Bacterial Genetics

Genetics is the study of heredity and variation to understand the cause of resemblance and differences between parents and their progeny. The term *genetics* was coined by William Bateson,
a British biologist, in 1906.
The unit of heredity is the ***gene***, a segment of deoxyribonucleic acid (DNA) that carries in its nucleotide sequence
information for a specific biochemical or physiologic property. All hereditary properties are encoded in DNA. Hence, the chromosomal
DNA plays an important role in the maintenance
of character from generation to generation. Genes carry the information to code for all the necessary components and the actions of life. The genes at each cell division are replicated and a copy is transmitted to each daughter cell

Gene

It is a segment of DNA that carries ***codons*** specifying for a particular polypeptide. A DNA molecule consists of a large number
of genes, each of which contains hundreds of thousands
of nucleotides. The DNA of a bacterial chromosome is usually arranged in a circular form and when straightened, it measures around 1000 ⌈. The length of DNA is usually expressed as kilobases
(1 kbp = 1000 base pairs, or bp). Bacterial DNA measures usually 4000 kbp and the human genome about 3 million kbp.

Mutation

Mutation is a random, undirected, and heritable variation seen in DNA of the cell. This is caused by a change in base sequence of DNA due to addition, deletion, or substitution of one or more bases in the nucleotide sequence of DNA. It can

involve any of the genes present in the bacterial chromosome. Mutation results in insertion of a different amino acid into a protein, resulting in the appearance of an altered phenotype.

Types of Mutations

Mutations are a natural event occurring in dividing cells. The frequency of mutations ranges from 10□2 to 10□10 per bacterium
per division. These occur spontaneously or are enhanced by different mutagens. Mutations are of three types: (*a*) base substitution,
(*b*) frame-shift mutation, and (*c*) mutations due to transposons or insertion sequences.

- **Mutation due to base substitution**

This type of mutation occurs when one base in the nucleotide sequence is inserted in place of another. This occurs during replication of DNA either due to an error in the function of DNA polymerase or due to a mutagen that alters the hydrogen bonding of the base being used as a template in such a manner that the wrong base is inserted. The base substitution mutation may be of two types: *missense mutation* and *nonsense mutation*.

A. Missense mutation: It is one in which the base substitution results in a codon that specifies a different amino acid to be inserted.

B. Nonsense mutation: It is another type of mutation in which the base substitution produces a terminal codon that stops synthesis of protein prematurely. Entire protein function is destroyed during the process of nonsense mutation.

- **Frame-shift mutation**

It is the second type of mutation. This occurs when one or more base pairs are added or deleted in the DNA. This, therefore, leads to shifting of the reading frame of the ribosome that results in incorporation of the wrong amino acids downstream from the mutation. Result of the frame-shift mutation ends in production of an inactive protein.

- **Mutation due to transposons or insertion sequence**

This is the third type of mutation that occurs when transposons

or insertion sequences are integrated into the DNA. These newly inserted pieces of DNA cause profound changes in the gene into which they are inserted and also causes changes in the adjacent genes.