Foundations in Microbiology

Fifth Edition

Talaro

Chapter

9

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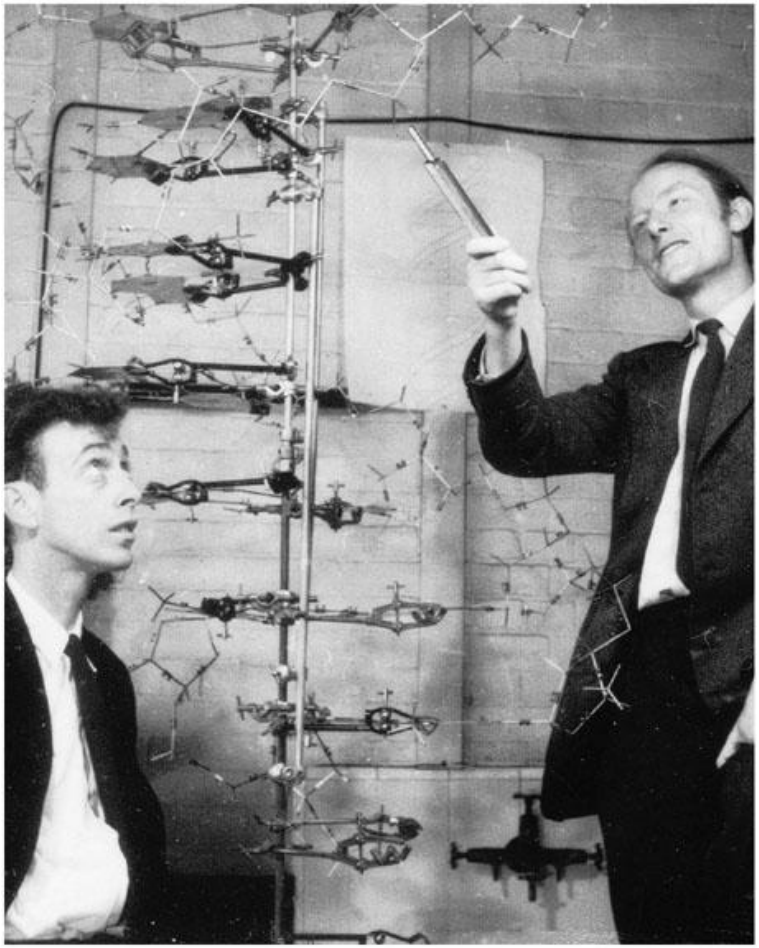

Microbial Genetics

Chapter 9

Genetics – the study of heredity

1. transmission of biological traits from parent to offspring
2. expression & variation of those traits
3. structure & function of genetic material
4. how this material changes

Levels of genetic study

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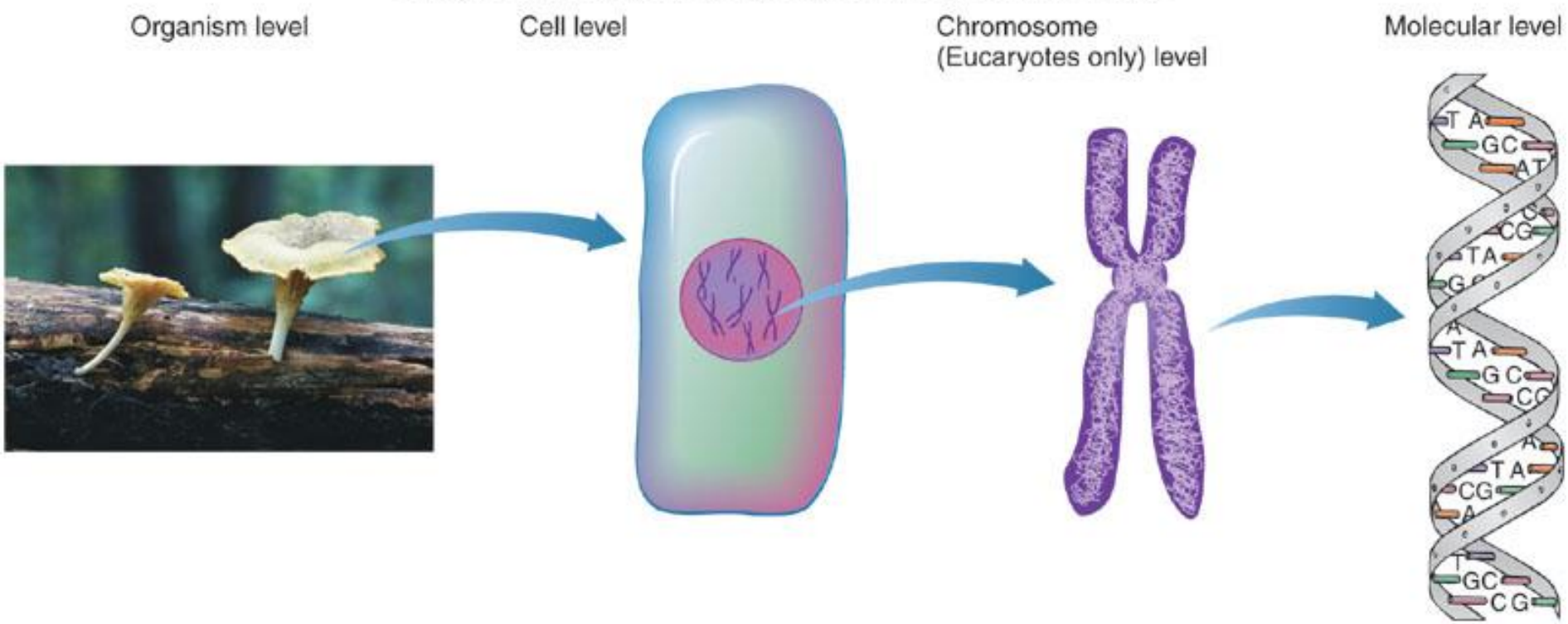

Levels of structure & function of the genome

- **genome** – sum total of genetic material of an organism (chromosomes + mitochondria/chloroplasts and/or plasmids)
  - genome of cells – DNA
  - genome of viruses – DNA or RNA
- **chromosome** – length of DNA containing genes
- **gene**-fundamental unit of heredity responsible for a given trait
  - site on the chromosome that provides information for a certain cell function
  - segment of DNA that contains the necessary code to make a protein or RNA molecule

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DNA structure

- 2 strands twisted into a helix
- sugar -phosphate backbone
- nitrogenous bases form steps in ladder
  - constancy of base pairing
  - A binds to T with 2 hydrogen bonds
  - G binds to C with 3 hydrogen bonds
- antiparallel strands 3'to 5' and 5'to 3'
- each strand provides a template for the exact copying of a new strand
- order of bases constitutes the DNA code

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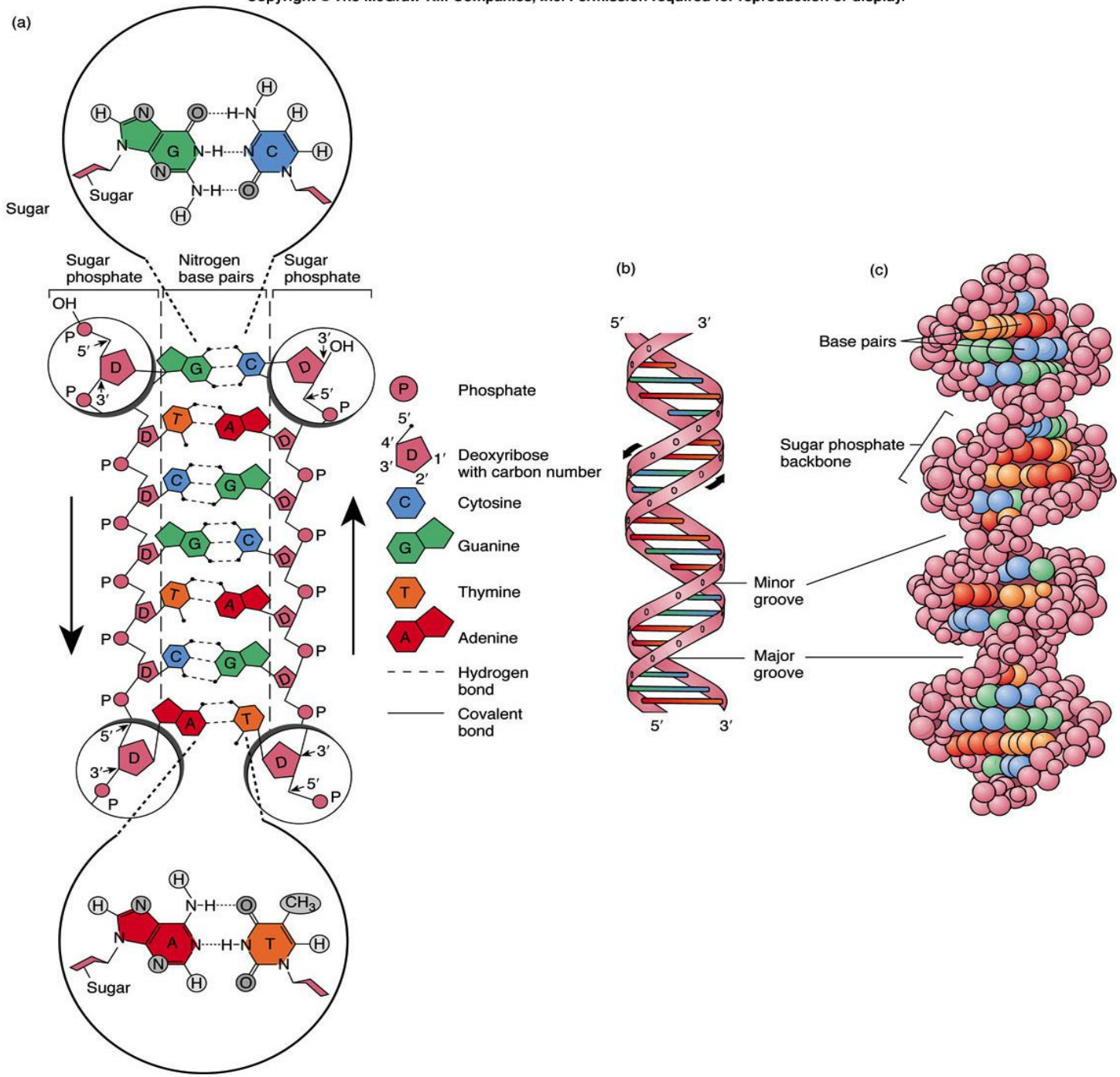

Significance of DNA structure

1. Maintenance of code during reproduction. Constancy of base pairing guarantees that the code will be retained.
2. Providing variety. Order of bases responsible for unique qualities of each organism.

Semi-conservative replication of DNA

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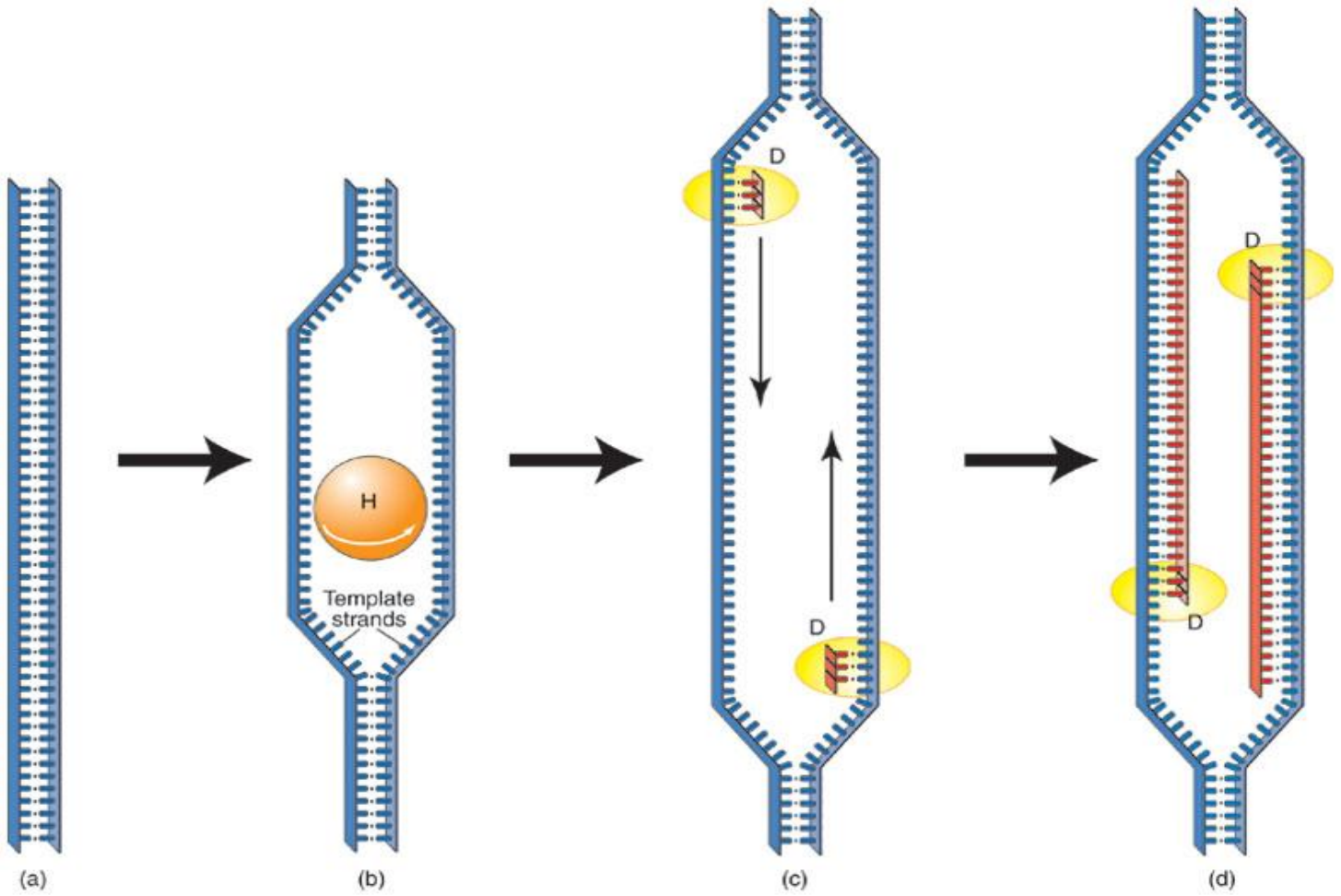
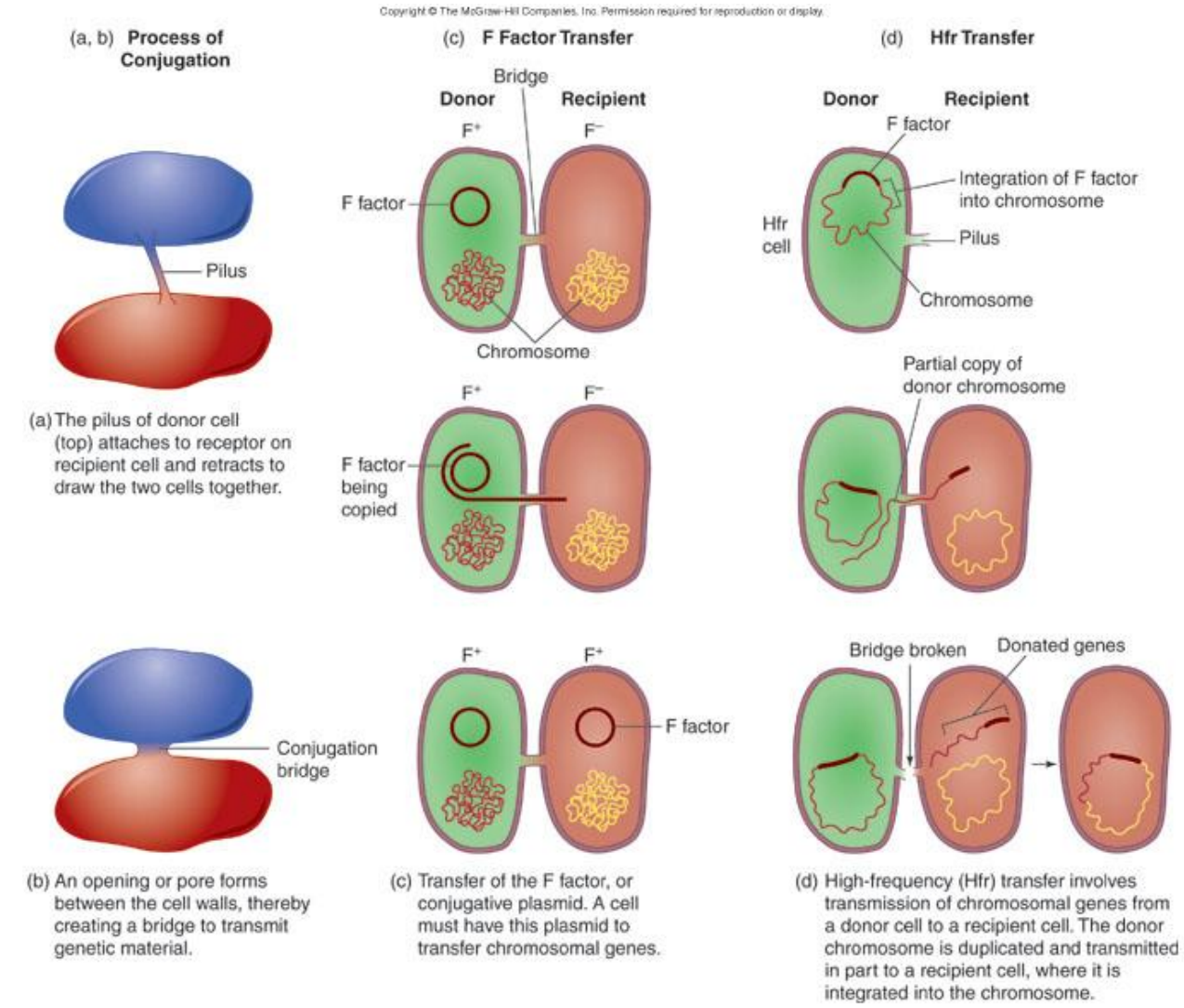


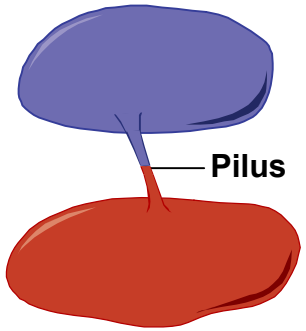
Types of intermicrobial exchange

conjugation	requires the attachment of two related species & formation of a bridge that can transport DNA
transformation	transfer of naked DNA
transduction	DNA transfer mediated by bacterial virus

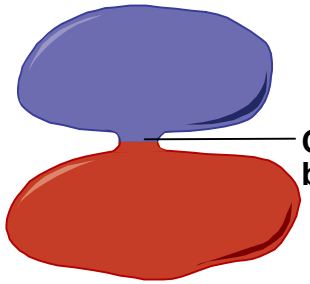
conjugation



(a, b) Process of Conjugation

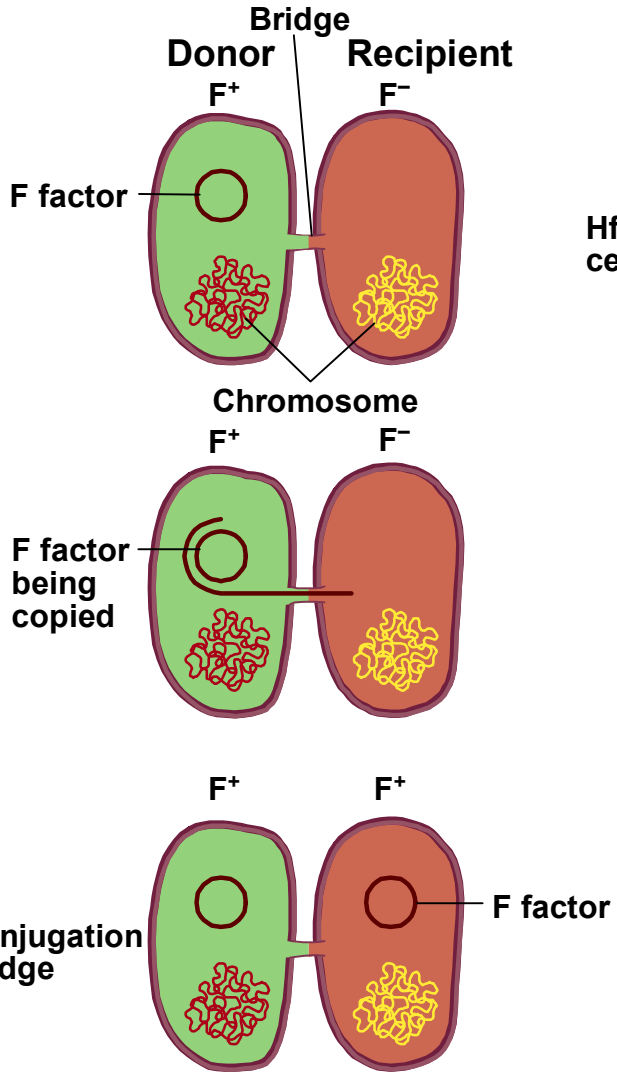


(a) The pilus of donor cell (top) attaches to receptor on recipient cell and retracts to draw the two cells together.



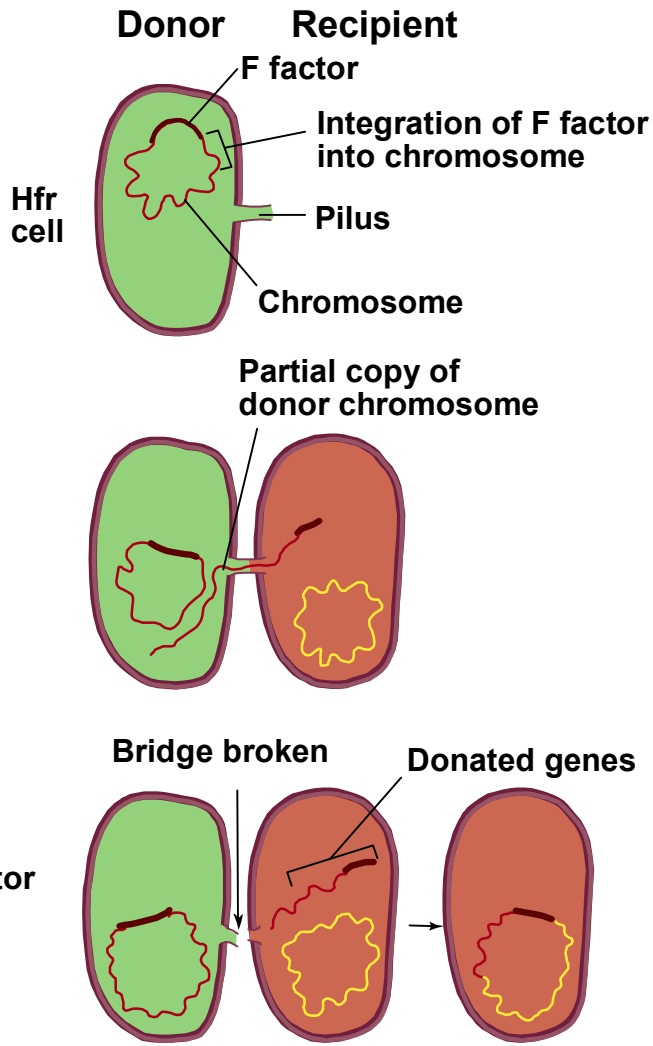
(b) An opening or pore forms between the cell walls, thereby creating a bridge to transmit genetic material.

(c) F Factor Transfer



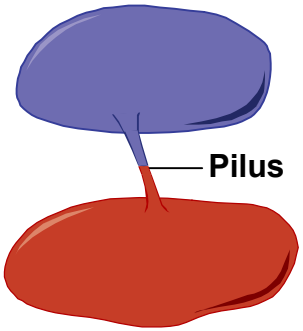
(c) Transfer of the F factor, or conjugative plasmid. A cell must have this plasmid to transfer chromosomal genes.

(d) Hfr Transfer



(d) High-frequency (Hfr) transfer involves transmission of chromosomal genes from a donor cell to a recipient cell. The donor chromosome is duplicated and transmitted in part to a recipient cell, where it is integrated into the chromosome.

(a, b) Process of Conjugation



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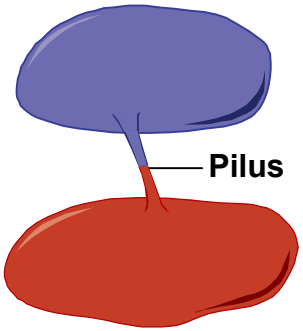

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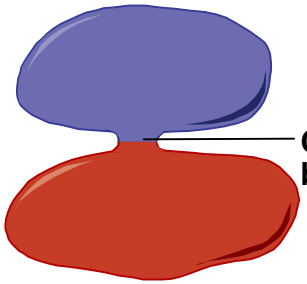
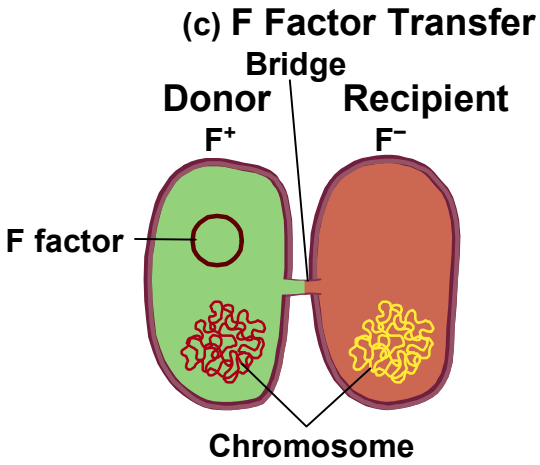
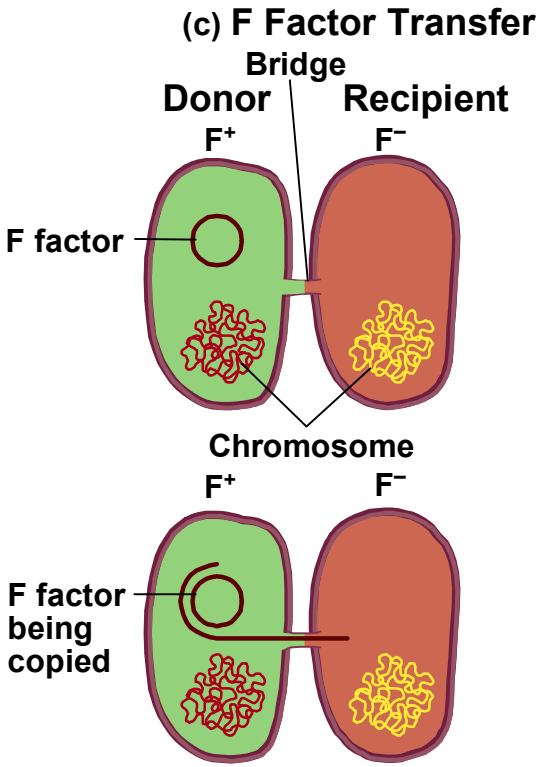
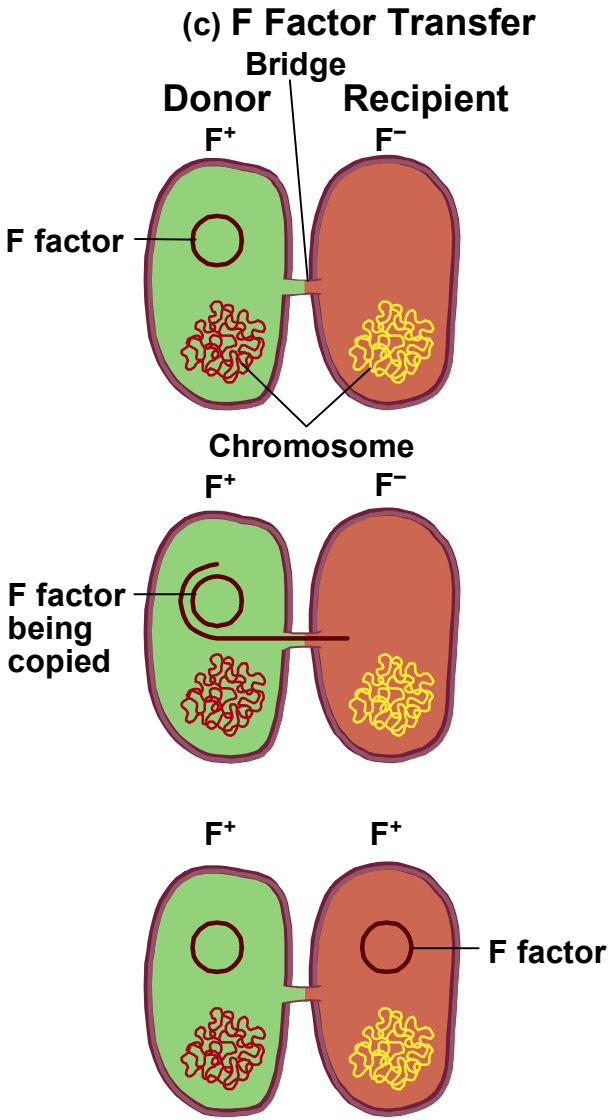


(b) An opening or pore forms between the cell walls, thereby creating a bridge to transmit genetic material.


(c) F Factor Transfer
Bridge
Donor
Recipient
F+
F−
F factor
Chromosome

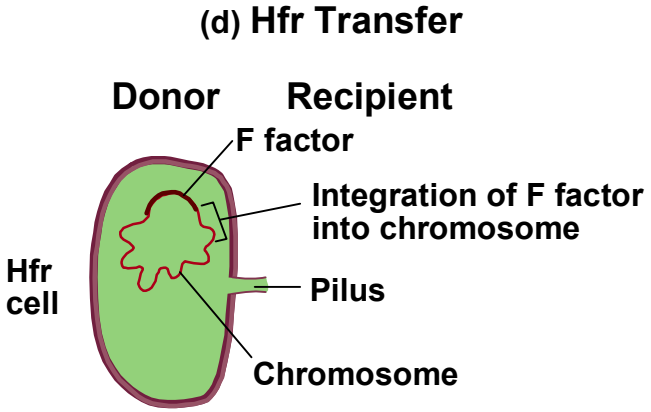

(c) F Factor Transfer
Bridge
Donor
Recipient
F+
F−
F factor
Chromosome
F+
F−
F factor being copied

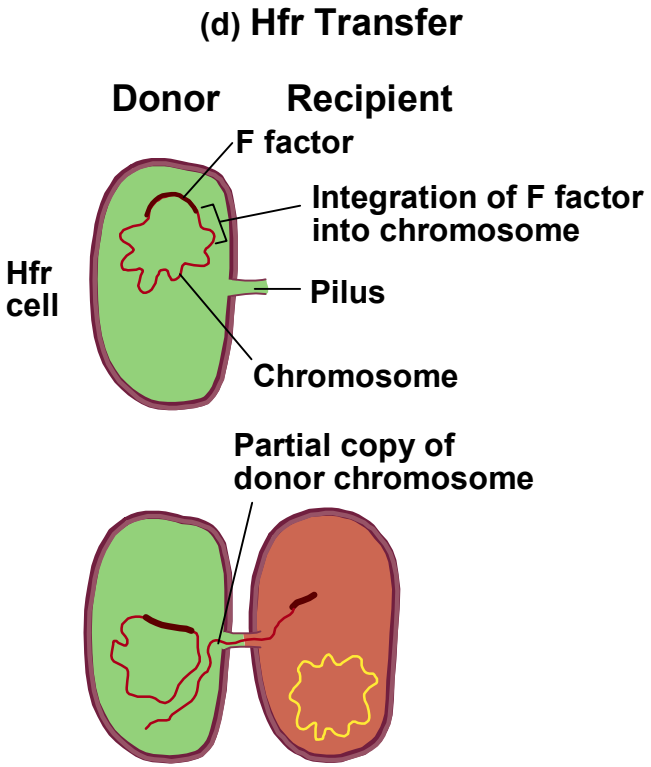


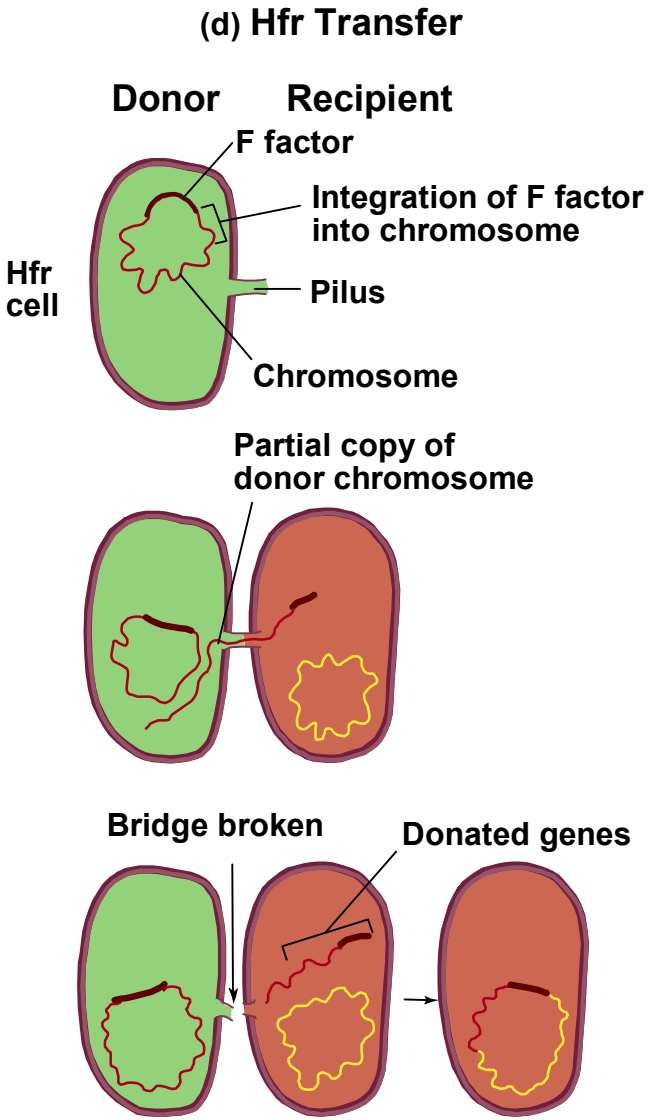
(c) Transfer of the F factor, or conjugative plasmid. A cell must have this plasmid to transfer chromosomal genes.

Conjugation

Video


(d) Hfr Transfer
Donor
Recipient
F factor
Integration of F factor into chromosome
Hfr cell
Pilus
Chromosome


(d) Hfr Transfer
Donor
Recipient
F factor
Integration of F factor into chromosome
Hfr cell
Pilus
Chromosome
Partial copy of donor chromosome

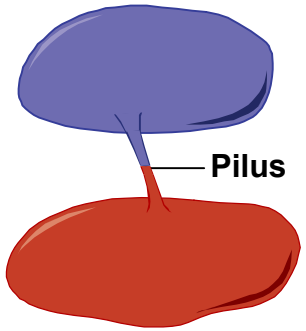


(d) High-frequency (Hfr) transfer involves transmission of chromosomal genes from a donor cell to a recipient cell. The donor chromosome is duplicated and transmitted in part to a recipient cell, where it is integrated into the chromosome.

Hfr Conjugation

Video

(a, b) Process of Conjugation



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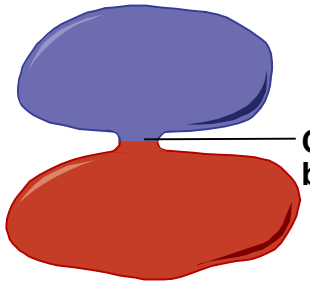

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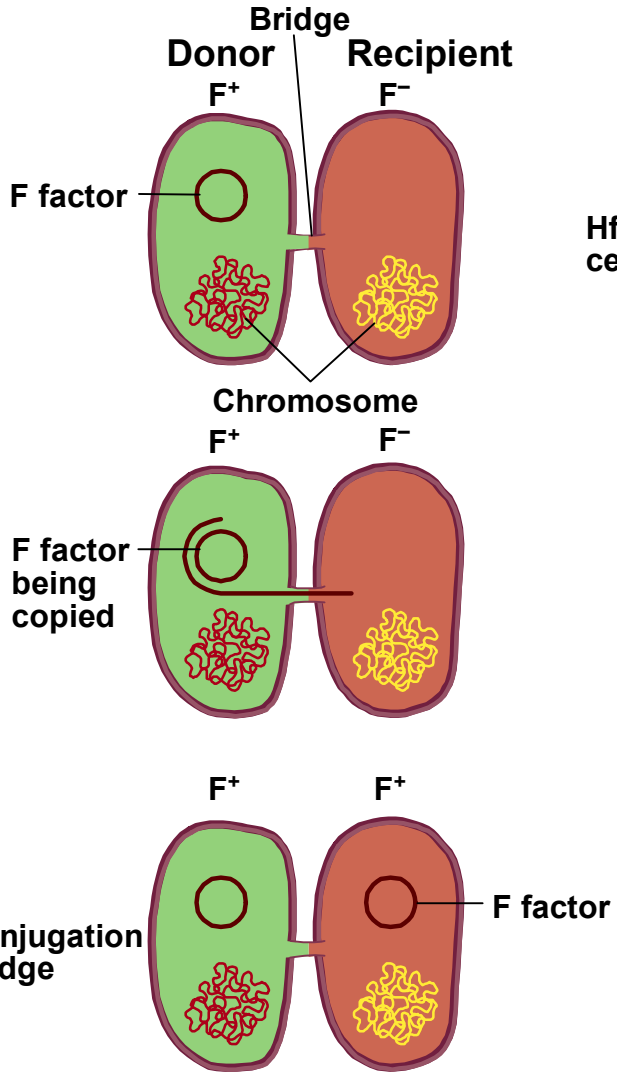
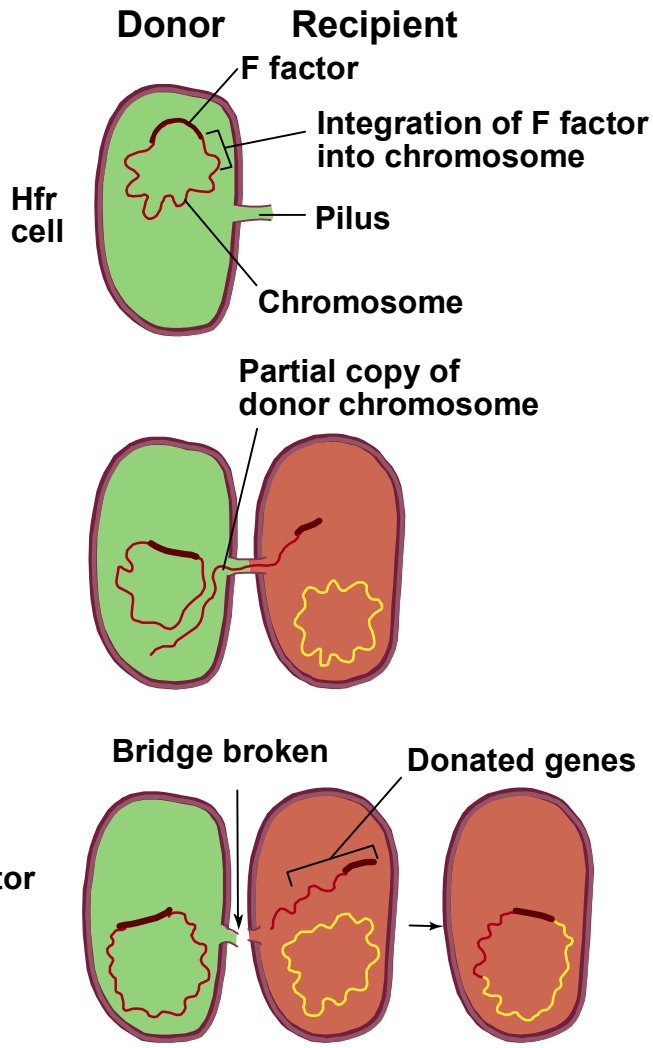


(c) Transfer of the F factor, or conjugative plasmid. A cell must have this plasmid to transfer chromosomal genes.

(d) Hfr Transfer



(d) High-frequency (Hfr) transfer involves transmission of chromosomal genes from a donor cell to a recipient cell. The donor chromosome is duplicated and transmitted in part to a recipient cell, where it is integrated into the chromosome.

"My God! They're at it again..."

transformation

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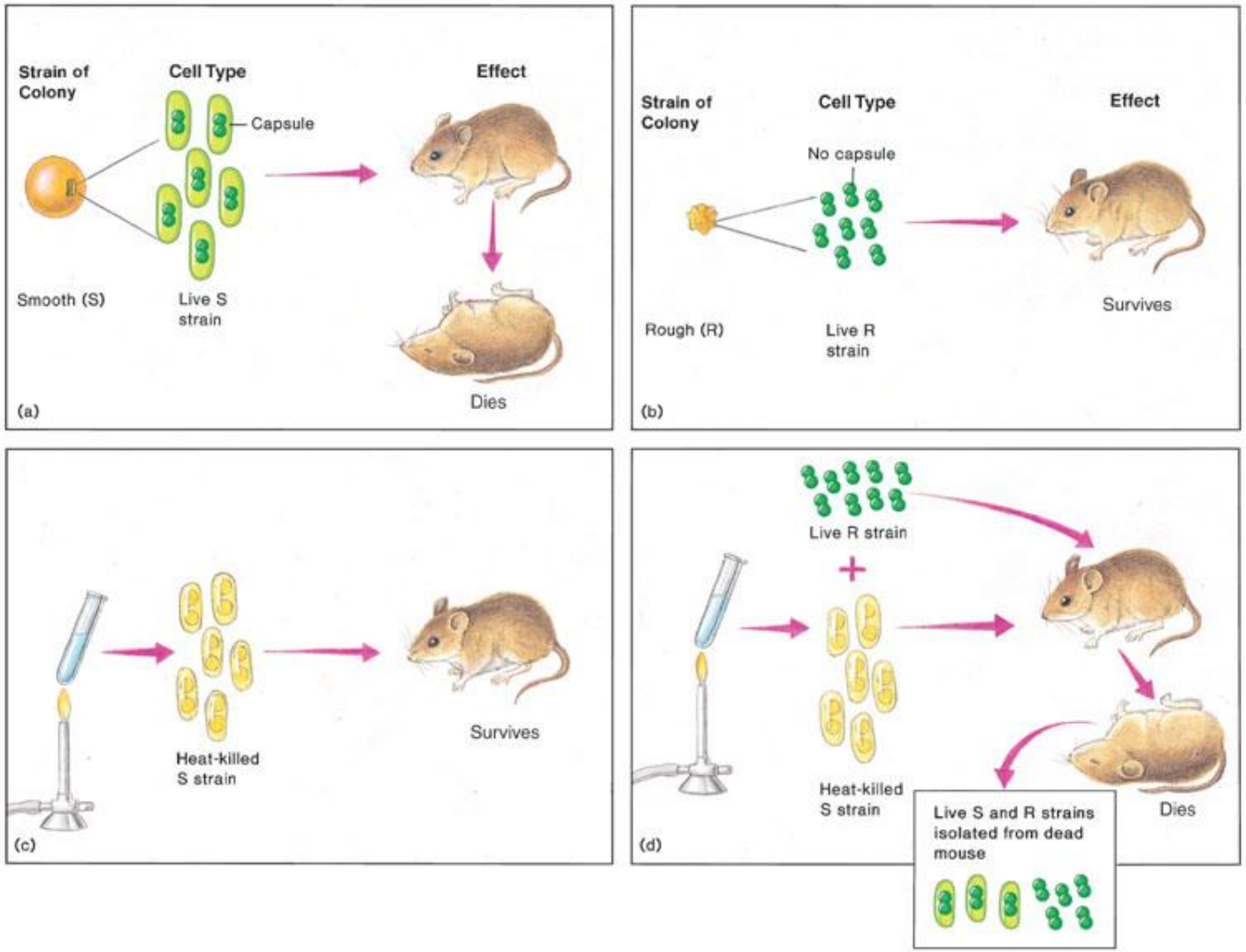
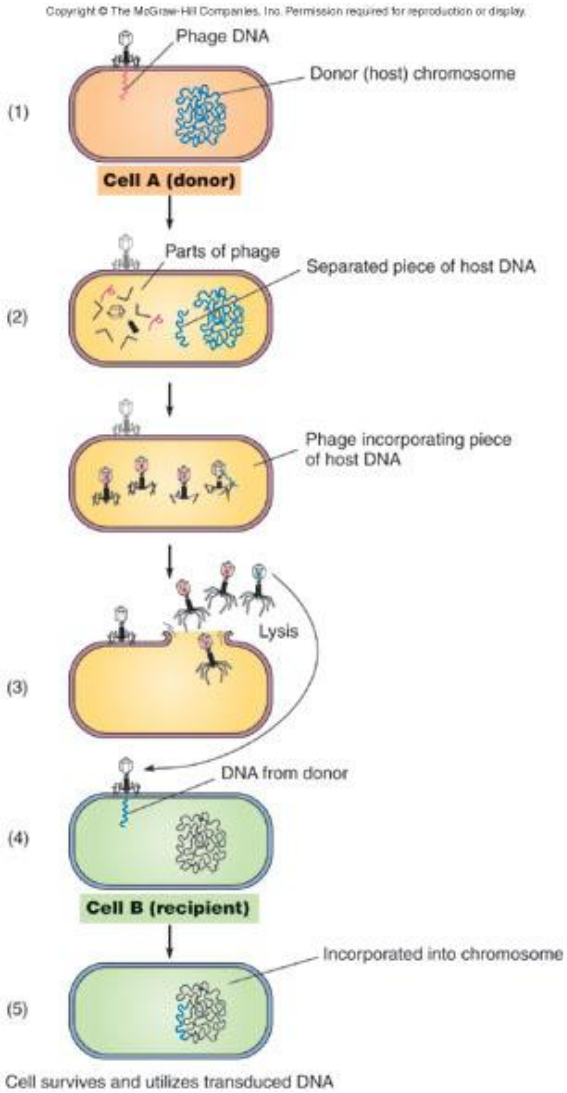
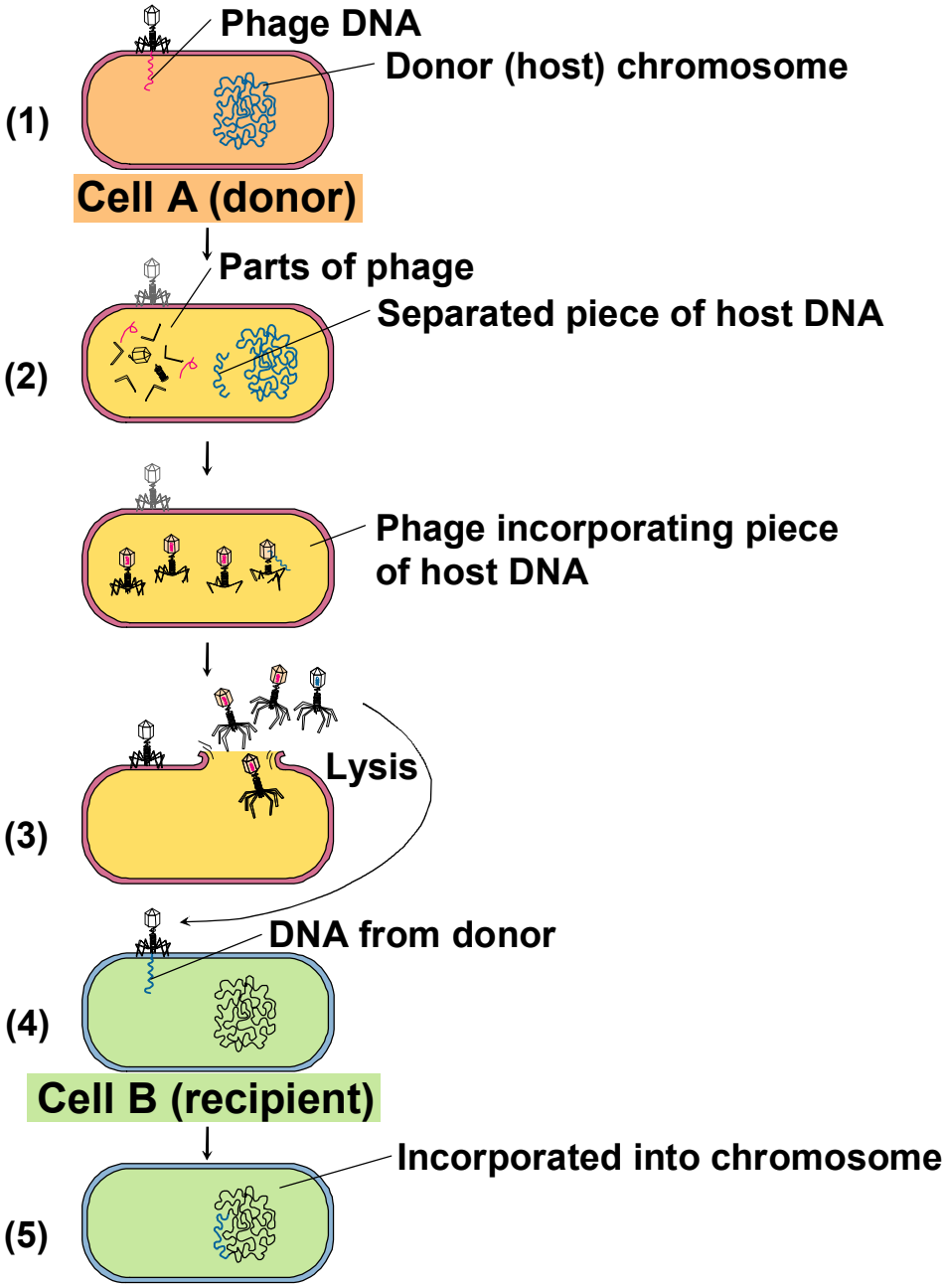


Transformation

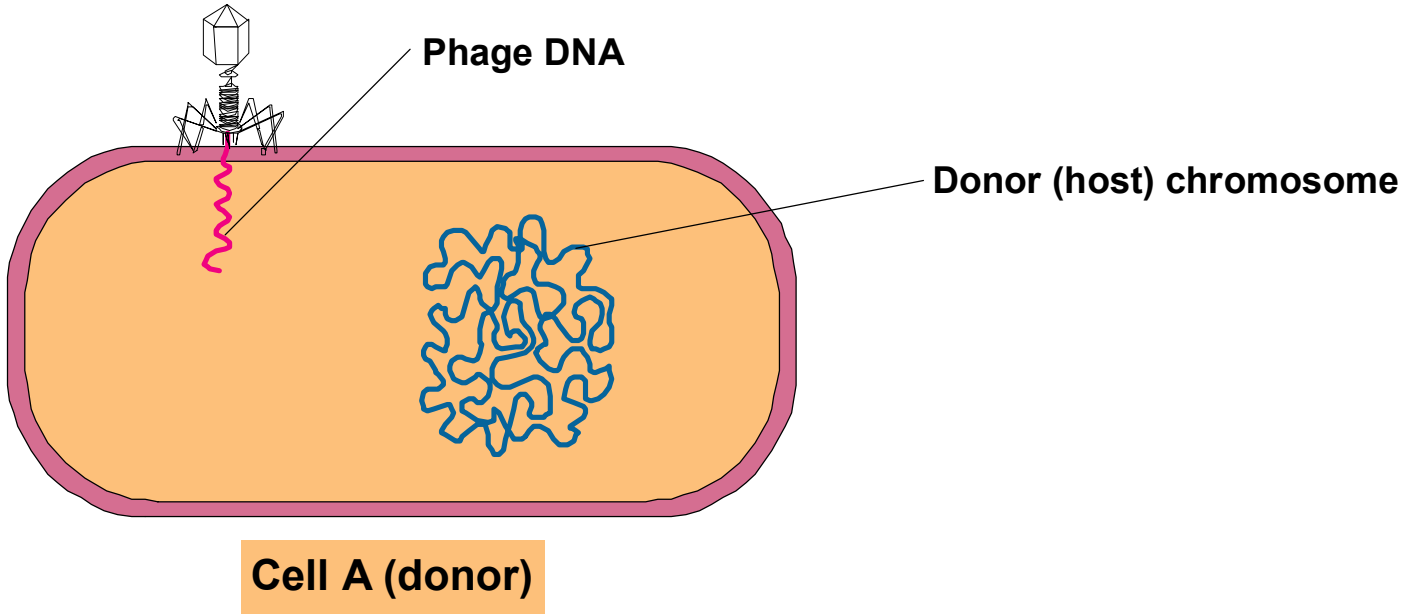
Video

Generalized transduction

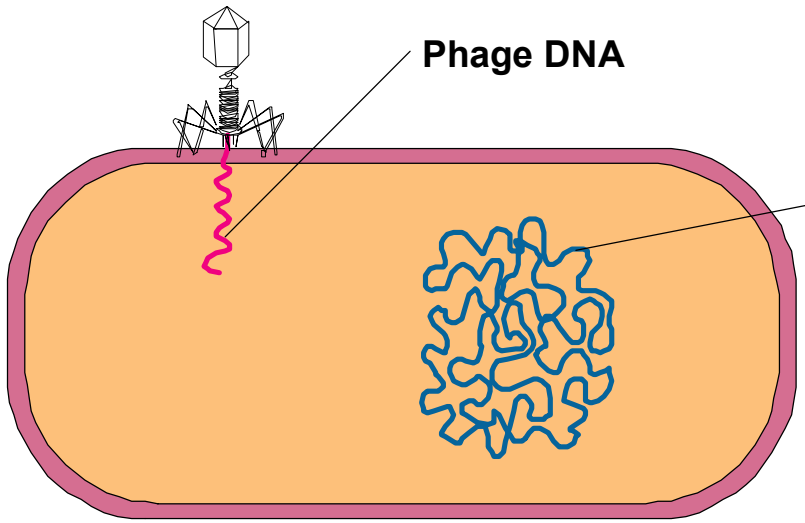



Phage DNA
Donor (host) chromosome
(1)
Cell A (donor)
Parts of phage
Separated piece of host DNA
(2)
Phage incorporating piece of host DNA
Lysis
(3)
DNA from donor
(4)
Cell B (recipient)
Incorporated into chromosome
(5)
Cell survives and utilizes transduced DNA

(1)

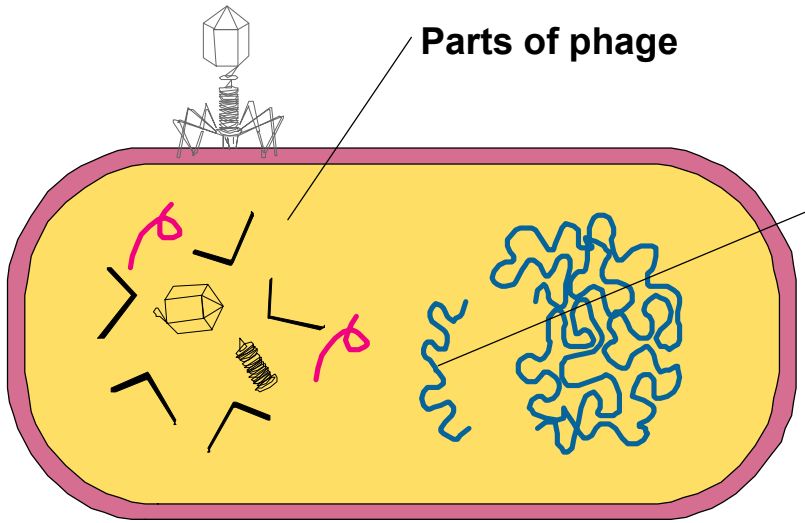


(1)

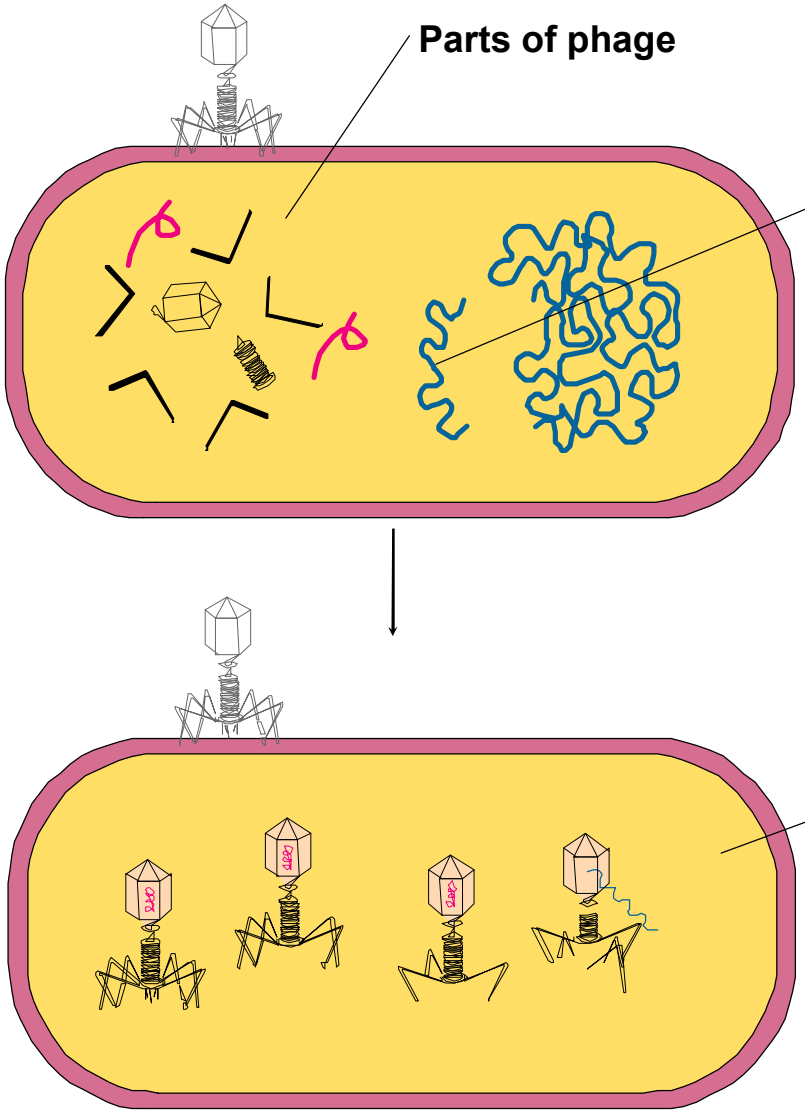


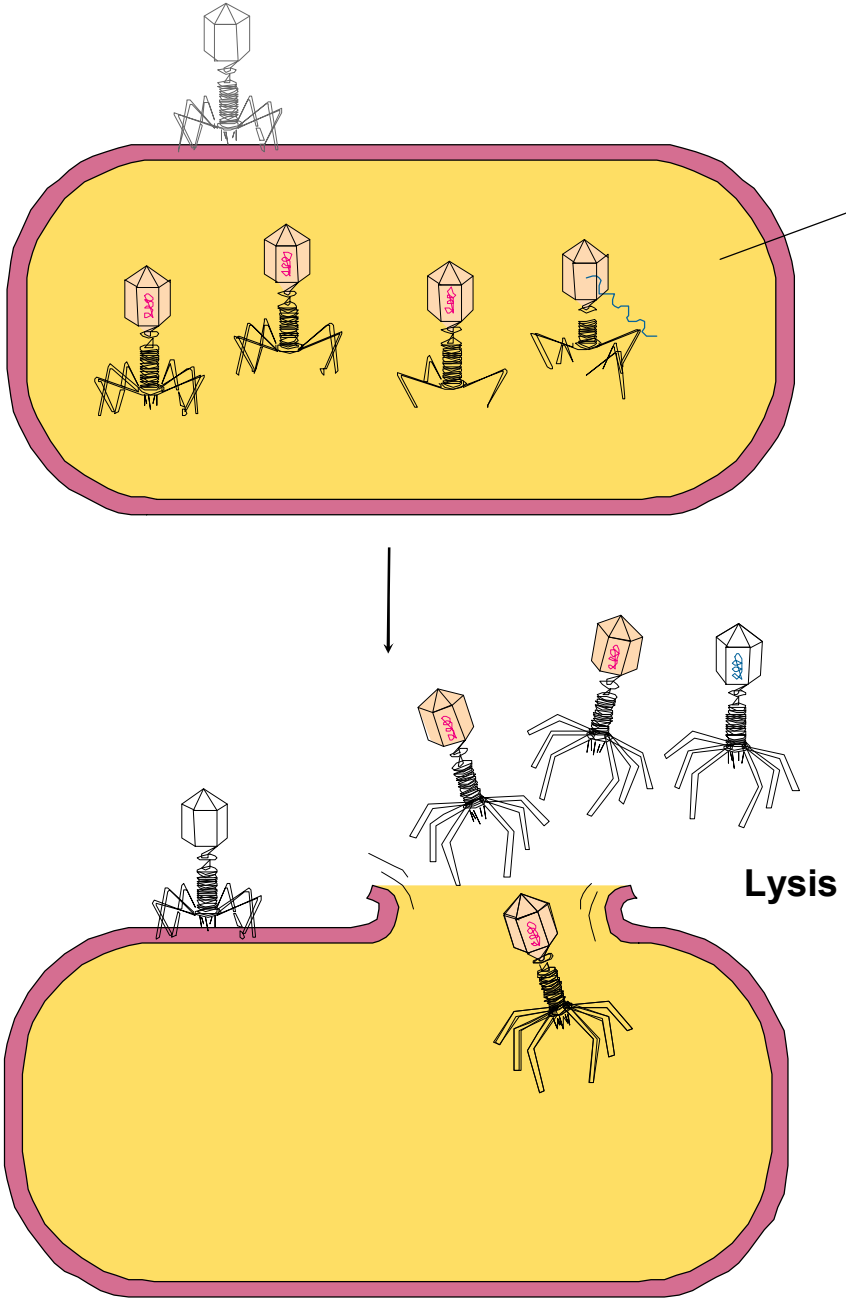
Cell A (donor)

(2)



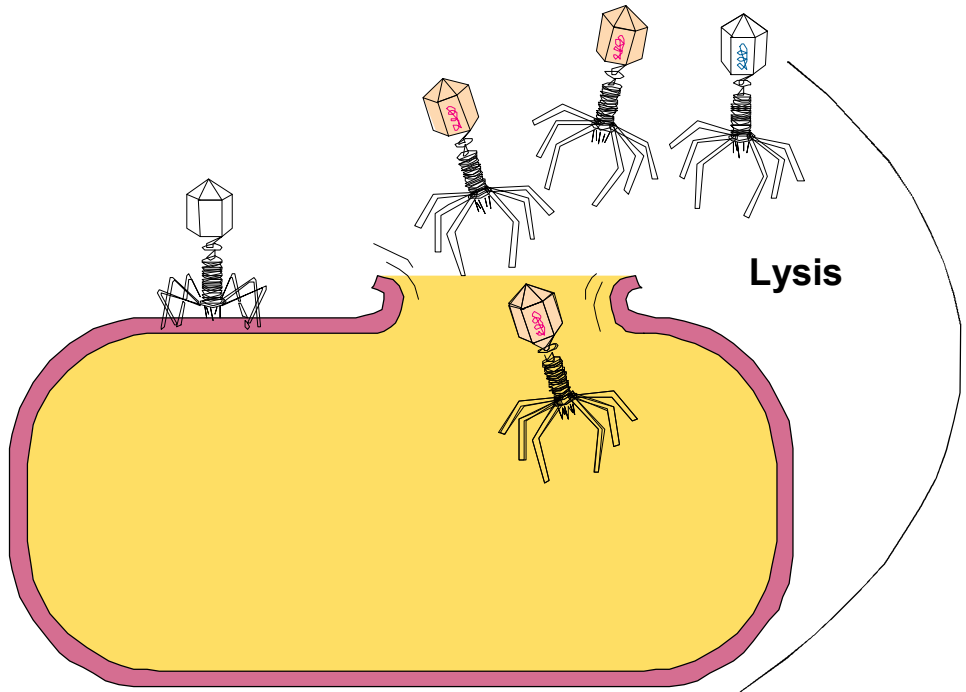
(2)


Parts of phage
Separated piece of host DNA
Phage incorporating piece of host DNA



(3)

(3)



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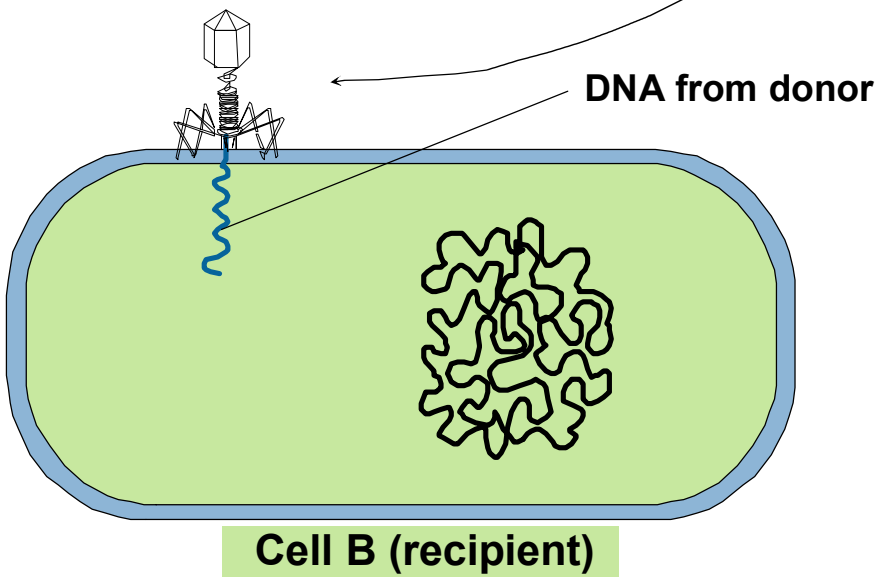

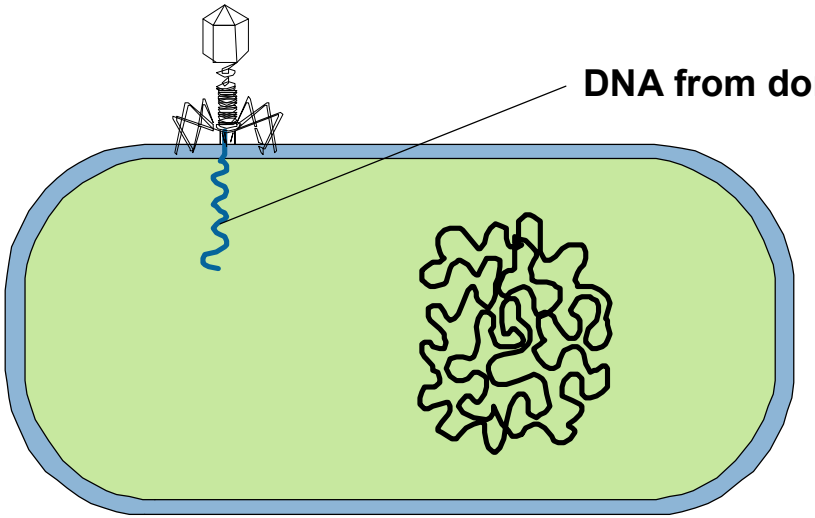

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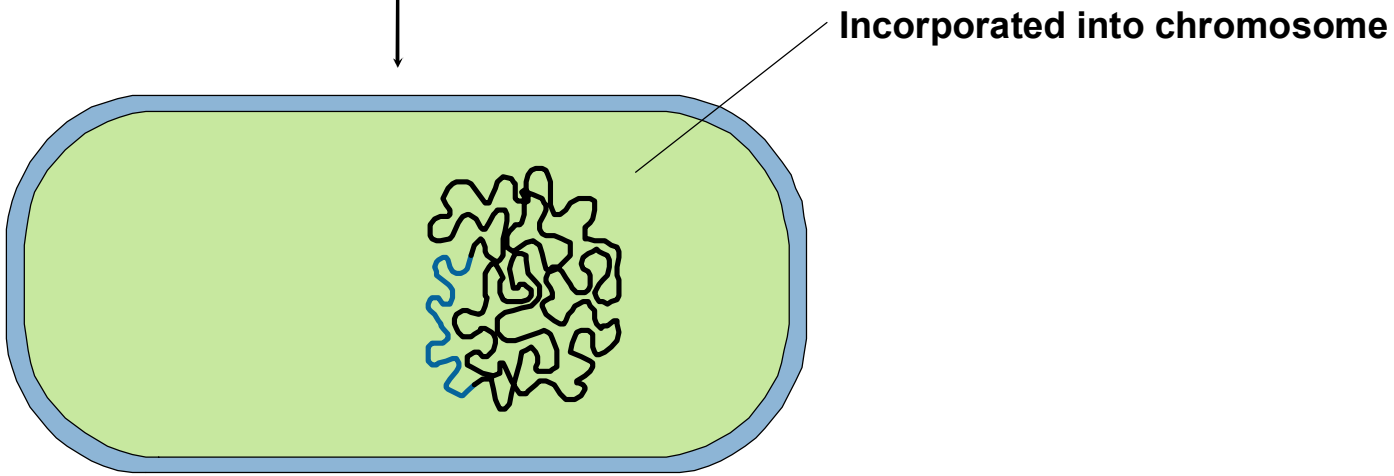


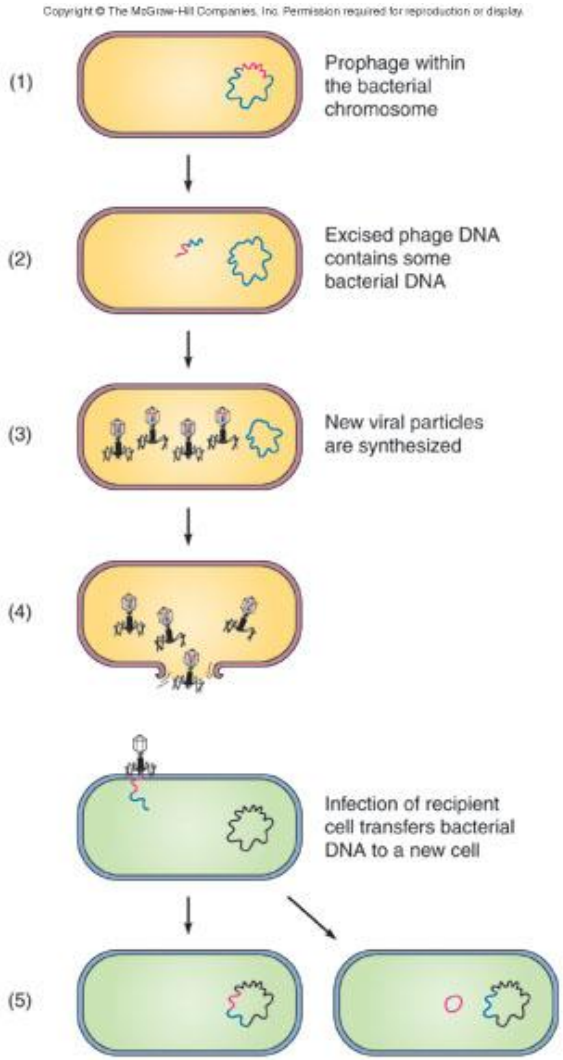
(5)

Cell survives and utilizes transduced DNA

Transduction

Video

Specialized transduction



Recombination results in two possible outcomes.

Specialized Transduction

Video

It was on a short-cut through the hospital kitchens that Albert was first approached by a member of the Antibiotic Resistance.