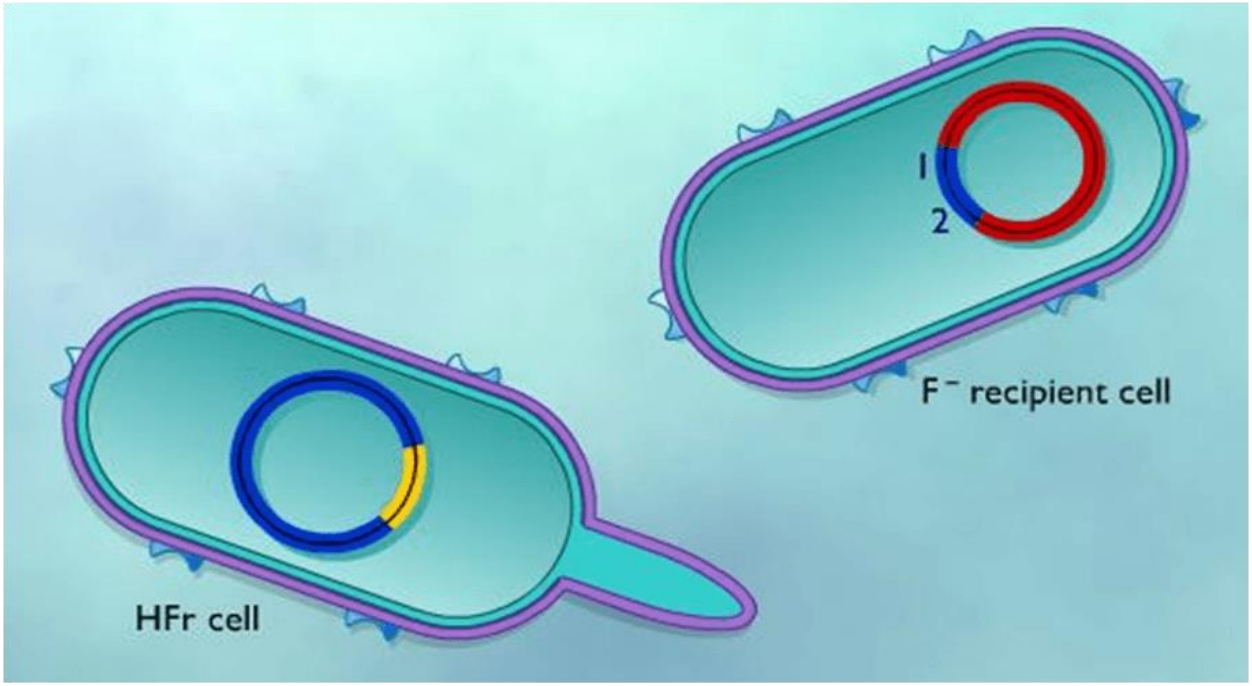
GENETIC RECOMBINATION IN BACTERIA (CONJUGATION)



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For B.Sc. (Hons.) Part I Paper 1 Group C (Microbiology)

Lecture No. 26

Genetic Recombination ????

Mixing of genetic materials of bacterial species into new combinations is known as genetic recombination.

- Most bacterial genome consists of a circular chromosome that contain single DNA molecule, several base pair in length with approximately3000-4000 genes. For example genome of *E. coli* have approximately 4.6 million base pairs of DNA .
- However, exceptions are also to the above example.

✓ Some bacteria contain multiple chromosomes. e.g. *Vibrio cholerae*

✓ Few bacteria also have linear chromosomes. e.g. *Borrelia burgdorferi*

Genetic recombination in bacteria takes place by-

1. Conjugation
2. Transformation
3. Transduction.

➢ The process of genetic exchange in bacteria differ from sexual reproduction of eukaryotes in the following important ways

✓ The genetic exchange brings about horizontal genetic transfer.

✓DNA exchange and reproduction are not coupled in bacteria

✓Exchange (donated) genetic material that is not recombined into the host DNA is usually degraded, so recipient remains haploid.

✓Gene transfer in bacteria is unidirectional from a donar to recipient cell and donar usually gives small part of its DNA to the recipient, so complete zygotes are not formed , rather partial zygote **(merozygotes)** are formed.

1. Conjugation

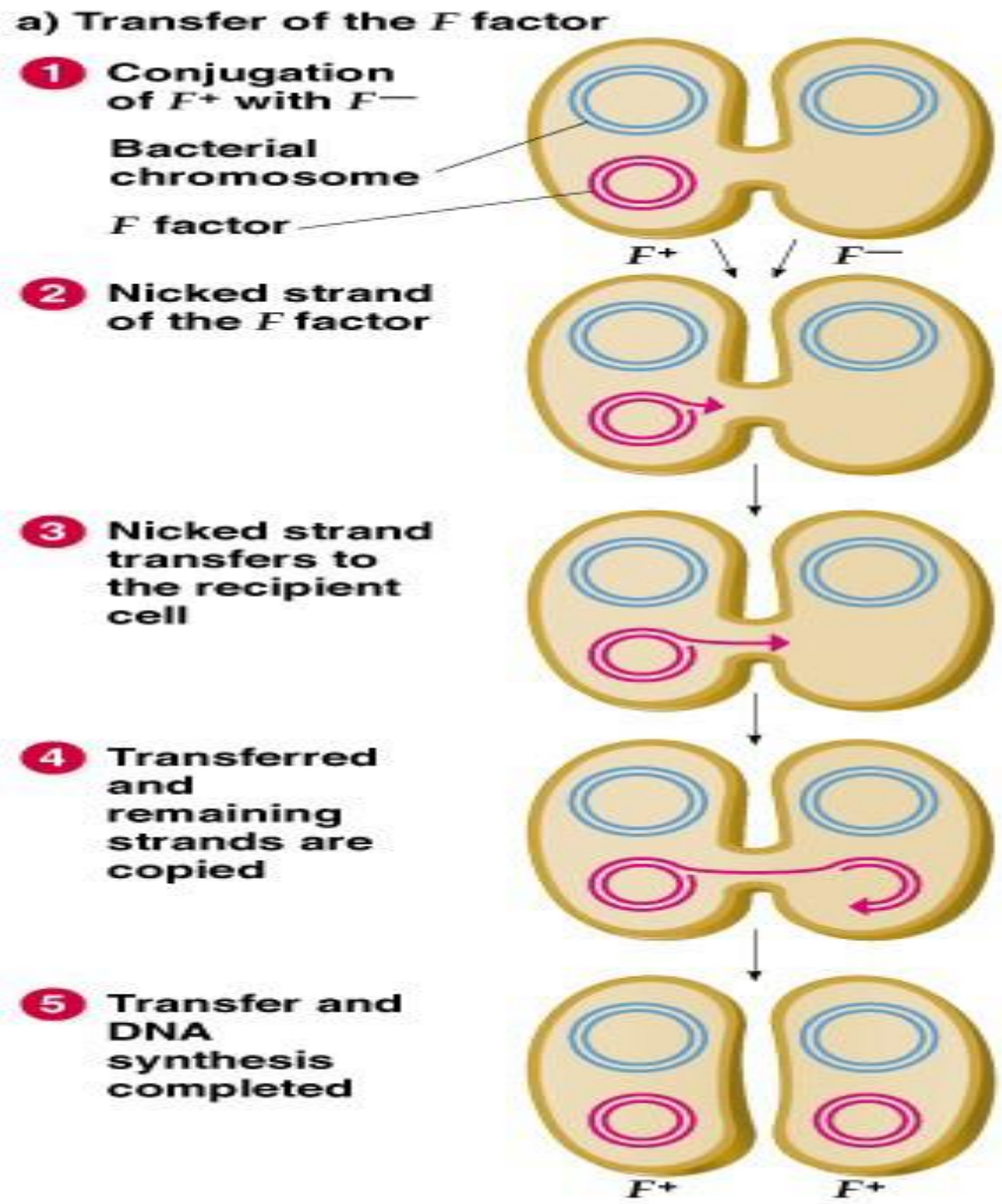
➢ Conjgugation takes place when genetic material passes directly from one bacterium to another bacterium with the help of conjugation tube.

➢The process was first postulated by Joshua Lederberg and Edward Tatum (1946) in *Escherichia coli* and awarded the Nobel Prize in 1958 for their work on bacterial genetics

➢The mechanism could be understood following the works of Bernard Davis in 1956.

- In conjugation two bacteria lie close together and a connection form between them.
- A plasmid or the part of bacterial chromosome posses from one cell (donar) to the another (recipient).
- In conjugation DNA is transferred from donar to the recipient , with no reciprocal exchange of genetic material.
- In most bacteria conjugation depends on a fertility (F) factor that is present in donar cell and absent in the recipient cell . The cells that contain F are referred as F^+ and the cell lacking F are F^-
- The F factor contains an origin of replication and a number of genes required for conjugation .
- A cell containing F factor produces a sex pili that makes contact with a receptor on F^- cell and pulls the two cells together.
- DNA is then transferred from F+ to F- cells.
- Conjugation can takes place only between the cell that possess F and a cell that lacks F.
- In majority of cases the only genes transferred during conjugation between an F+ and F- cells are those on the F factor.

- Replication takes place on the nicked strand, proceeding around the circular plasmid and replacing the transferred strand.
- The plasmid in the F+ cell is always nicked at Ori site, this site always enters the recipient cell first followed by rest of the plasmid.
- Inside the recipient cell, the single strand replicates and producing a circular double stranded copy of F plasmid.
- Transfer is initiated when the F plasmid is nicked at the origin. One end of the nicked DNA separates from the circle and passes into the recipient.
- If the entire F factor is transferred to the recipient F- cells become an F+ cell.
- When transfer is complete, both cells are F+ double-stranded.
- The transfer of F factor shown in the diagram.

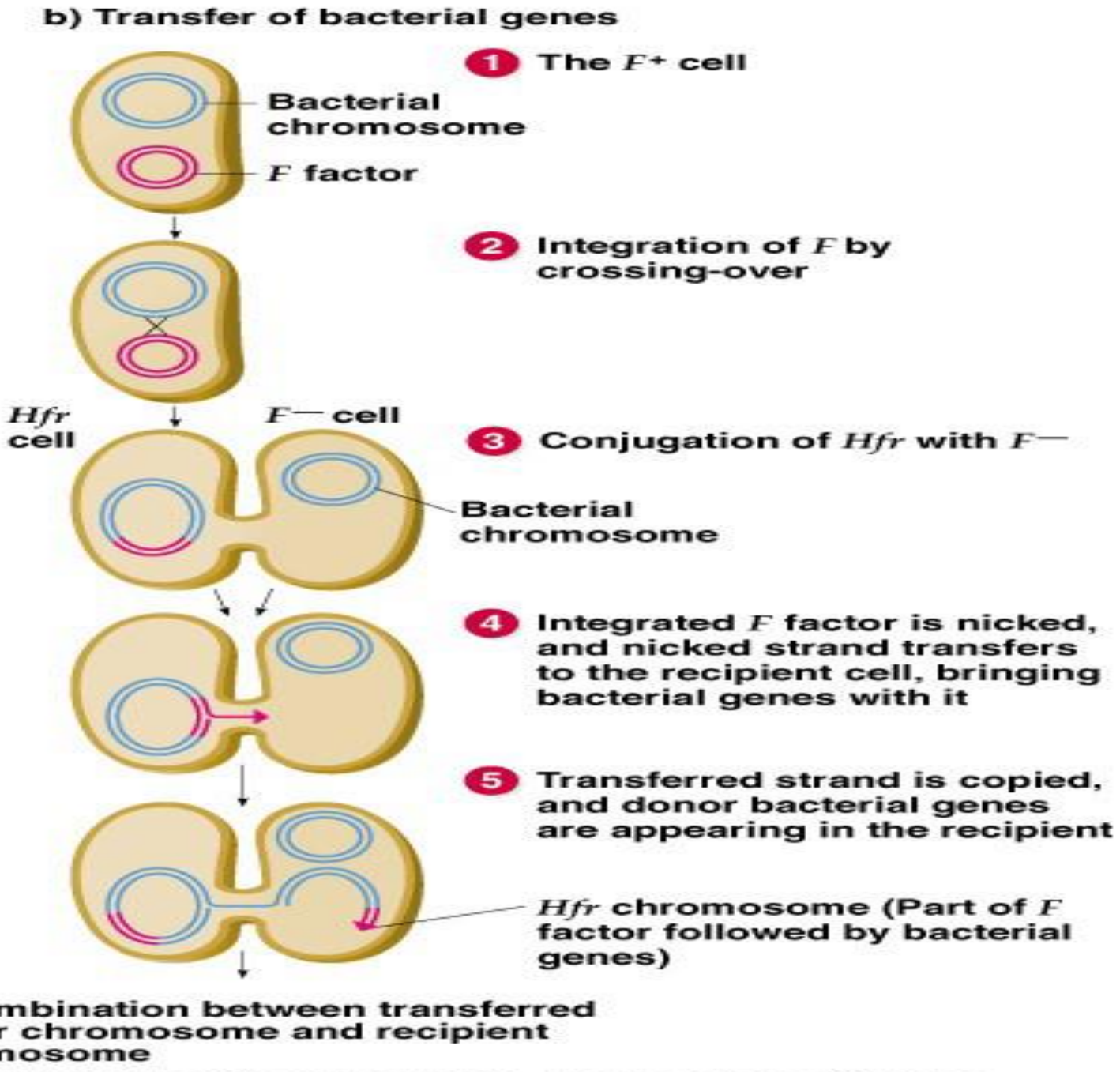


Conjugation of high-frequency recombinant strains

- In Hfr (high frequency recombination) strains, the F factor is integrated into bacterial chromosome.
- The Hfr cell behave as F+ cells, forming sex pili and undergoes conjugation with F- cells.
- Hfr strains replicate F factor as part of their main chromosome.
- Conjugation in Hfr strains begins when F+ is nicked at the origin, and F+ and bacteria chromosomal DNA are transferred into the F- cell just as it does in conjugation between F+ and F- cell (using the rolling circle mechanism).
- In Hfr cell the F factor is linked to bacterial chromosome and so chromosome follows it into the recipient cell.
- How much of the bacterial chromosome is transferred is depend on the length of time the two cells remain in conjugation.
- In mating of Hfr x F- , the F- cell almost never become F+ or Hfr, because the F factor is nicked in the middle during the initiation of strand transfer.

- To become F+ or Hfr, the recipient cell must receive the entire F factor, requiring that the entire bacterial chromosome is transferred.
- This events occur rarely because most conjugating cell break apart before the entire chromosome has been transferred.

- When a F factor is excise from the bacterial chromosome , a small amount of bacterial chromosome may be removed with it, and these chromosomal genes will then be carried with the F plasmid.
- F plasmid with some bacterial genes are called **F prime** . They act as donors.



Note- Transformation and Transduction will be presented in next lecture

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Thank You!!!