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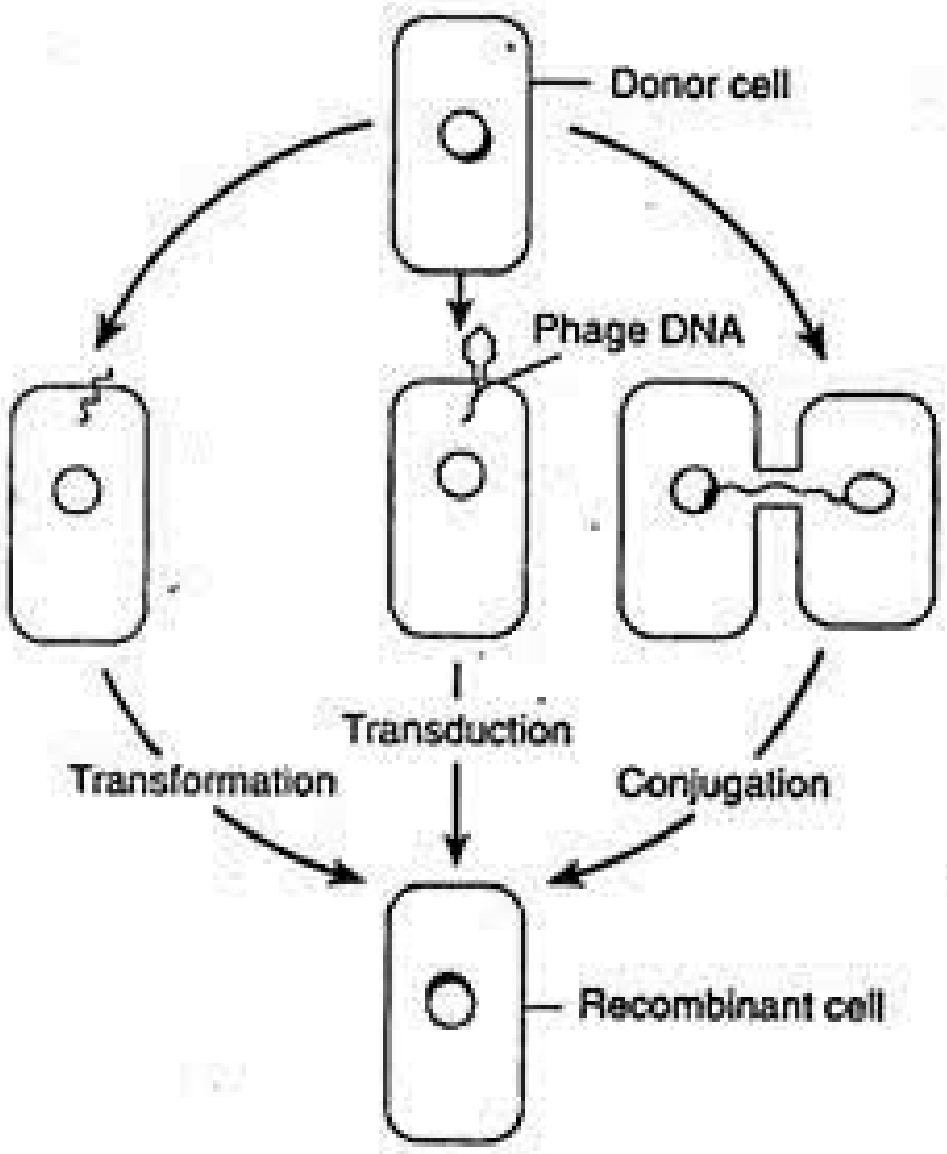
CORE CONCEPT OF

Microbiology

GENETIC RECOMBINATION IN BACTERIA

Many microbiologists refused to believe that bacteria had stable hereditary systems which could undergo permanent changes. But in 1943 Max Delbruck and Salvador Lauria through a classical experiment demonstrated that bacteria have stable hereditary mechanisms. The establishment of the similarity between the genetic systems of bacteria and higher forms of life resulted in the experimental use of Escherichia coli.The first demonstration of genetic recombination in bacteria was achieved by Lederberg and Tatum in 1946. They combined two different auxotrophic strains (strains that use only inorganic materials as a source of nutrients) of Escherichia coli and allowed to mate. They found nutritionally independent (prototrophic) colonies growing there. These must have been result of transfer of genetic material (DNA) from cell to cell and a recombination between the auxotrophs by conjugation and is indeed a true sexual fusion. But genetic recombination in bacteria is basically different from that of higher plants and animals. In genetic recombination there is the occurrence of progeny whose combination of genes are different from those that are present in the parents. In higher plants and animals genetic recombination is the fusion of two haploid genetic nuclei resulting in the development of a diploid nucleus. The complete genomes of both gametes are involved and recombination comes about from the independent assortment of chromosomes or by the process of crossing-over between homologous chromosomes. Whereas bacteria are free living organisms and are not differentiated into genetic and somatic cells. Each cell is a potential gamete. Bacteria displaying sexuality have cells which behave as gametes and are differentiated into two functional types : donors (or males) and recipients (or females). In bacteria only a fraction of the genetic constitution of the donor cell is transferred to recipient cell which contributes it's entire genome and cytoplasm resulting in the development of a mesozygote, a zygote that is incompletely diploid. The recombination chromosome is formed from DNA contributed by two different organisms.

The transfer of DNA from donor cells to recipient cells and recombinant forms can be accomplished by three distinct mechanisms :
1.cell conjugation (mating)
2. Transformation (uptake of naked soluble DNA from the environment) or
3. Transduction (bacteriophage infection)



In conjugation there is an actual cell-to-cell contact between the mating bacteria. The double stranded is closed. DNA opens and part of it is transferred through pili called sex pili which behave as bridges through which DNA is transferred from donor to recipient cells. The amount of DNA is transferred is directly related with the duration of conjugation between the mating bacterial cells. Donors contain a small circular piece of DNA called the fertility cell or F factor or F+. Recipients are as F-. Donor F+ strain donates only a small portion of its genome, whereas donor Hfr strain donates large portion of its genome to the recipients . Sex-factor-DNA is an episome which sometimes replicates autonomously in the bacterial cytoplasm and at other times integrated into the bacterial chromosome DNA and replicates

with it.

In transformation, the DNA paases between the bacteria as a naked molecule, and nucleic acid can be isolated in active form from the medium separating the bacteria. The fragments of DNA are taken up by the recipient cells. This fragment is known as exogenote takes place recombination with the recipient bacterial chromosome.

Transduction has been demonstrated in several bacterial species. This technique is used for making new bacterial strains. In isogenization the agency is a temperate phase, whose DNA on entering into the bacterial cell remains attached to the DNA of the host bacterial cell, reproduces along with it.