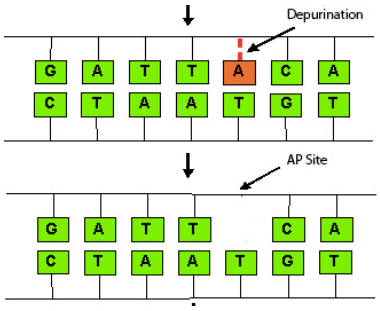
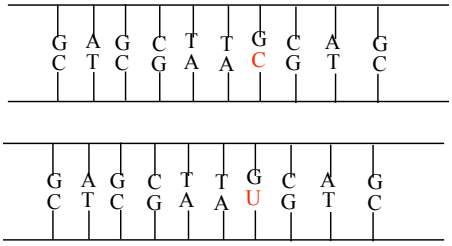
CONCEPT: DNA REPAIR AND RECOMBINATION

Overview

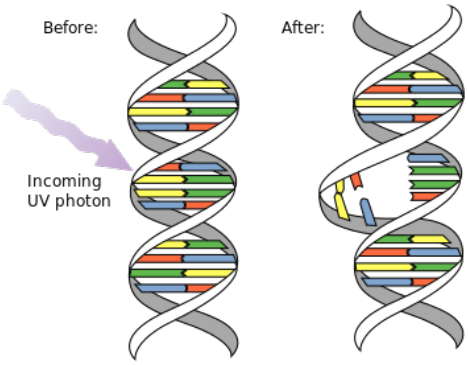
- There are many different _____ of DNA damage
  - □ **Deupriation** is when purine bases (A and G) are spontaneously lost (like missing teeth)



  - □ **Deamination** is when a base is chemically converted into a different base (cytosine to uracil)



  - □ **Thymine dimer** is when UV light exposure causes two adjacent thymines to dimerize



  - □ **Double Strand Break** is when both strands of a DNA double helix are damaged

- If damaged DNA is not repaired it can cause serious diseases
  - □ Xeoderma pigmentosum – "light allergy" – have inability to repair UV lesions

Repair mechanisms

● Each mutation is repaired by the cell in a _____ way

□ **Mismatch repair** fixes mismatched or lost bases

- Mismatched nucleotides cause distortion in double helix

□ **Base Excision Repair (BER)** removes nucleotide damage caused by chemicals (Ex: deamination)

- **DNA glycosylase** is the enzyme that cleaves out uracil for repair

□ **Nucleotide excision repair (NER)** fixes bulky lesions (Ex: thymine dimers)

- Repair involves a “cut and paste” method;

- DNA ligase reseals the cut

□ **Double Strand Break** is when both strands of a DNA double helix are damaged

- **Nonhomologous end joining** is when the cell just sticks the broken ends back together

- **Homologous recombination** is when the cell uses undamaged DNA as a template to repair the break

Homologous Recombination

● Homologous recombination repairs double strand breaks in 8 steps

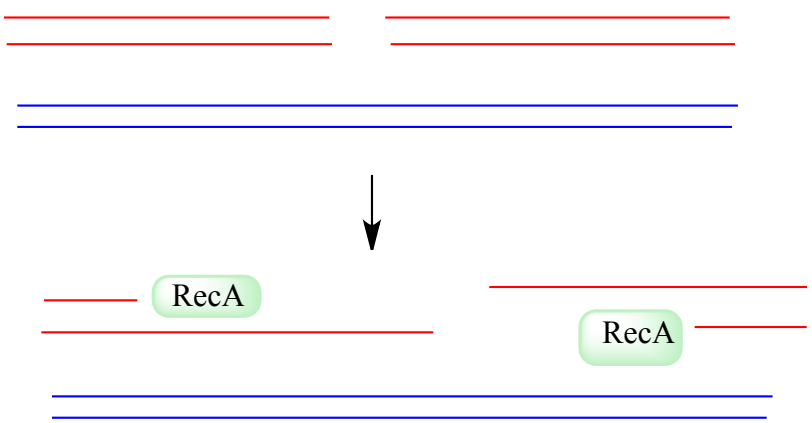
□ Homologous recombination occurs shortly after DNA has been replicated

- Undamaged copy can act as a template

1. Double Strand Break occurs

2. **RecA** protein binds to a single strand of broken DNA

- Also binds to single strand of undamaged DNA

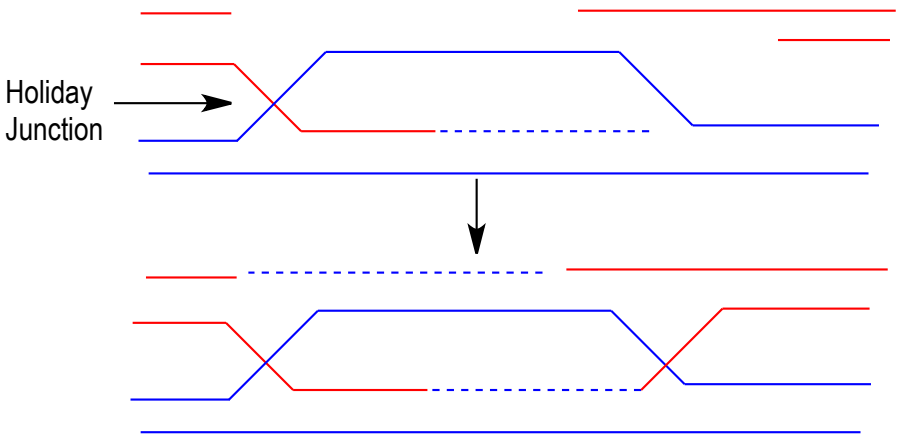


3. Single broken strand and single undamaged strand interact with their complementary regions

4. The DNA repair begins using the undamaged strand as a template

5. **Holiday junctions** form. These are connections between four DNA strands on two helices

- Sometimes called **cross-strand exchange**



6. **Branch migration** occurs when the cross-strand point (holiday junction) moves down the DNA

    - Movement increases the amount of DNA template available for repair

7. DNA repair is completed

8. Holiday junction is cleaved and the two DNA strands are rejoined to form two separate DNA helices

    - Cleavage can result **crossing-over** causing DNA exchange outside of the damaged area (break point)

    - Cleavage can result in non-complementary regions between the two helices where holiday junctions were

        - Can stay in genome OR be corrected through base excision repair

Non-Crossover Crossover

PRACTICE:

1. Which of the following is not a type of DNA damage repair?
    a. Mismatch repair
    b. Base Excision repair
    c. Lost nucleotide repair
    d. Double Strand Break repair

2. Which of the following types of DNA damage occurs when a base is chemically converted into another base?
    a. Depurination
    b. Deaminatino
    c. Thymine Dimer

3. Which type of DNA repair is responsible for fixing bulky lesions through a “cut and paste” method?
    a. Base excision repair
    b. Mismatch Repair
    c. Nucleotide Excision Repair
    d. Homologous Recombination

4. True or False: Homologous recombination occurs directly after DNA replication?
    a. True
    b. False