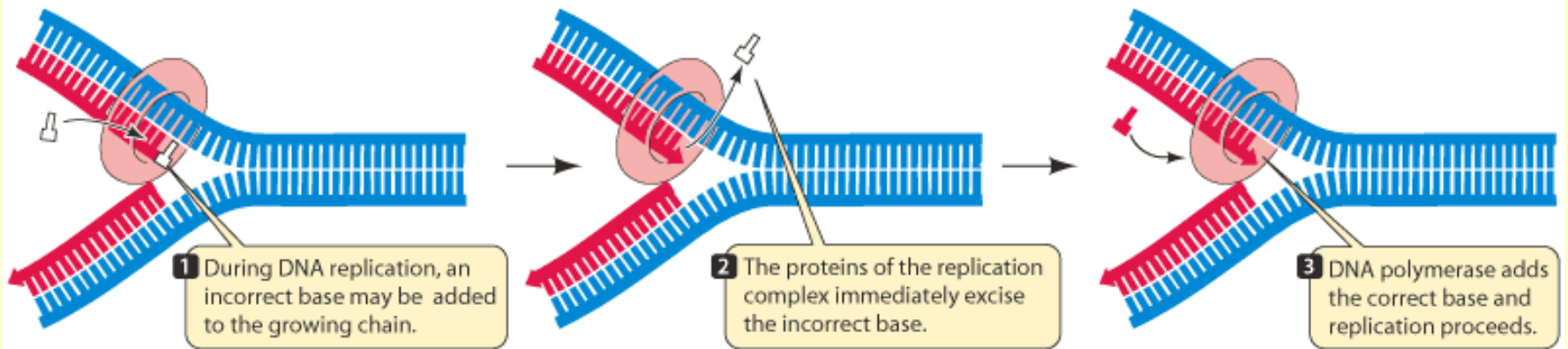
- 2) The procedure of repair of induced mutations is the same one that occurs during DNA replication.
 - A) 20 different enzymes are involved with scanning
 - B) 50 different enzymes are involved with clipping and repairing
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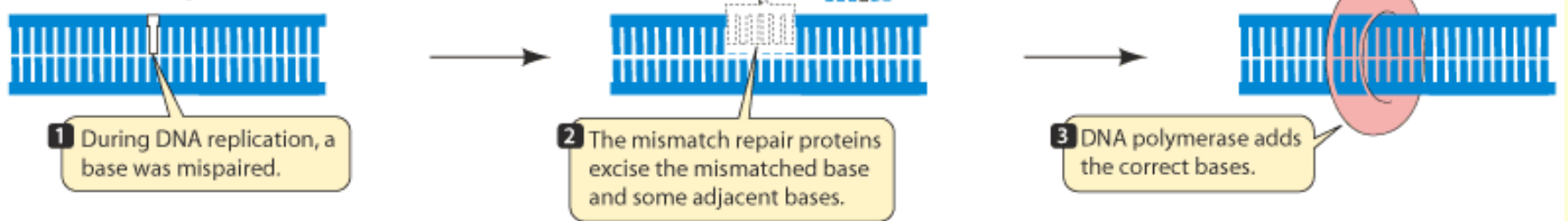
Repair of other mutations

- **Some mutations still occur:**
 - **A) mutations are too close to each other for the repair enzymes to correct them.**
 - **B) repair enzymes ‘miss’ the mutation.**
 - **C) repair enzymes cause the mutation.**
 - **Misalignment deletion – too many base pairs break at the same time and misalign, leaving exposed bases which are mistakenly clipped.**
 - **Deamination of methylated cytosine – When methyl groups are added to cytosine, the cytosine changes to thymine and the repair enzymes do not recognize this.**
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(a) DNA proofreading



(b) Mismatch repair



(c) Excision repair

