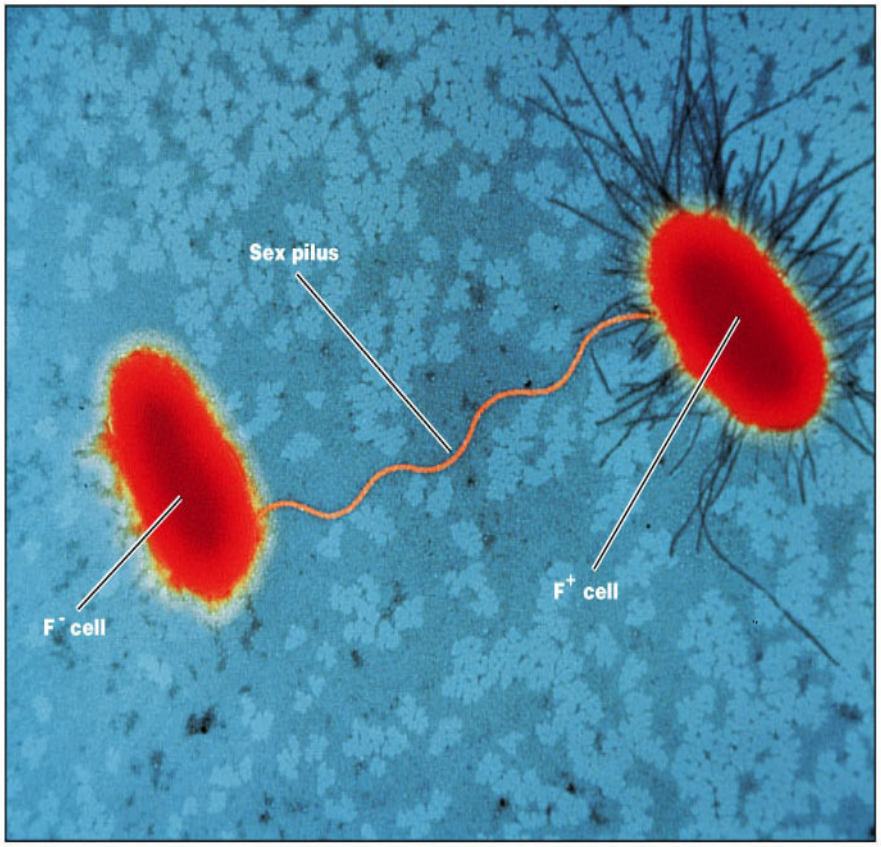
Lecture 31

BT 206

24 April 2023

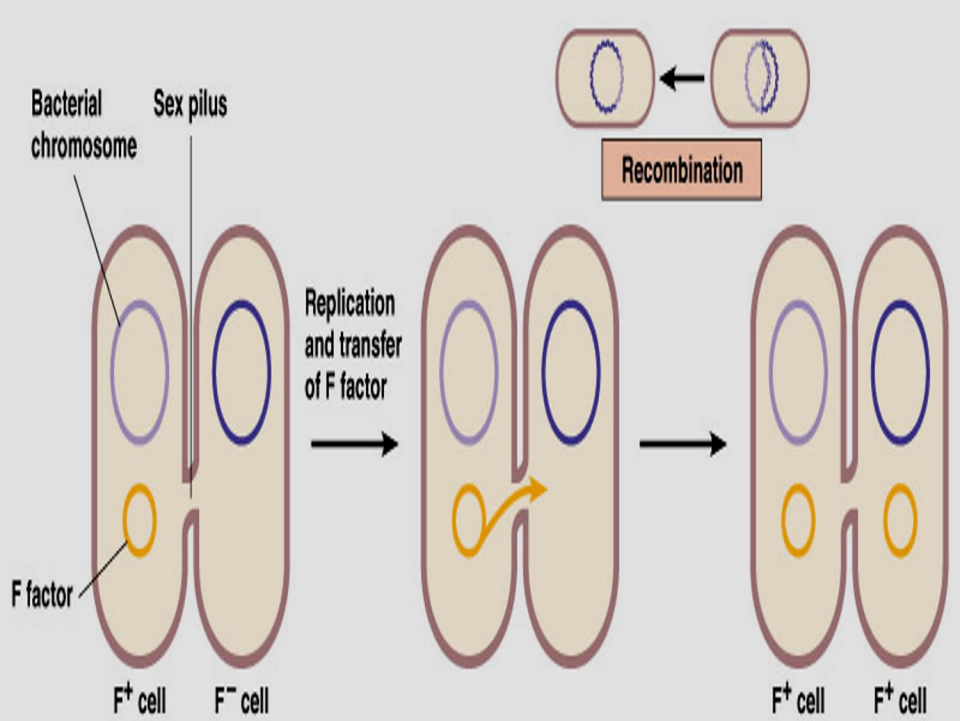
Conjugation

- Conjugation
  - Involves plasmid
    - Circular piece of DNA
    - Replicates independent of chromosome
    - Non essential for growth genes
  - Requires cell to cell contact
  - Opposite mating type
    - Donor cell carries plasmid
    - Recipient cell lacks plasmid



Conjugation

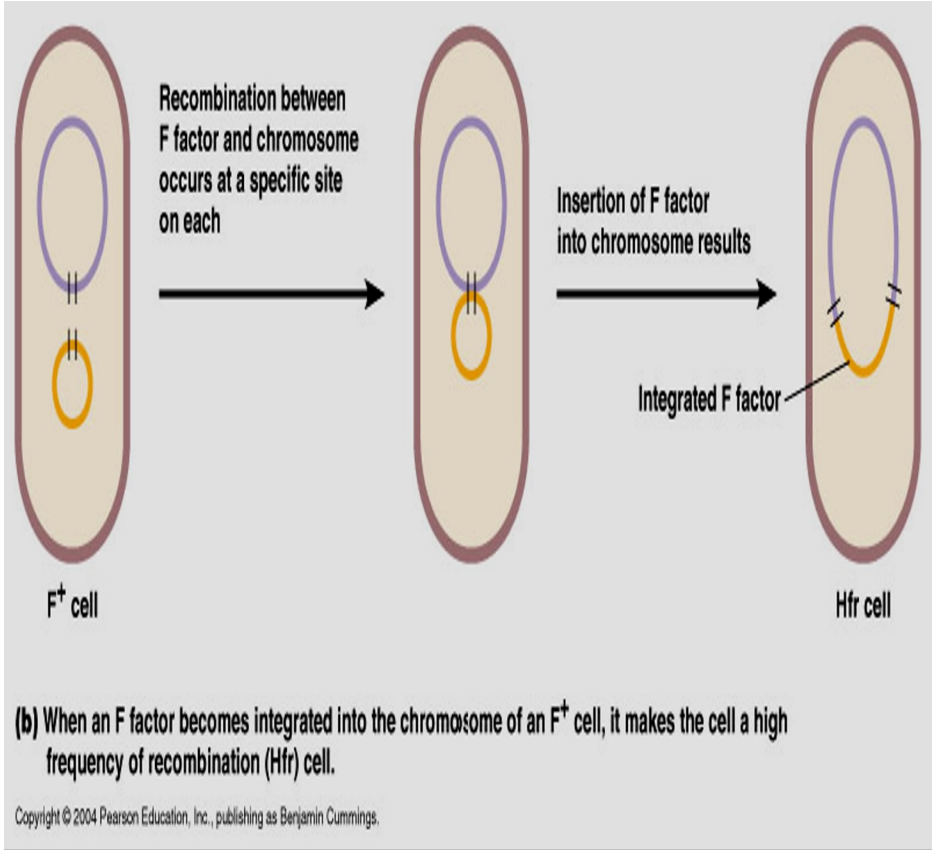
- Gram positive
  - Sticky surfaces cause bacteria to come in contact with one another
- Gram negative
  - Utilize sex pili



(a) When an F factor (a plasmid) is transferred from a donor (F^+) to a recipient (F^-), the F^- cell is converted into an F^+ cell.

Conjugation

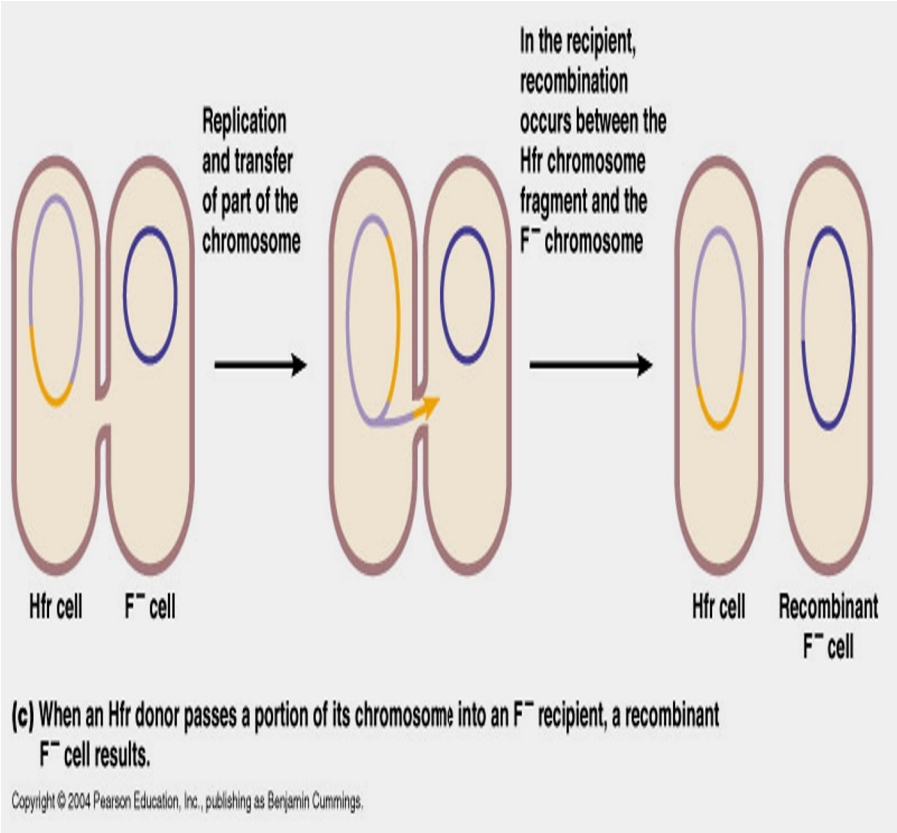
- *E coli* model
  - F factor plasmid
    - Fertility factor
    - Donors (F^+)
    - Recipients (F^-)
      - Converted to (F^+)
  - F^+ factor integrated into chromosome
    - Becomes Hfr (high frequency of recombination) cell



(b) When an F factor becomes integrated into the chromosome of an F^+ cell, it makes the cell a high frequency of recombination (Hfr) cell.

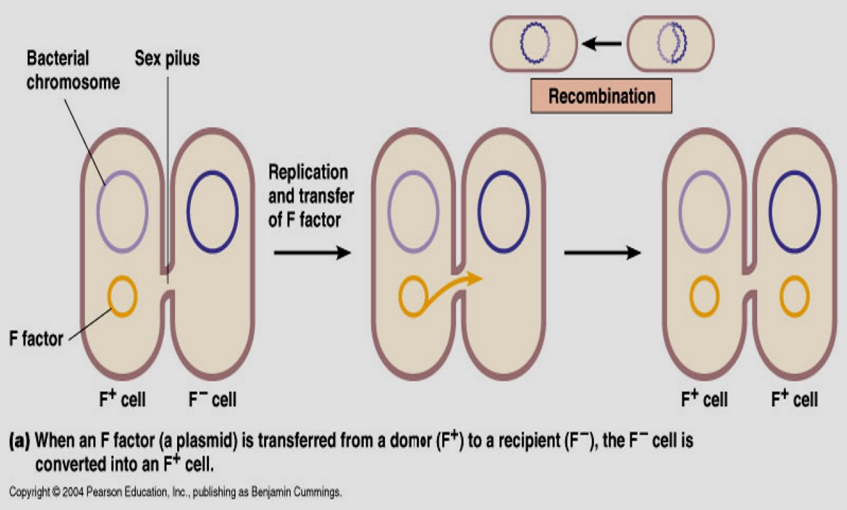
Bacterial Conjugation

- Hfr conjugates with F^- cell
- Chromosomal strand replicates and transferred to recipient
- Incomplete transfer of donor DNA
- Recipient integrates new DNA
  - Acquires new versions of chromosome
  - Remains F^- cell

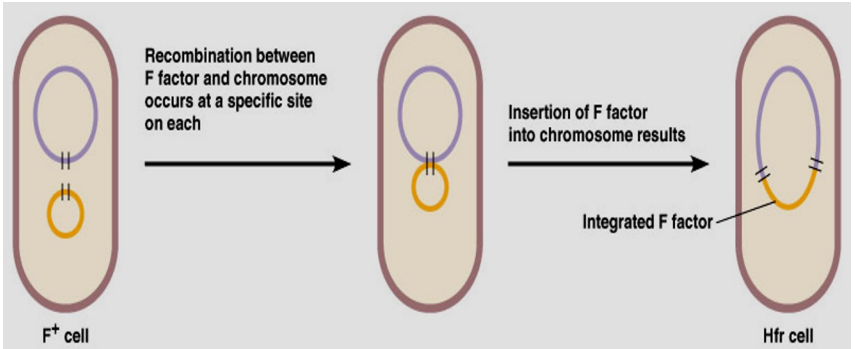


(c) When an Hfr donor passes a portion of its chromosome into an F^- recipient, a recombinant F^- cell results.

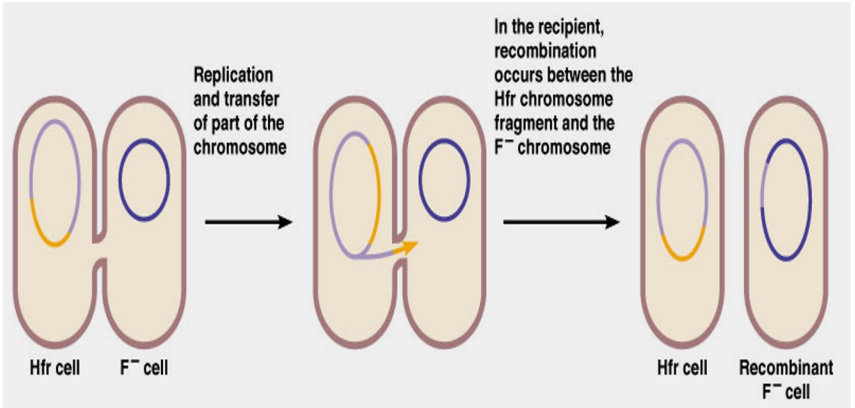
Conjugation in *E. coli*



(a) When an F factor (a plasmid) is transferred from a donor (F^+) to a recipient (F^-), the F^- cell is converted into an F^+ cell.



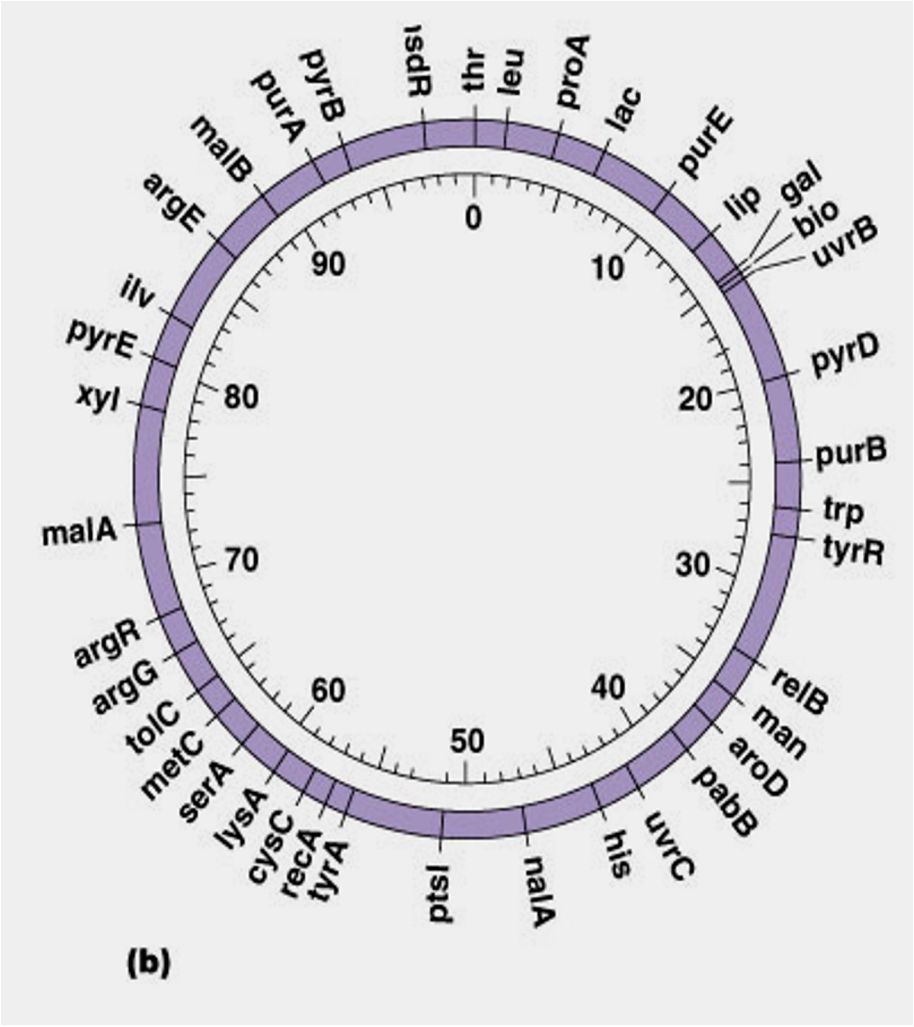
(b) When an F factor becomes integrated into the chromosome of an F^+ cell, it makes the cell a high frequency of recombination (Hfr) cell.



(c) When an Hfr donor passes a portion of its chromosome into an F^- recipient, a recombinant F^- cell results.

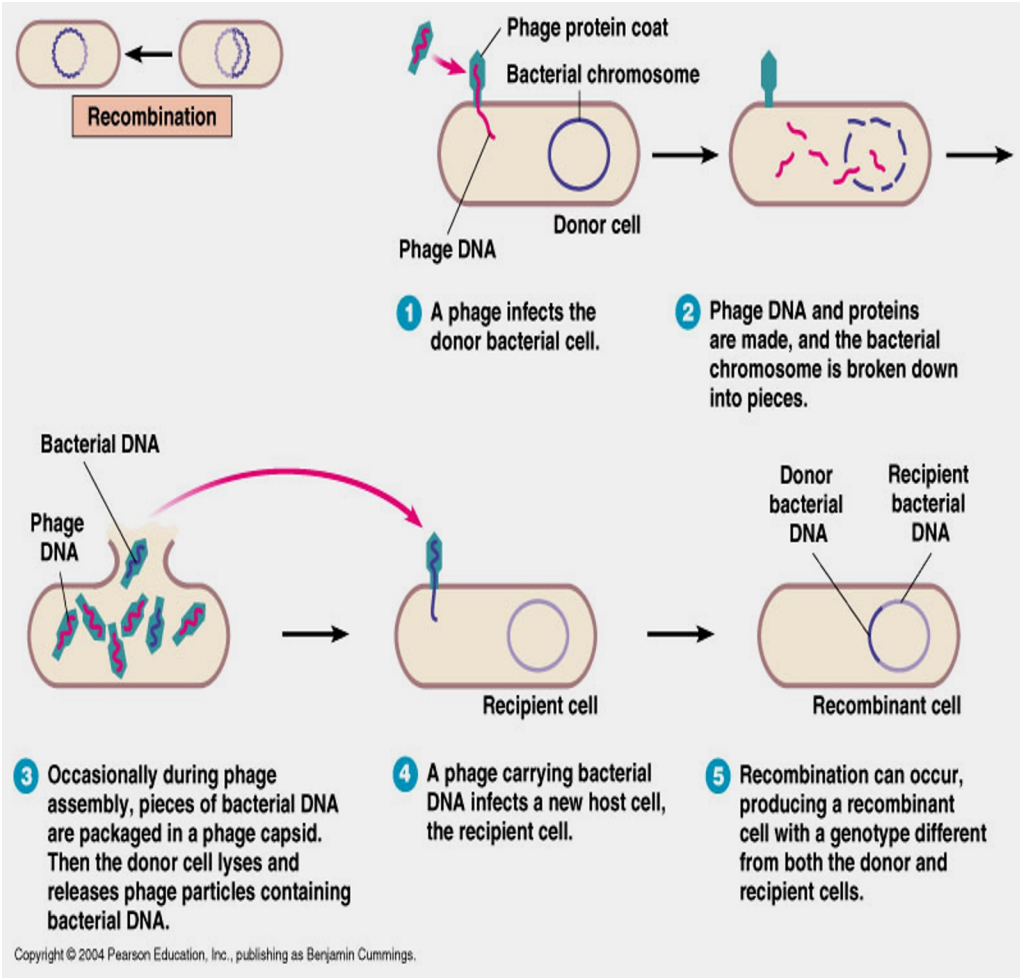
Conjugation

- Minutes and conjugation
  - Identify locations of various genes
  - Hfr
    - His, pro, thr, leu, and F (+)
  - F(-)
    - His, pro, thr, leu, and F(-)



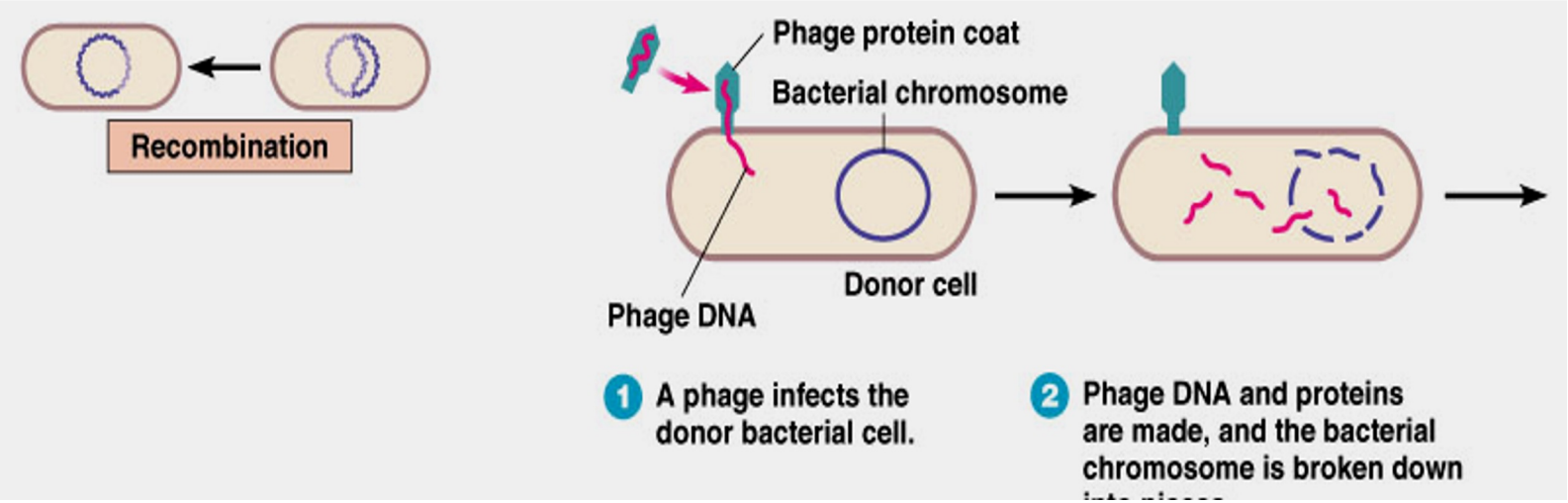
Transduction in Bacteria

- Transfer of bacterial DNA via bacteriophage
- Bacteriophage
  - Virus that infects bacteria



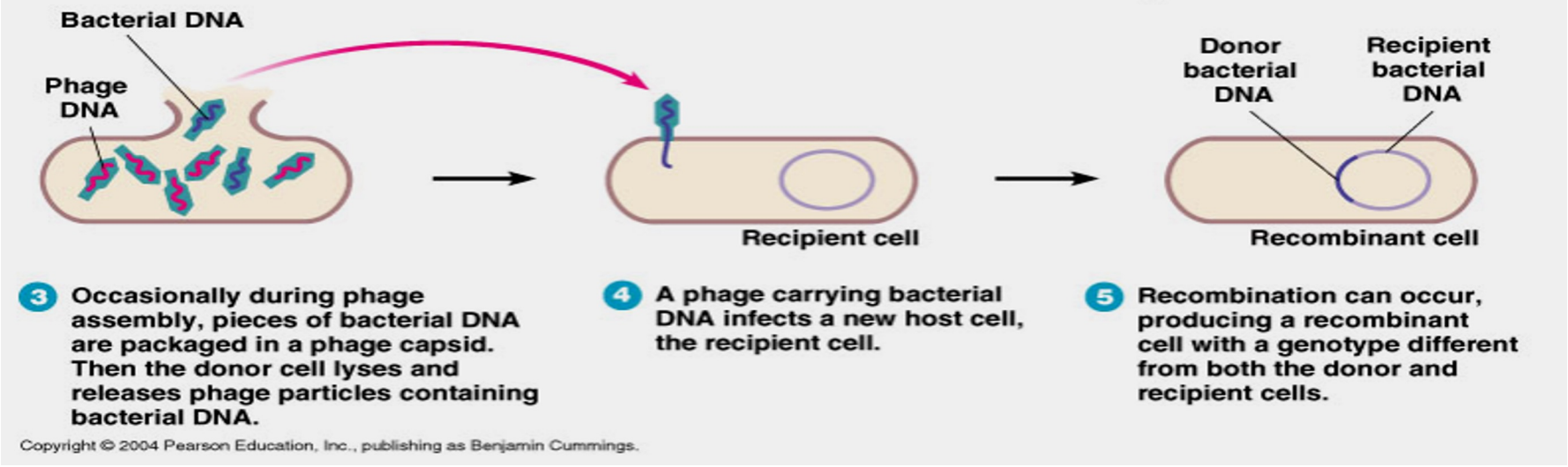
Transduction

- Steps of transduction
  - 1- bacteriophage infects donor bacterial cell
  - 2- Phage DNA and proteins, and bacterial chromosome is broken into pieces



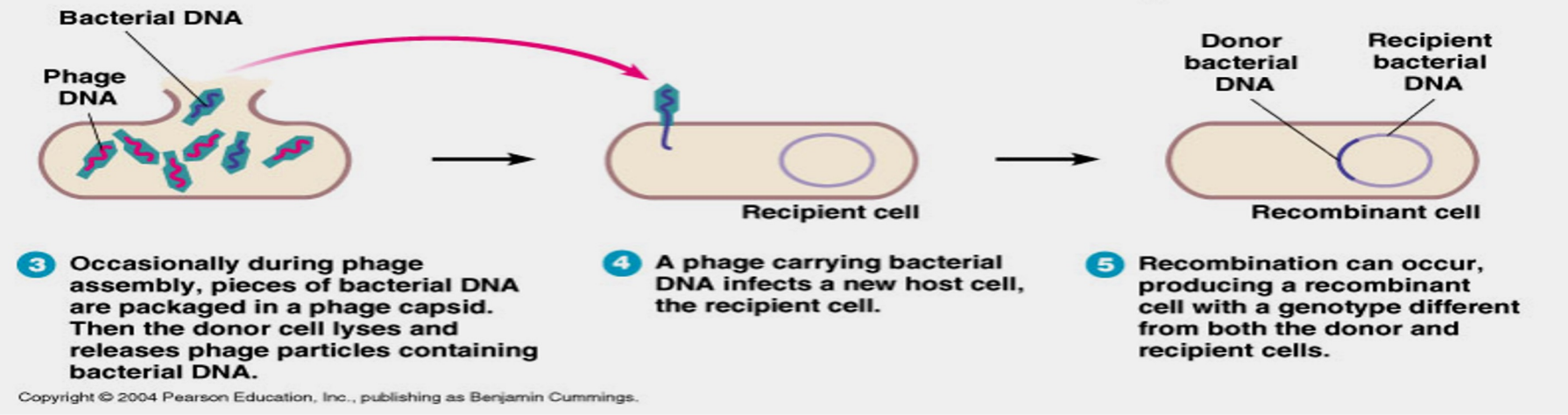
Transduction

- Steps of transduction
  - 3- during phage reassembly, bacterial DNA incorporated in capsid of bacteriophage
  - 4 – donor cell lysis releasing new bacteriophage particles



Transduction

- Steps in transduction
  - 5- phage carrying donor DNA infects new recipient cell
  - 6- recombination can occur
    - Producing bacteria with genotype different than donor and recipient

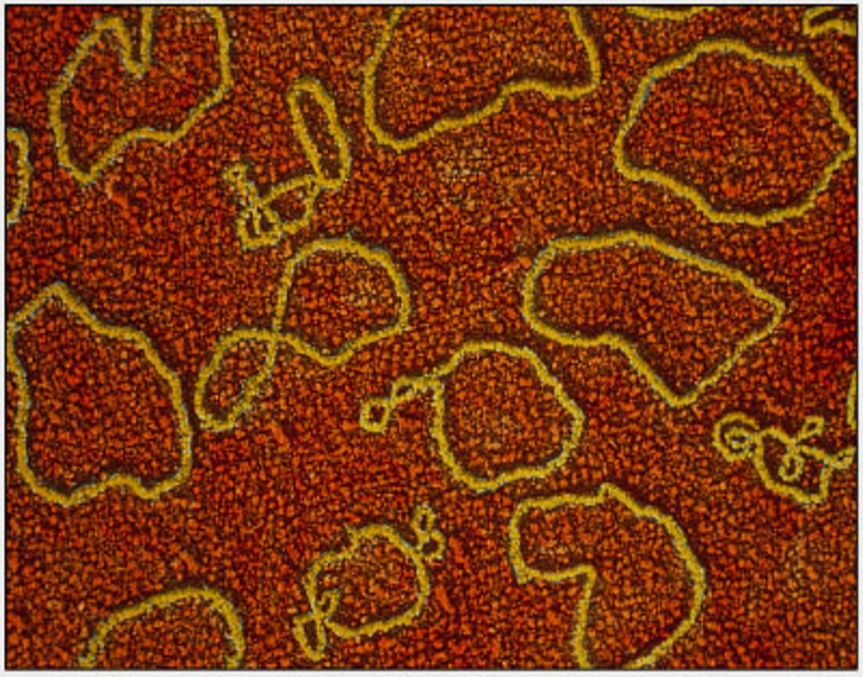


Transduction

- Generalized transduction
  - Previously explained
- Specialized transduction
  - Only certain genes are transferred
  - i.e. phage codes for toxins to be produced
    - *Cornybacterium diphtheriae* – diphtheria toxin
    - *Streptococcus pyogenes* – erythrogenic toxin
    - *Escherichia coli* – Shiga toxin (hemorrhagic diarrhea)

Plasmids

- Plasmids
  - Self replicating rings of DNA
  - 1-5% size of chromosomal DNA
  - Non – essential genes
  - Conjugative plasmid
    - F factor
  - Dissimilation plasmids
    - Code for enzymes to breakdown unusual sugars and hydrocarbons
    - Help in survival of unusual environments



(a)

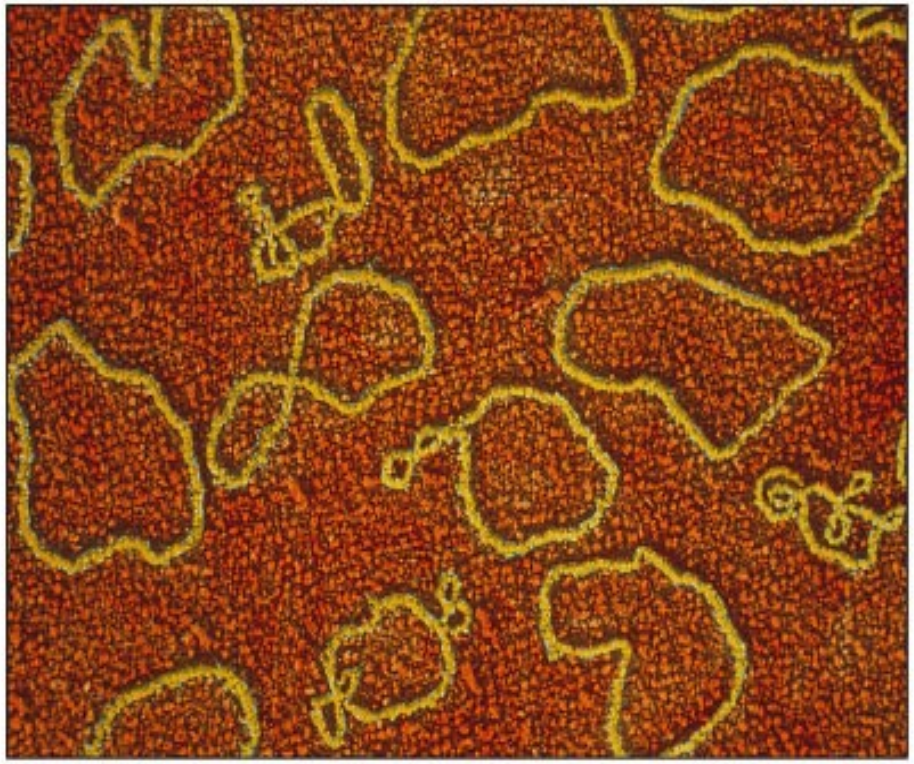
Plasmids

- Other plasmids
  - Toxins (Anthrax, tetanus, Staph)
  - Bacterial attachment
  - Bacteriocins
    - Toxic proteins that kill other bacteria
  - Resistance factors (R factors)
    - Resistance to antibiotics, heavy metals, cellular toxins

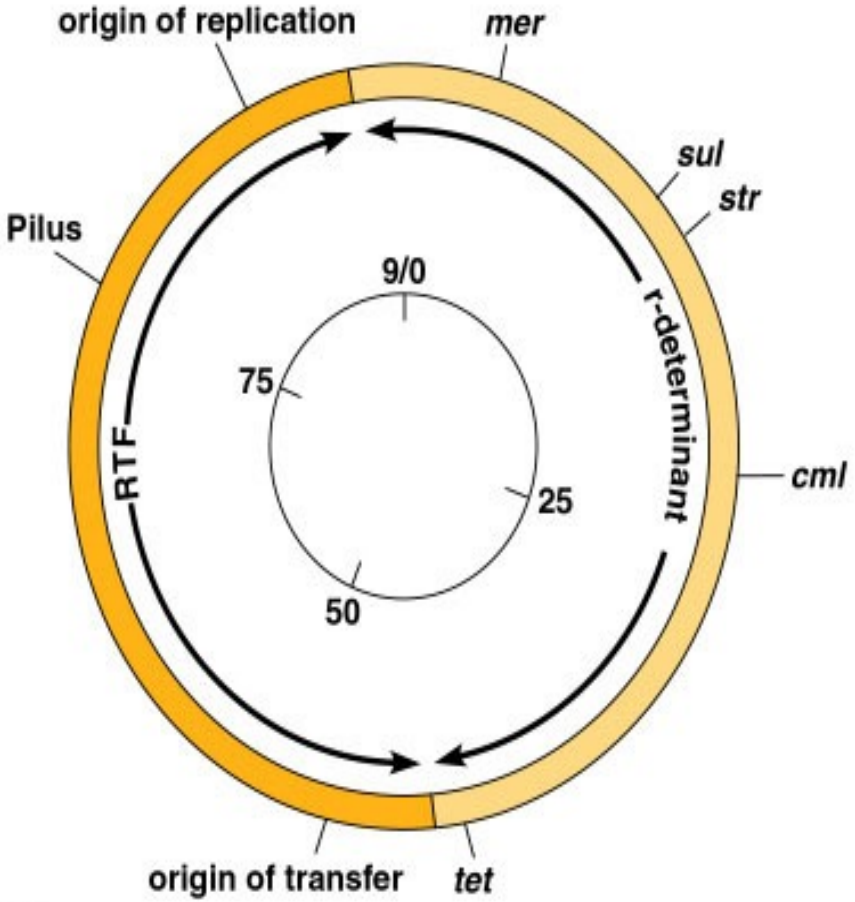
Plasmids

- Resistance factors
  - Two groups
    - RTF – resistance transfer factor
      - Includes genes for plasmid replication and conjugation
    - r-determinant
      - Resistance genes
      - Codes for production of enzymes that inactivate drugs or toxic substances
- Bacteria can conjugate and transfer plasmids between species
  - *Neisseria*
    - Penicillinase resists penicillin

R factor Plasmids



(a)



(b)

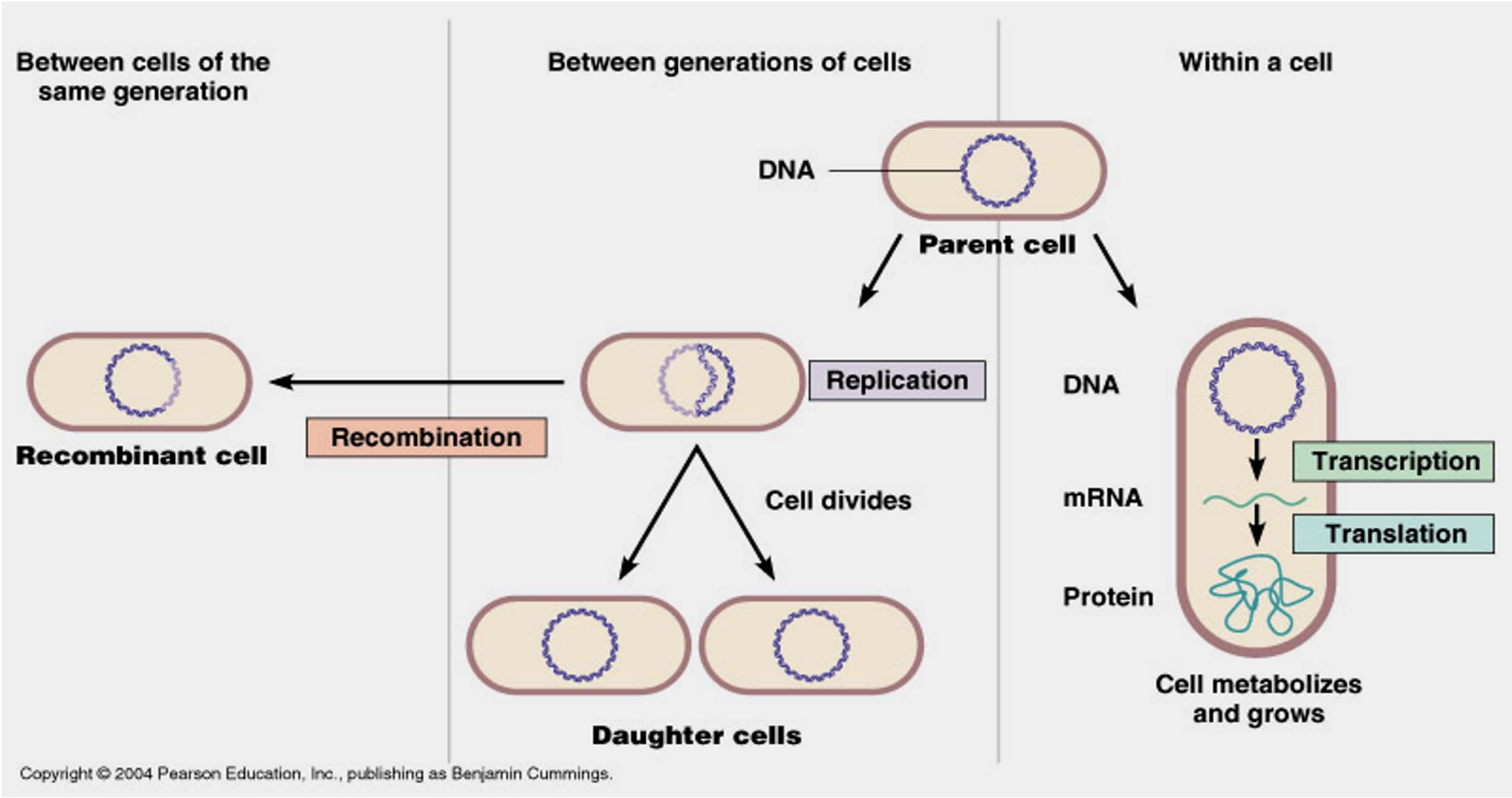
Transposons

- Transposons
  - Small segments of DNA that move from one region to another
  - 700-40,000 base pairs
  - Occur in all organisms
  - Can insert within genes
    - Disrupt transcription of gene
  - Occurs rarely (similar to spontaneous mutation rate)

Transposons

- Transposons
  - Contain gene for transposition
  - Insertion sequence (IS)
    - Codes for transposase
    - Cuts and seals DNA for transposons

Review


Between cells of the same generation
Between generations of cells
Within a cell
DNA
Parent cell
Replication
Recombination
Recombinant cell
Cell divides
Daughter cells
DNA
Transcription
mRNA
Translation
Protein
Cell metabolizes and grows
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