Extrachromosomal Genetic Elements (Plasmids)

- In some prokaryotes (Bacteria) and Eukaryotes, apart from its large circular and spiral chromosomes there are other genetic elements that called Plasmid .
- Extrachromosomal Genetic Elements ,can be found in the cytoplasm of a bacteria (Plasmid) ; and also they may be joined with the chromosome (Episome).

- genetic information carried by the plasmid is not required or essential for the bacterium's life. Without them bacteria can develop, live and reproduce.
- But plasmids give opportunities to bacteria, e.g Resistance to antibiotics and metals, adhesion, fermentation, pathogenicity, Proteolytic activity and virulence.

- NATURAL PLASMİDS
- Gram positive and Gram negative microorganisms have natural plasmids. They are genetic elements with DNA characteristic and their size is about 1-2% of the Chromosome Length.

- Large plasmids that found in Bacteria can transfer their specific genes or themselves to those of their own type. (Conjugative Plasmids)
- Small plasmids, on the other hand, may transfer with the help of the large plasmid (Nonconjugative Plasmids).

Classification of Plasmids

- 1) By size : Very small plasmids : $1\text{-}10*10^6$ Small Plasmids: $10\text{-}50*10^6$

  Large Plasmids: Larger than given values .

2) By Incompatibility Features

3) By conjugative Features

4) By the specific sequence they carry

   a) F- factor (Fertility factor): Sex Pili. (high-frequency recombination) Hfr cells transfer their chromosome and F factor to F- Bacterias and they become F+ Bacteria.

- b) Col Plasmid (Colicinogenic Plasmid): will cause the death of the species who synthesize Colisin. Bacteriocins and Bacteriocinogenic Plasmids are the general name for this kind.
- Y. Pestis: Pestisin; M. tuberculosis: Tuberculosin
- E. coli: Colisin
- K. pneumonia: Pneumosin
- L. Monocytogenes: Monosin

- c) R- Plasmids: These plasmids called as Resistens Plasmids. They may transfer by conjugation and transduction from a bacteria to other bacteria.

- d) Virulence plasmids : They provide or increase the virulence. Removal of this plasmid from a bacteria makes the bacteria avirulent.
- Among the factors that produce virulence we can name : capsule, synthesis of toxic substances, hemolysin, adhesion molecules and bacteriocins.

MİCROORGANİSMS NAME	PLASMİD	CODED SUBSTANCE
B. anthracis	Pox1 Pox2	Toxin Formation Capsule Formation
C. tetani	Plasmid 75 md	Beta Toxin
E. coli	CFA 1-2, E8775	Colonization Factor Enterotoxin(LT, ST)

- e) Other Plasmids: Metabolic plasmids, plasmids encoding the synthesis of enzymes which ferment various substances.

- ARTIFICIAL PLASMIDS
- In vitro conditions with the desired DNA sequences or plasmids with genes to synthesize , It is used with success in cloning.

TRANSPOSONS

- Are double-stranded linear genetic elements with DNA characteristics connected with the chromosome or plasmid in the bacterium that can be displaced at the same time mutually on chromosome or plasmid. They have particular genes which are important for the resistance to the antibiotics .

- Transposons;
- Can transfer new genes to the host and bring new characters to the host.
- Can active or deactive the genes in the area it combined to or settled.

TRANSFER of GENETIC SUBSTANCES in BACTERIA

- In natural conditions part of a bacterial DNA can be transferred to another bacteria. If the transferred DNA have the high homology with the DNA of other bacteria, DNA can be integrated to the genome and if the transferred DNA carry a gene , can make it positive in terms of character for recipient bacteria. Natural gene transfer among bacteria happens with the 3 ways:

1) TRANSFORMATION

- A bacterial DNA fragments taken up spontaneously by another bacterial cell as a food. This event may occur in vitro and in vivo conditions. In this way the features related to bacterial pathogenicity or resistance to antibiotics can pass to another bacteria.

GRIFFITH'S EXPERIMENT (S. pneumonia)

S type live virulent strains — injected to mouse → Mouse(dead) Septicemia

S type dead — injected to mouse → Mouse not dead

R type
live
virulent

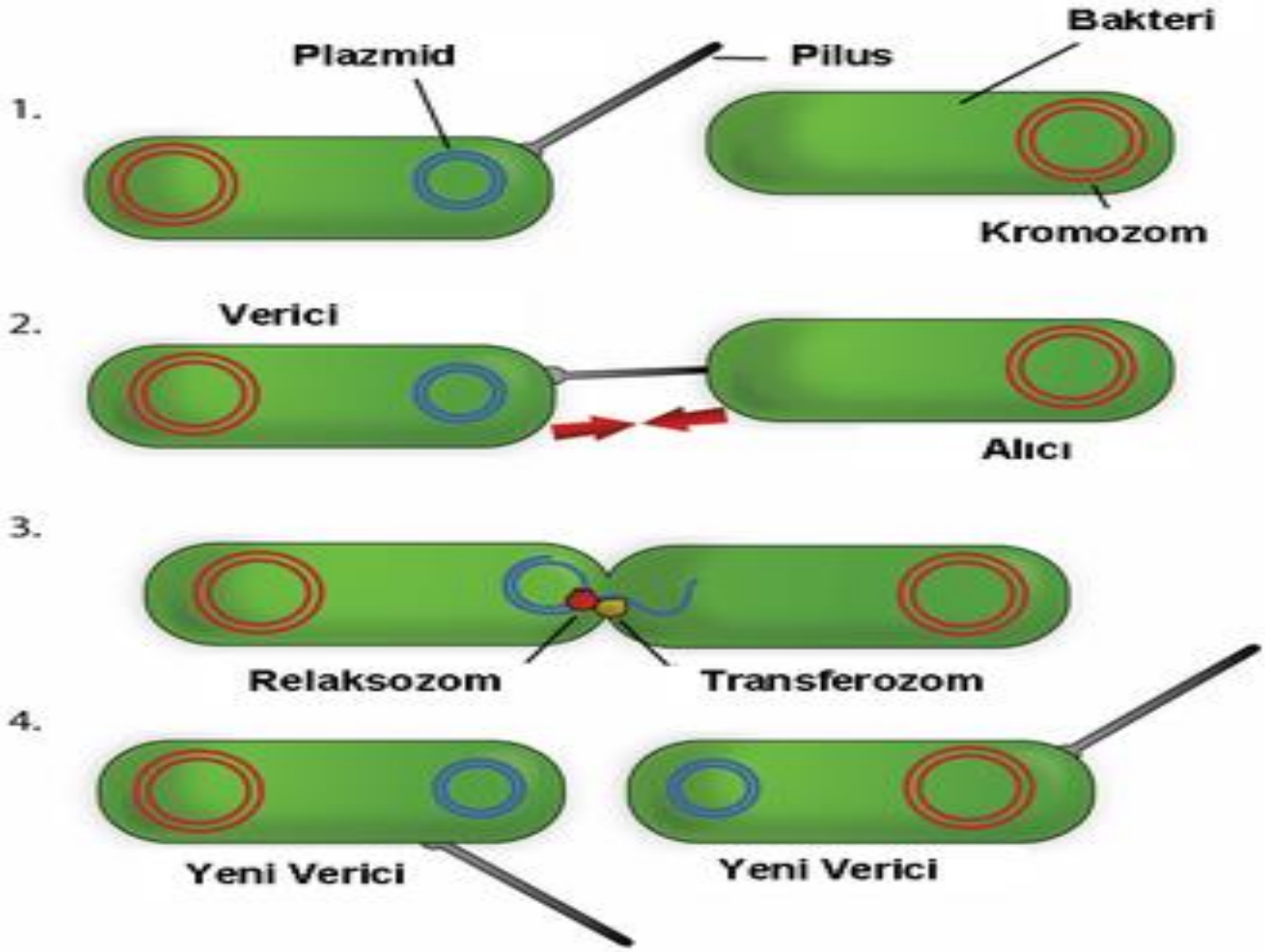
injected to mouse → Mouse not dead

S. pneumonia+S. pneumonia → Mouse dead+Septicemia

in mouse blood S- type S. pneumonia and live

2) CONJUGATION

- A portion or all of the bacterial DNA transferred from a living bacteria to another with sex pilus or direct contact . The events of sex pilus formation and conjugation are usualy directed by plasmids. Conjugation in natural conditions is the most important way of transferring virulence factor and antibiotic resistance genes.


Bakteri
Plazmid
Pilus
1.
Kromozom
Verici
2.
Alıcı
3.
Relaksozom
Transferozom
4.
Yeni Verici
Yeni Verici

3) TRANSDUCTION

- DNA of the donor bacteria is transferred to recipient bacteria by phages. After phage leaves the bacteria and infect to other bacteria, DNA that staying in phages structure during the assembly of the phage in to donor bacteria, will be transferred to other bacteria.
- Transduction is carried out in 3 ways :

A) GENERALIZED TRANSDUCTION

- In this event when phage matures in bacteria a piece of hosts shattered DNA enters into the phage capsid accidentally. Thus, phage carry a foreign DNA in its capsid. If this is combined with the DNA recipient bacterial DNA , it make the receiver positive in terms of the character it is carrying.

B) SPECIALIZED TRANSDUCTION

- Phage is localized to a specific point of hosts DNA and turn into prophage. If this phage is activated by factors such as UV radiation, it cuts off the DNA in the area it Merged, and leaves the cell with a piece of DNA. When it enters another bacteria, gets the DNA of other bacteria into the receiver.

C) ABORTİVE TRANSDUCTİON

- Transported DNA, does not integrate into the recipients DNA , it only remains within the cell. This piece of DNA is not replicated simultaneously with the recipient DNA. However, it will make the receiver cell positive in terms of the character it is carrying.