RAMA UNIVERSITY

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FACULTY OF ENGINEERING &TECHNOLOGY
DEPARTMENT OF BIOTECHNOLOGY

Transformation, conjugation, transduction

Transformation

Bacterial transformation is a process of horizontal gene transfer by which some bacteria take up foreign genetic material (naked DNA) from the environment.

It was first reported in *Streptococcus pneumoniae* by Griffith in 1928.

DNA as the transforming principle was demonstrated by Avery et al in 1944.

❖The process of gene transfer by transformation does not require a living donor cell but only requires the presence of persistent DNA in the environment.

❖The prerequisite for bacteria to undergo transformation is its ability to take up free, extracellular genetic material.

❖Such bacteria are termed as competent cells.

❖Once the exogeneous free DNA is brought into the cell, it may become integrated into the recepient's genome by homologous recombination.

❖Recepient cells that undergo this process and acquire a new phenotype as a result are said to be transformed.

❖This phenomenon allows only the uptake of DNA from the same or related species.

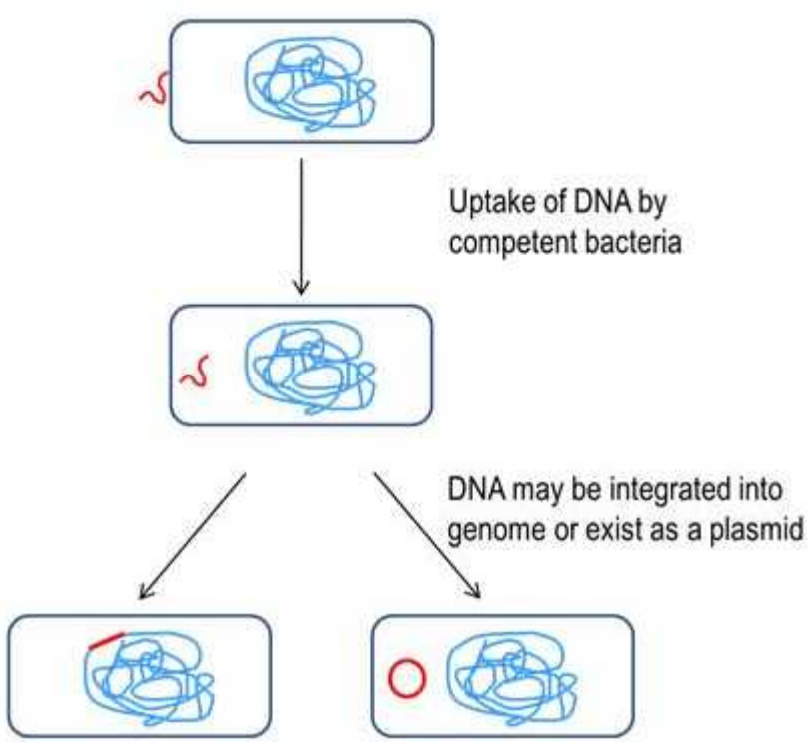

Figure: Schematic representation of transformation in bacteria

Reasons for Transformation

The phenomenon of natural transformation has enabled bacterial populations to overcome great fluctuations in population dynamics and overcome the challenge of maintaining the population numbers during harsh and extreme environmental changes.

During such conditions some bacterial genera spontaneously release DNA from the cells into the environment free to be taken up by the competent cells.

The competent cells also respond to the changes in the environment and control the level of gene acquisition through natural transformation process.

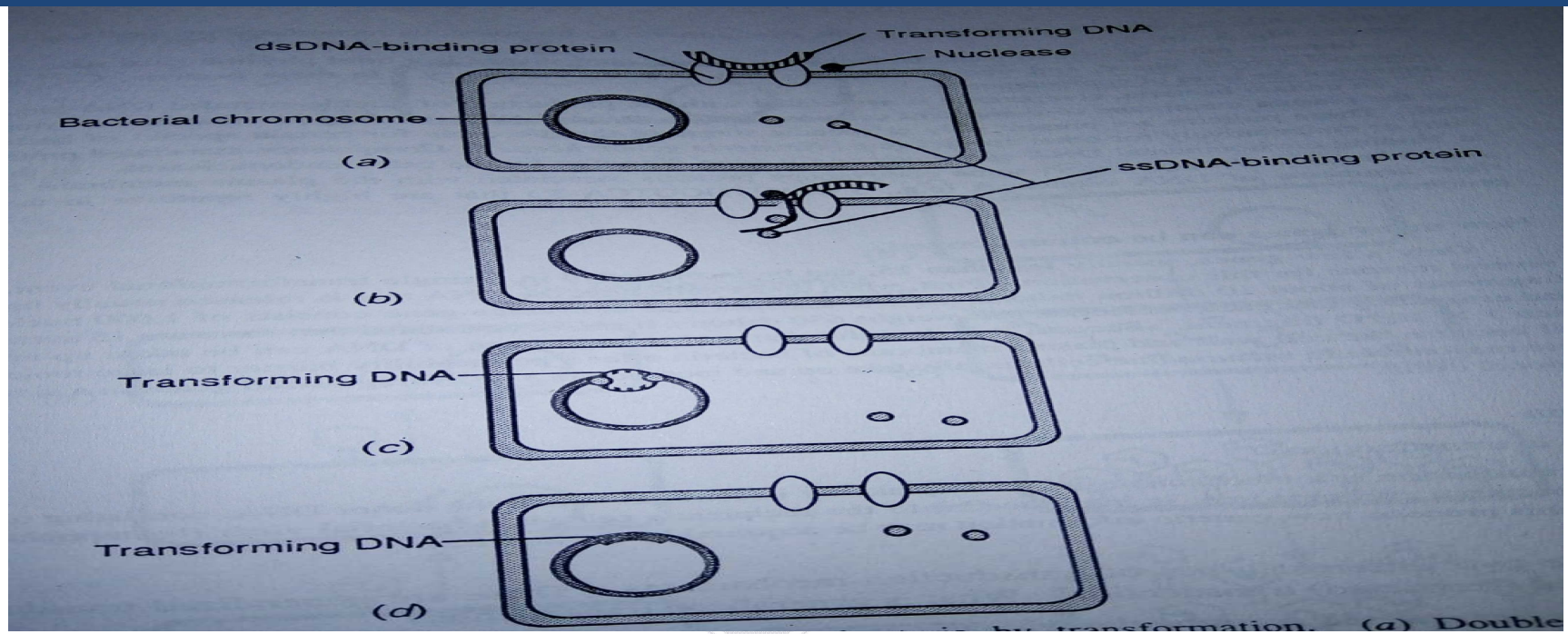

Figure: Mechanism of DNA transfer in *E.col (bacteria)*: (a) Double stranded DNA (dsDNA) attaches to membrane-bound dsDNA binding protein. (b) one of the two strands of transforming DNA passes into the cell while the other strand is degraded by a nuclease. (c) The single stranded DNA (ssDNA) within cell is bound by ss-DNA binding protein. During this process, homologous recombination takes place and the transforming DNA is incorporated into the bacterial chromosomes. The integrated ssDNA is converted ino dsDNA by DNA polymerase I. (d) The transformed cell contains the segment of transforming DNA incorporated into its genome.

Competence of Bacteria

Some bacteria are naturall competent cells such as *Haemophilus influenza*, *Bacillus subtilis* and *Streptococcus pneumonia*.

But not all bacteria are capable of taking up exogenous DNA from their environment.
The practical approach to acquire competent cells is to make the bacterial cells artificially competent using chemicals or electrical pulses.

Chemical induction of competence involves the following steps:

chilling the cells in the presence of calcium phosphate to make them permeable incubation with DNA

heat shock treatment at 42°C for 60-120 seconds that causes the DNA to enter the cells