# وراثة الأحياء الدقيقة
# Microbial Genetics

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## أساسيات في علم الوراثة
## Fundamentals of Genetics
## Lecture 8

# DNA repair systems

- DNA is the macromolecule repaired by cells.
- Repair mechanisms are divided to categories:
  - ***Damage reversal***- Restoring normal structure without breaking backbone.
  - ***Damage removal***- Cutting out and substituting a damaged or inappropriate base or section of nucleotides.
  - ***Damage tolerance***- Coping with damage.

# DNA repair systems

- **Damage reversal:**
  - **<u>Photoreactivation</u>**
    - Involves a single enzyme spliting pyrimidine dimers (breakdown the covalent bond) in presence of light- Photolyase enzyme- catalyzes this reaction.
    - Found in many bacteria, lower eukaryotes, insects, and plants.
  - **<u>Single strand breaks Ligation</u>**
    - X-rays and some chemicals can cause breaks in backbone of DNA.
    - DNA ligase repairs rapidly simple breaks in one strand.

# DNA repair systems

- **Damage removal:**
  - **Base excision repair**
    - Removal of the damaged or inappropriate base from its sugar linkage and replaced- glycosylase enzymes (cutting the base-sugar bond).
    - Uracil glycosylase-enzyme removes uracil from DNA (DNA replication or deamination of cytosine).
  - **Mismatch repair**
    - Occurs after DNA replication as a last "spelling check process“ (Accuracy-**Proofreading**).
  - **Nucleotide excision repair**
    - Works on DNA damage which is "large" and blocks DNA replication & transcription (UV-induced dimers).

# DNA repair systems

- **Damage removal:**
  - **<u>Nucleotide excision repair</u>**
    - Works on DNA damage which is "large" and blocks DNA replication & transcription (UV-induced dimers).
    - Cleavage of the DNA strand containing the damage by **endonucleases** followed by the removal of a short segment containing the damaged region by **exonuclease**.

# DNA repair systems

- **Damage tolerance:**
  - Not all DNA damage can be removed immediately as in some it may persist for a while- Eukaryotes.
  - DNA replication initiates at multiple sites.
  - Recombinational (daughter-strand gap) repair.
  - Mutagenic repair (trans-lesion synthesis)
    - Insert any nucleotide oppose to the dimer and continue replication ("mutate or die" scenario).

# PLASMIDS

- First discovered in the 1950s using *Escherichia coli.*
- Transfer of genetic information *depend on the presence* of a small “extra-chromosomal DNA” called F (fertility) factor “F factor”.
- Plasmids share some common features:
  - generally double-stranded.
  - closed circular DNA molecules.
  - capable of autonomous replication (independent of chromosomal replication).
  - Some plasmids, called “episomes”, commonly integrate into the bacterial chromosome.

# PLASMIDS

- A plasmid that can mediate its own transfer to a new strain is called a **conjugative plasmid vs nonconjugative.**
- Cryptic plasmids- no known identifiable function other than self-replication.
- **Partitioning assures that after replication each daughter cell** gets a copy of the plasmid.

# RECOMBINATION

- Ability of bacteria to integrate donor DNA into their genomes.
- Types of recombination:
  - **RecA-dependent "general recombination"-** require large regions of homology between donor and recipient DNA.
  - **RecA-independent:**
    - **site specific.**
    - **Illegitimate-**Insertion Sequences and Transposable Elements.

# RECOMBINATION

- The process of recombination can be viewed in six steps:
  - Strand breakage.
  - Strand pairing.
  - Strand invasion/assimilation.
  - Chiasma or crossover formation.
  - Breakage and reunion.
  - Mismatch repair.

# QUESTIONS??