

Plasmids

Presented by

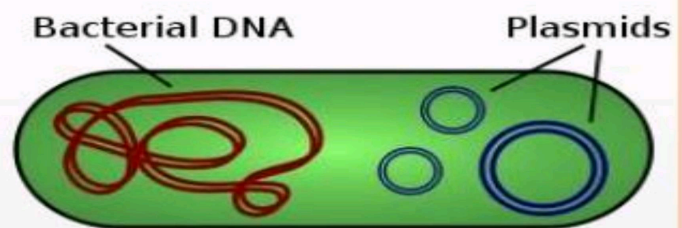
Dr.P.POONGOTHAI

Department of microbiology

NKR Govt Arts College for women, Namakkal

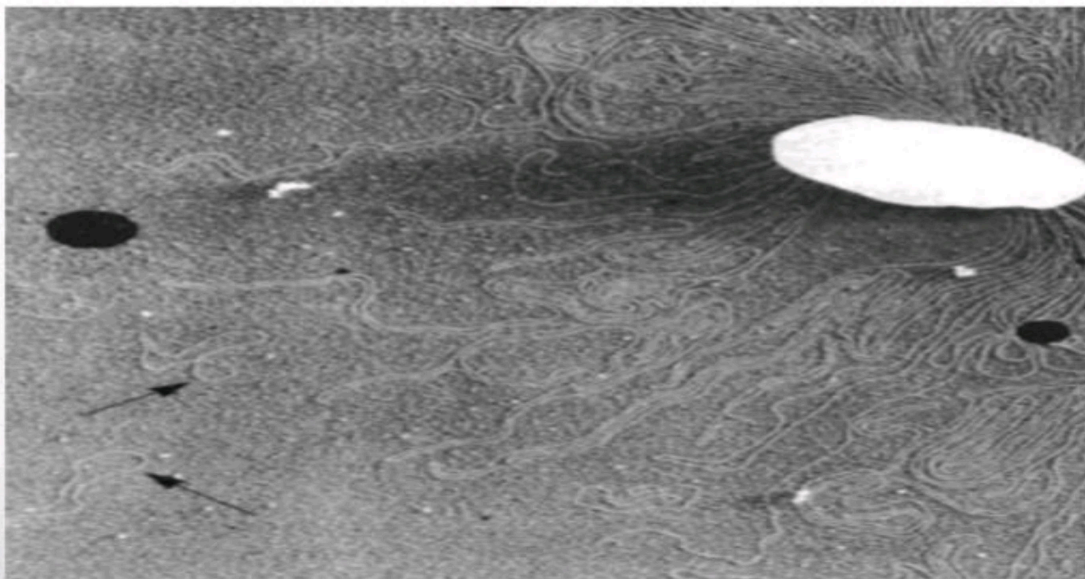
Bacterial Plasmids

❖ The term *plasmid* was first introduced by the American molecular biologist Joshua Lederberg in 1952.



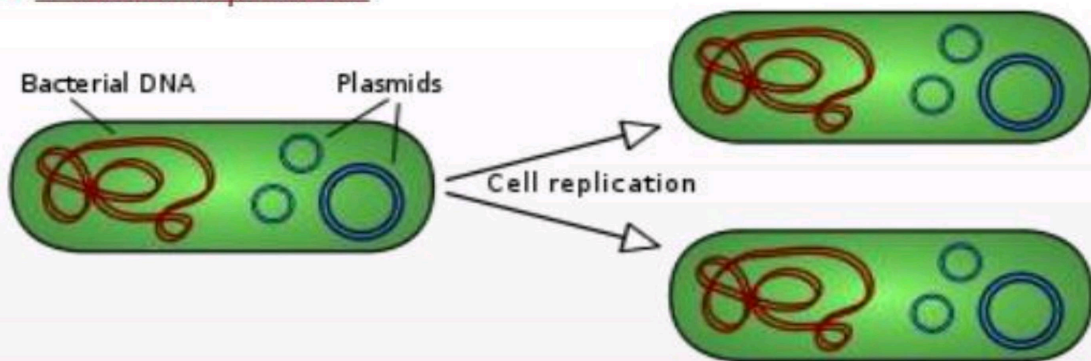
❖ A plasmid is a short, usually circular, and double-stranded segment of DNA that is found in the cytoplasm separate from the main bacterial chromosome.





The bacterial chromosome and bacterial plasmids, as shown in the electron microscope. The plasmids (arrow) are the circular structures, much smaller than the main chromosomal DNA.


❖ Plasmid Replication

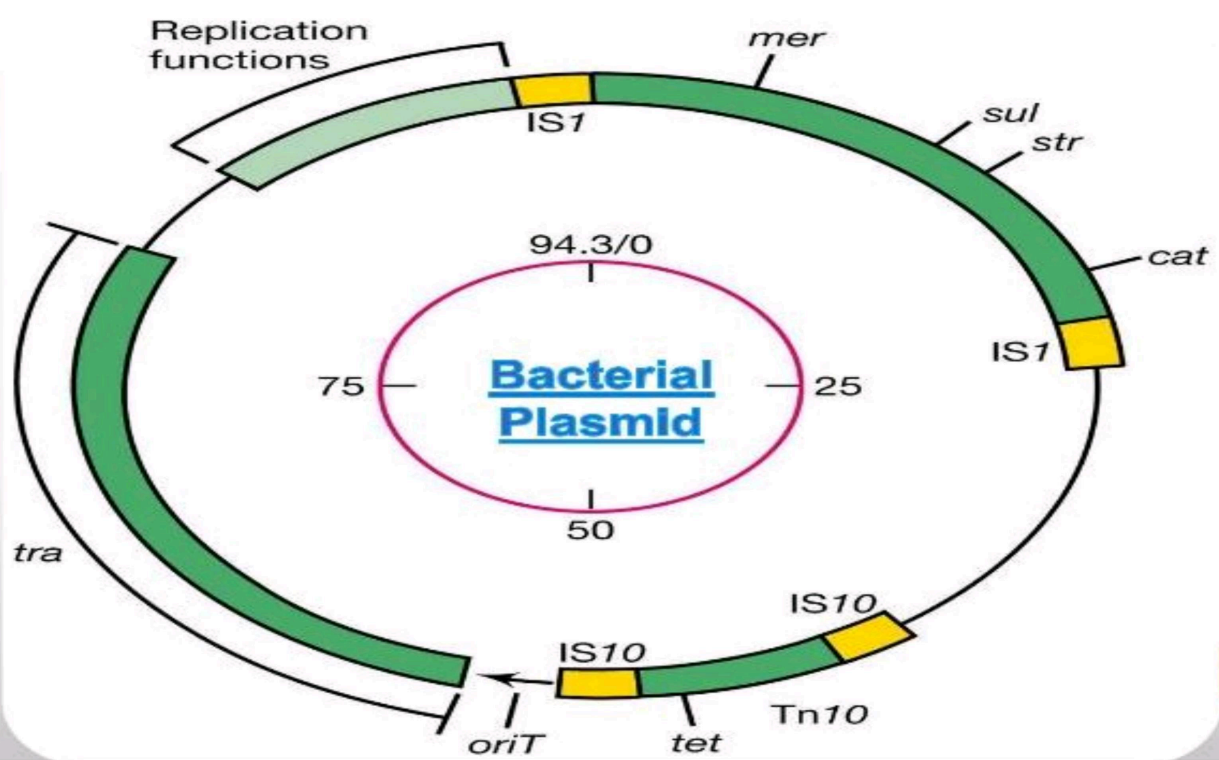


Plasmids carry genes that direct their own replication and additional factors that ensure that the copies get separated into the new daughter cells. This ensures that the plasmids are not lost from the cells during binary fission.



Plasmid features

- ❖ Plasmid sizes vary from 1 to over 1,000 kbp.
 - ❖ They usually contain 5 to 100 genes and usually carry genes that are useful but not essential to survival: e.g. genes which make bacteria resistant to antibiotics.
 - ❖ As long as the bacterium is thriving in a low-stress environment, removing all the plasmids would not affect the ability of the bacterium to survive.
 - ❖ **Specifically, plasmids are nonessential, extrachromosomal pieces of DNA.**
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Classification Of Plasmids.

I. Based on their ability to transfer to other bacteria.

- a) **Conjugative plasmids** - contain *tra* genes, which perform the complex process of conjugation, the transfer of plasmids to another bacterium.
e.g., F plasmid, many R plasmid & some Col plasmid.



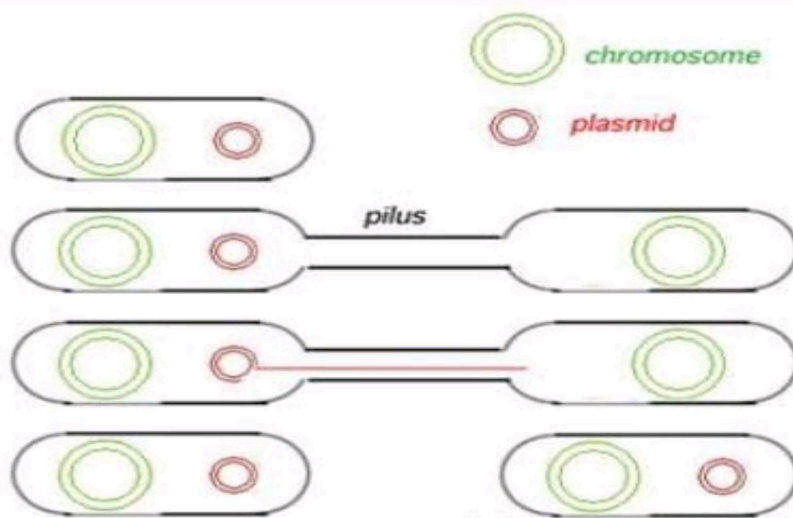
b) **Non-conjugative plasmids** - incapable of initiating conjugation, hence they can be transferred only with the assistance of conjugative plasmids.

e. g., many R plasmid & most Col plasmid.

c) **Mobilisable plasmid** - An intermediate class of plasmid. They carry only a subset of the genes required for transfer. They can parasitize another plasmid, transferring at high frequency in the presence of a conjugative plasmid.




The sexual transfer of plasmids to another bacterium through a pilus.

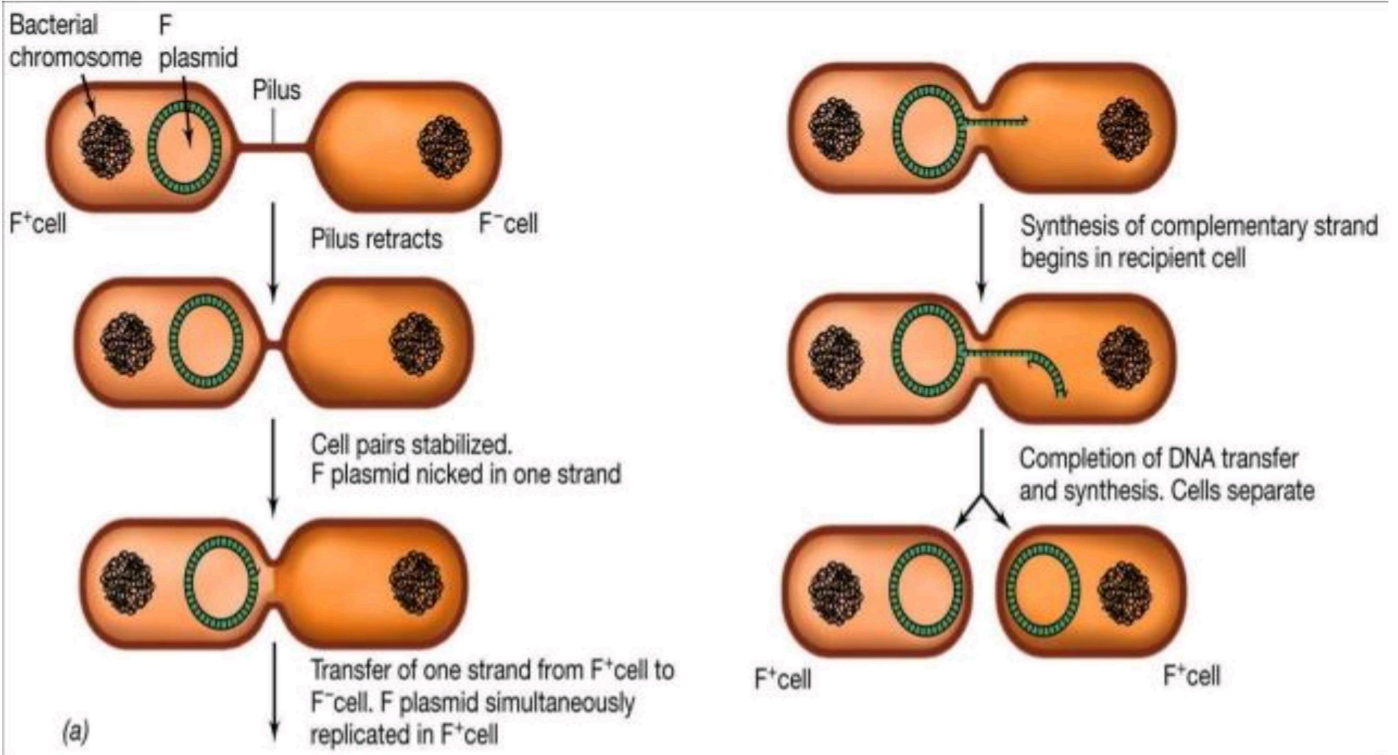


jp herveg y m barcia-macay, 2005



II. Based on function.

- a) **Degradative plasmids** – They are able to digest unusual substances like toluene and salicylic acid.
e.g., TOL plasmid of *Pseudomonas putida*.
 - b) **Virulence plasmids** – contains *vir* genes which turn the bacterium into a pathogen.
e. g., Ti & Ri plasmids
 - c) **Fertility (F)-plasmids** - contain *tra* genes. They are capable of conjugation and result in the expression of sex pilli.
Example: F plasmid of *E. coli*.
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d) Resistance (R)plasmids – contain genes that provide resistance against antibiotics or poisons. Historically known as R-factors, before the nature of plasmids was understood. e. g., pRP4 of *Pseudomonas sp.*

e) Col plasmids - contain genes that code for bacteriocins & toxins that can kill other bacteria. e. g., ColE1



III. Based on copy number.

- a) **Stringent Plasmid** – It replicates only along with the main bacterial chromosome & is present as a single copy, or at most several copies, per cell.

- a) **Relaxed Plasmid** – It replicates within a cell independently of the chromosomal DNA replication. Thus multiple copies of plasmids are present.



IV. Based on compatibility

It is possible for plasmids of different types to coexist in a single cell. Several different plasmids have been found in *E. coli*. However, related plasmids are often incompatible, in the sense that only one of them survives in the cell line, due to the regulation of vital plasmid functions. Thus, plasmids can be assigned into incompatibility groups.



Uses of plasmids

- ❖ Plasmids serve as important tools in genetics and biotechnology labs, where they are commonly used to multiply (make many copies of) or *express* particular genes.
- ❖ Disease Models - Plasmids were historically used to genetically engineer the embryonic stem cells of rats in order to create rat genetic disease models.



❖ Gene therapy- plasmid vectors are used for the insertion of therapeutic genes at pre-selected chromosomal target sites within the human genome.

❖ Another major use of plasmids is to make large amounts of proteins. In this case, researchers grow bacteria containing a plasmid harboring the gene of interest.
eg: insulin & antibiotics.



