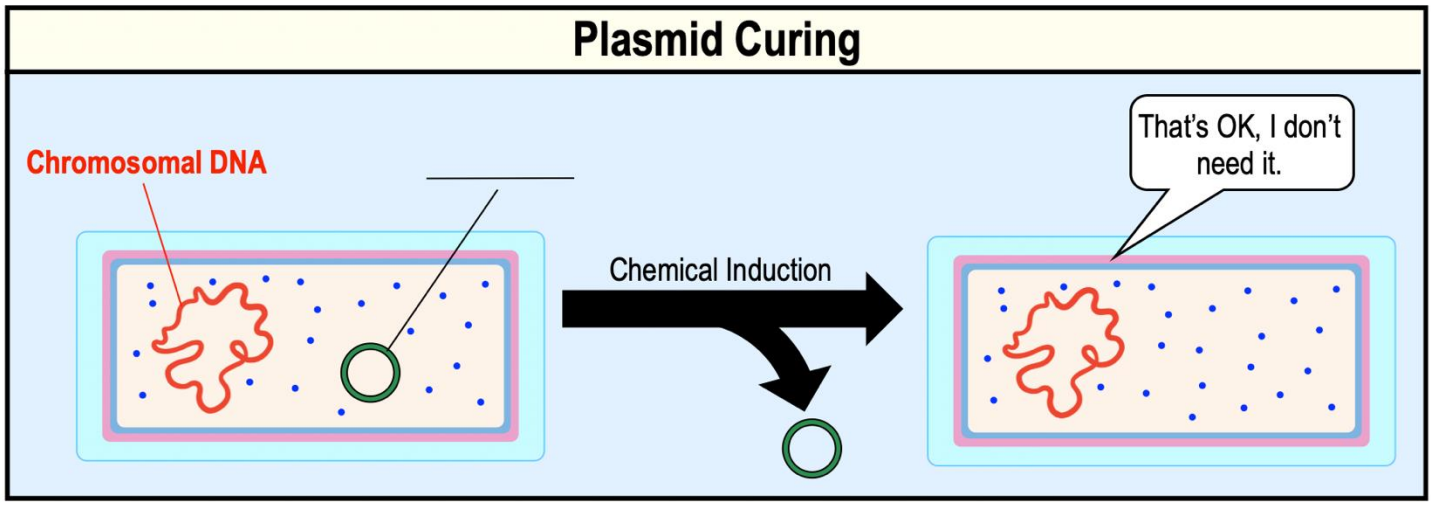
TOPIC: PROKARYOTIC REPRODUCTION

Introduction to Bacterial Plasmids

- _____**:** small molecules of circular, double-stranded DNA replicated *independently* of the cell's chromosome.
  - □ Contain genes that are typically _____ required for the cell to survive.
  - □ Replicated by the cell's _____ *Polymerase.*
- _____**:** a cell loses its plasmid which can happen spontaneously, or it can be induced chemically.

EXAMPLE: Plasmid curing with chemical induction.



PRACTICE: Which of these is NOT true regarding bacterial plasmids?

a) Bacterial plasmids are found in all bacteria.
b) Bacterial plasmids are not essential for bacterial life.
c) Bacterial plasmids replicate independently of the bacterial chromosome.
d) Bacteria can lose their plasmids in a process called "plasmid curing".
e) Bacterial plasmids are replicated by the same DNA machinery that replicated the bacterial chromosome.

PRACTICE: Which types of genes are commonly found in bacterial plasmids?

a) Genes that encode for proteins used in cellular respiration.
b) Genes that encode for proteins used in DNA replication.
c) Genes that encode for antibiotic resistance.
d) Genes that encode for cell envelope/membrane development.

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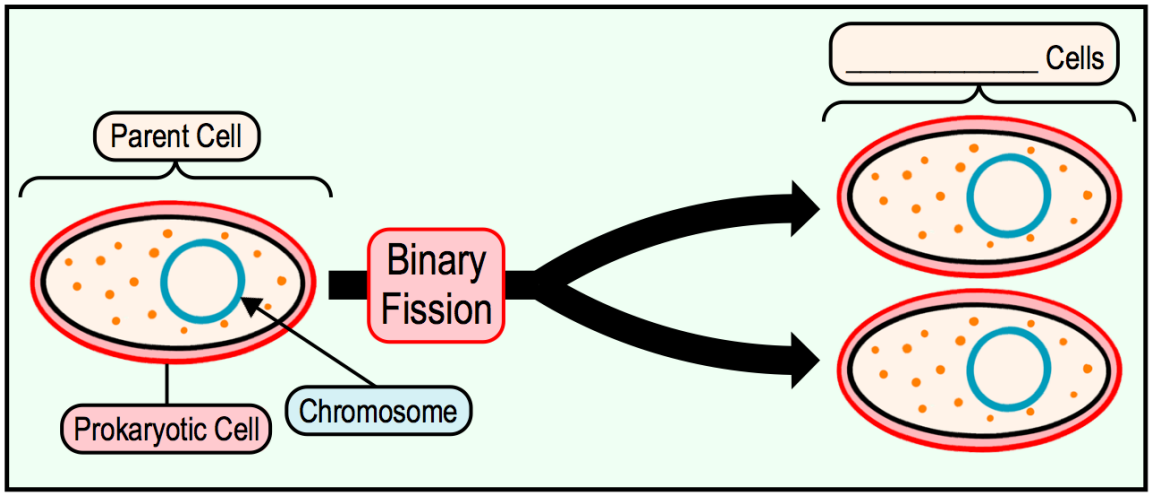
Binary Fission

- *Recall:* Prokaryotes replicate by the process of *binary fission* BUT Eukaryotes do _____.
- _____ **Fission:** prokaryotic asexual reproduction; one cell *divides* to form _____ new *daughter cells.*
  - □ **Daughter cells:** either of the two _____ cells that form after a cell *divides*.



PRACTICE: The cellular process by which two cells arise from one is known as:

a) Conjugation.
b) Meiosis.
c) Binary fission.
d) Mitosis.

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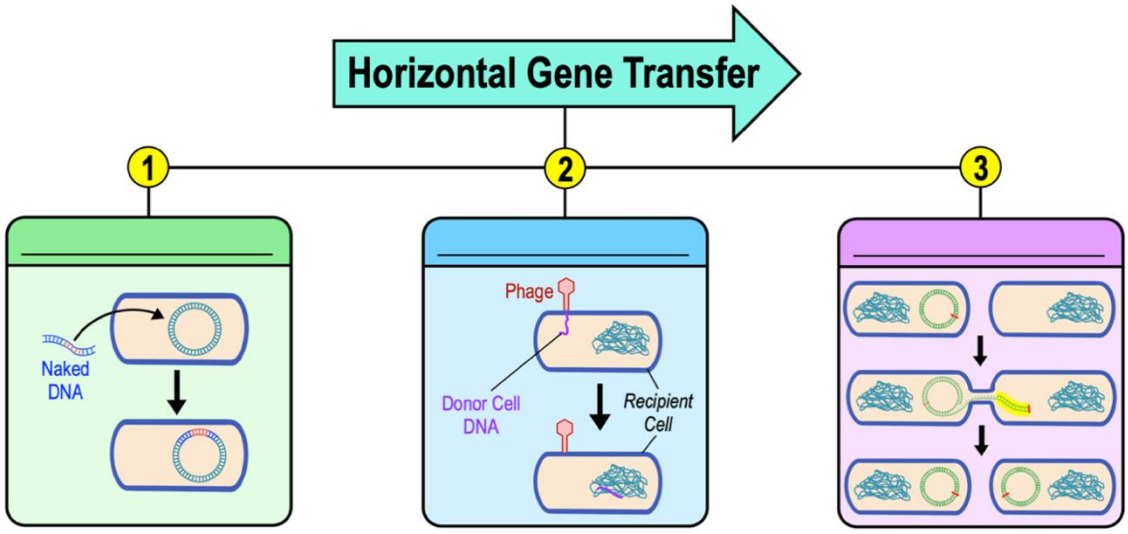
Horizontal Gene Transfer

●*Recall:* **Horizontal gene transfer** is between 2 organisms that are _____ direct descendants of one another.

□ Allows cells to quickly acquire new traits & drives genetic diversity among organisms.

●There are ____ known mechanisms of *horizontal gene transfer* in bacteria:

1) **Transformation:** horizontal gene transfer via _____ of free (naked) DNA in the *environment* by the cell.
2) **Transduction:** horizontal DNA transfer between cells mediated by a _____ virus.
3) **Conjugation:** _____ horizontal DNA transfer between cells during cell-to-cell contact.



PRACTICE: Which of the following is not a type of horizontal gene transfer?

a) Transduction. b) Transformation. c) Transamination. d) Conjugation.

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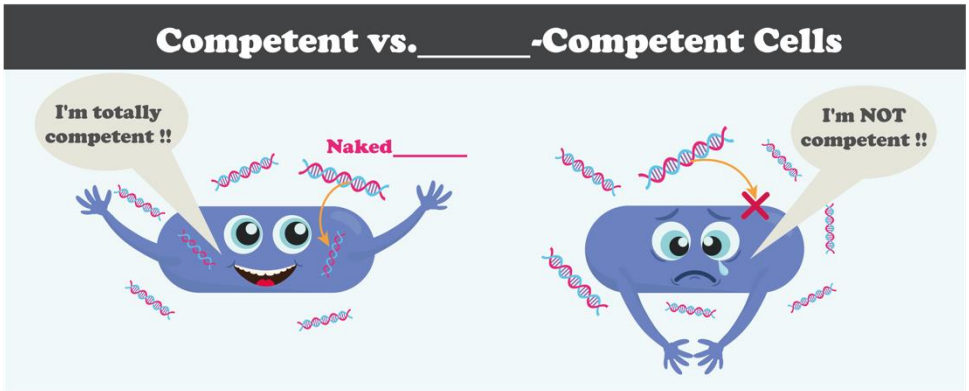
Bacterial Transformation

●*Recall:* **Transformation:** horizontal gene transfer by the uptake of free (naked) DNA in the *environment* by the cell.

●In order for a cell to transform DNA, it MUST be a _____ *cell.*

□ **Competent Cells:** have the _____ to transform DNA from the environment.



●Cells can be _____ competent or *induced* by chemical treatment.

PRACTICE: What does it mean when a bacterial cell is *naturally competent*?

a) The bacterial cell is able to transform its chromosomal DNA into RNA.
b) The bacterial cell is able to transform DNA from their environment.
c) The bacterial cell is able to degrade viral DNA from attacking viruses.
d) The bacterial cell is able to take in naked DNA and incorporate that DNA into its genome.
e) A and C.
f) B and D.

PRACTICE: Bacterial cells can become *competent* in two ways, which are:

a) Spontaneously.
b) Instinctively.
c) Horizontally.
d) Induced.
e) A and D.
f) A and C.
g) B and C.

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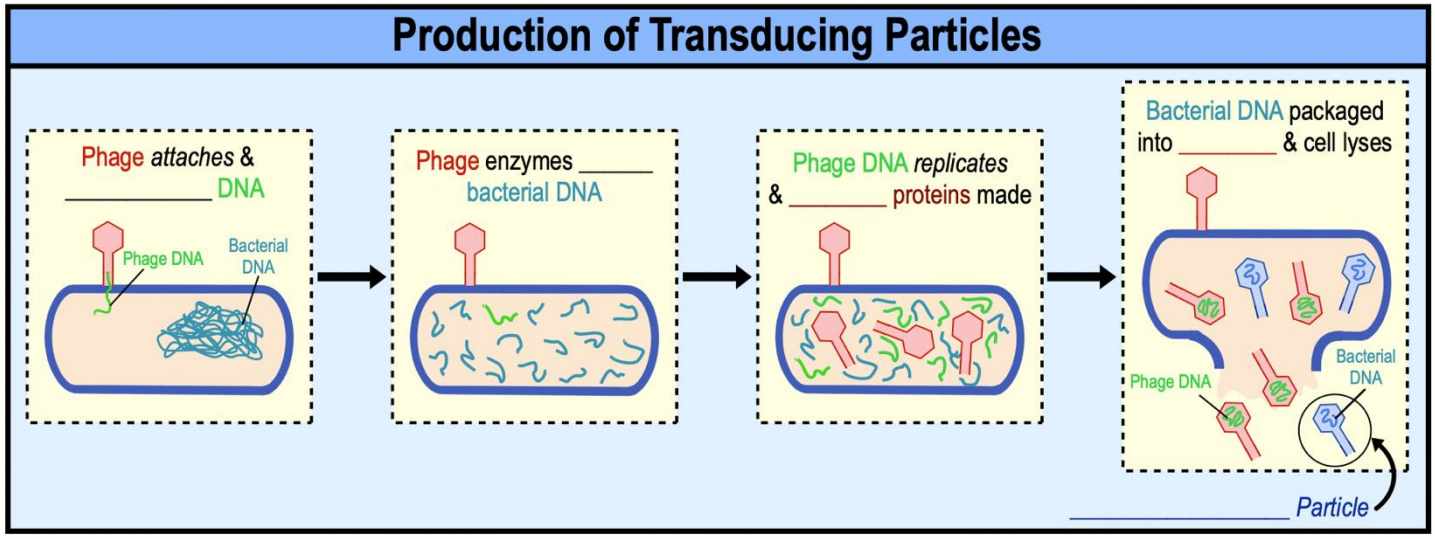
Transduction

- *Recall:* **Transduction:** horizontal DNA transfer between cells mediated by a *bacteriophage* virus (or phages).
  - □ _____**:** bacterial obligate intracellular parasite made of DNA or RNA packed into a protein coat.
  - □ Phage *infects* cell, *replicates*, & _____ cell so new phage particles are released.
- *Transduction* results from an _____ where bacterial DNA is packaged into the phage creating a *transducing particle*.
  - □ **Transducing Particle:** *defective* phage carrying _____ DNA instead of its own.



PRACTICE: Transduction is a form of horizontal gene transfer which requires a carrier for the genetic information being transferred. What is this carrier and what is it made of?

a) Transduction particle made of a human virus carrying bacterial DNA.
b) Transformation particle made of bacteriophage carrying human DNA.
c) Transduction particle made of a bacteriophage carrying bacterial DNA.
d) Transduction particle made of a bacteriophage carrying viral DNA.

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Introduction to Conjugation

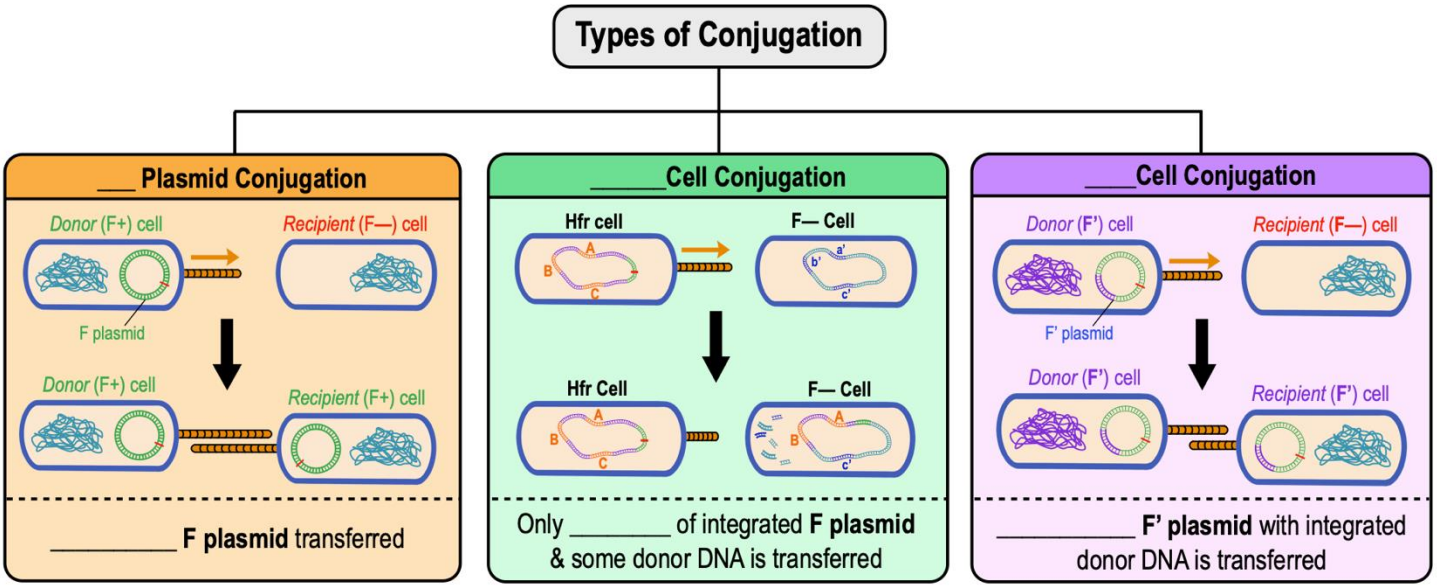
●*Recall:* **Conjugation** is the direct transfer of DNA between two bacterial cells making cell-to-cell _____.

□ Requires a *donor* cell & a *recipient* cell.

□ Can be the transfer of a _____, or part of the *donor* cell's chromosome.

There are _____ main types of conjugation:

1) ____ **Plasmid Conjugation** 2) _____ **Cell Conjugation** 3) ____ **Plasmid Conjugation**



PRACTICE: How is conjugation different from the two other forms of horizontal gene transfer, transformation and transduction?

a) Conjugation directly transfers DNA from donor to recipient cell.
b) Conjugation requires a phage to transfer the DNA between cells.
c) Conjugation requires a donor and a recipient cell.
d) Conjugation allows the recipient cell to take in free DNA from the environment.
e) A and D.
f) B and C.

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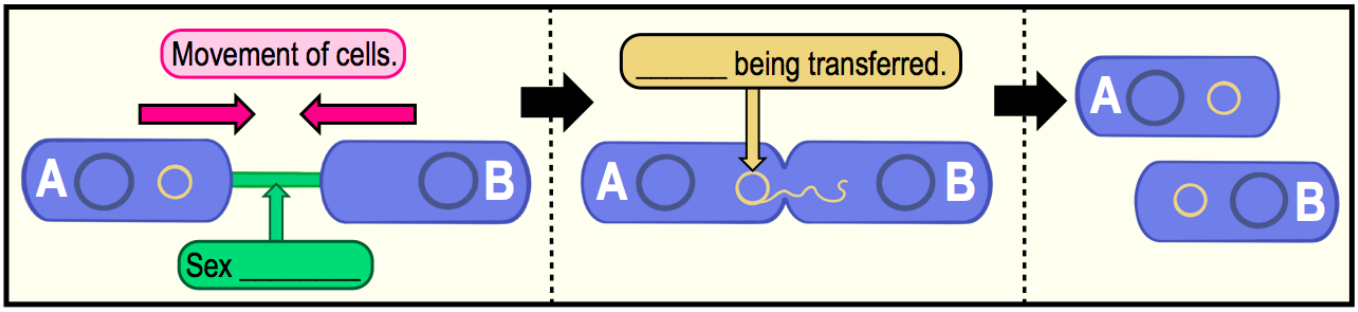
Sex Pilus

- _____ **Pilus (Conjugation Pilus):** connects two cells for a special type of DNA transfer.
  - □ _____: process of transferring *DNA* from one bacterial cell to another by *direct contact*.
  - □ Transferred DNA can add a new function to a cell (for example _____ to *antibiotics*).

EXAMPLE: A Sex pilus brings two cells together to directly transfer genetic material.



PRACTICE: Which of the following is NOT a function of pili?

a) Gliding motility of cells.
b) Conjugation (DNA transfer).
c) Antibiotic resistance.
d) Twitching motility of cells.
e) All are functions of pili.

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●Conjugation requires the presence of a special type of plasmid called a *conjugative plasmid.*

□ _____ **plasmids:** plasmids that direct their own transfer to a recipient cell via *conjugation*.

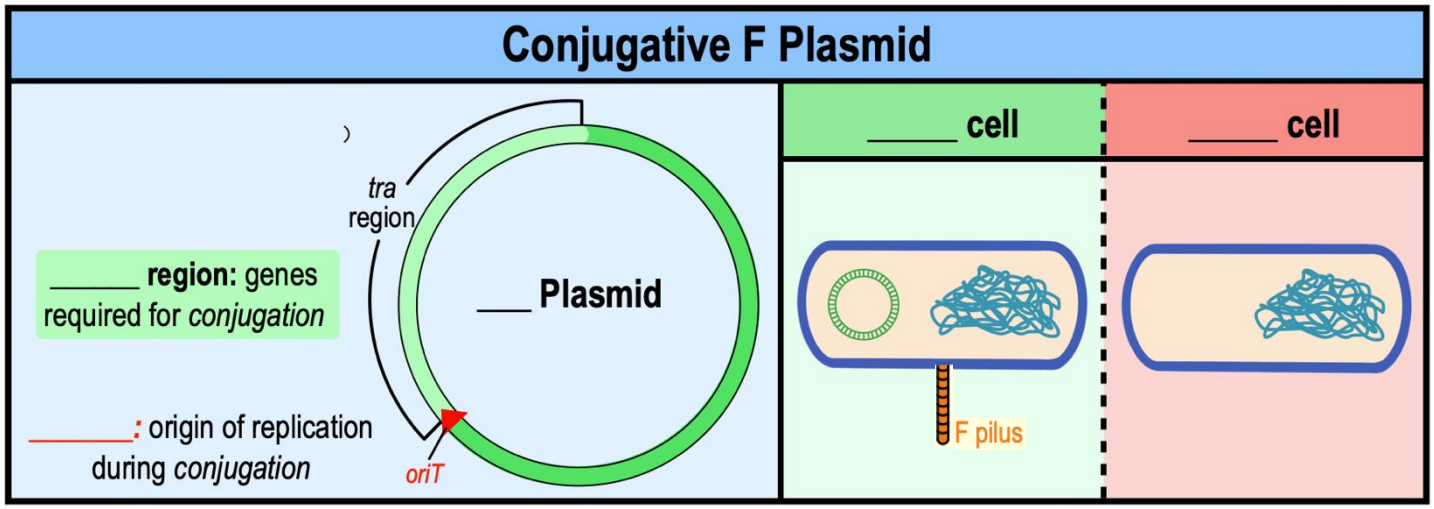
F Plasmid

●_____ **(Fertility) Plasmid:** the best studied example of a *conjugative plasmid* (discovered in *E. coli*).

□ _____ **Cell:** a cell that contains the entire F Plasmid (*donor* cell) that synthesizes the F pilus for conjugation.

□ _____ **Cell:** a cell that does NOT contain the entire F plasmid (*recipient* cell).

□ F– cell may contain a *portion* of the F plasmid BUT does _____ have an F pilus to initiate conjugation.



PRACTICE: During conjugation, the ____ cell transfers its _____ to the recipient cell.

a) F+; chromosome
b) F+; plasmid
c) F-; chromosome
d) F-; plasmid
e) None of the above

PRACTICE: What is the purpose of the conjugative plasmid in conjugation?

a) Causes the bacterial cell to begin binary fission.
b) Directs the process of conjugation.
c) Carries the genes required for conjugation.
d) Carries the genes for the transducing particle.
e) A and D.
f) B and C.

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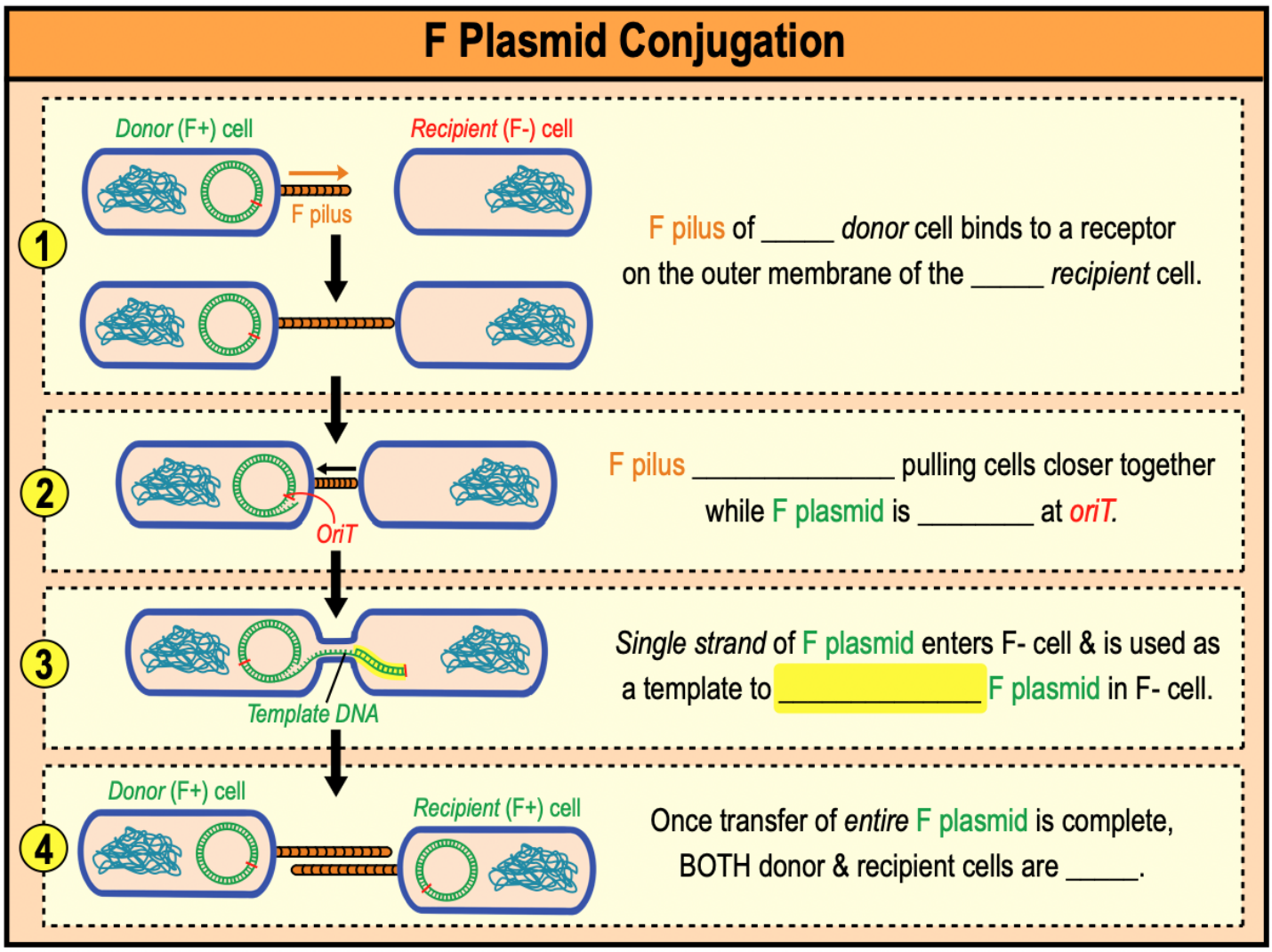
Mechanism of F Plasmid Conjugation in E. coli

●Transfer of the F Plasmid from an F+ cell to an F– cell involves a series of steps:



PRACTICE: What is the process where DNA is transferred from one bacterial cell to another through a pilus?

a) Horizontal gene transfer by conjugation.
b) Horizontal gene transfer by transduction.
c) Horizontal gene transfer by transformation.
d) Vertical gene transfer by transduction.
e) Vertical gene transfer by transformation.

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PRACTICE: Which of the following statements about conjugation is true?

a) Transferring DNA between cells in conjugation requires a virus carrier.
b) The donor and recipient cell must be in direct contact (touching) to transfer DNA.
c) Conjugation can only occur between bacteria of the same species.
d) Conjugation can occur with or without a conjugative plasmid.

PRACTICE: Which of the following statements about conjugation is false?

i. Conjugation is a form of horizontal gene transfer.
ii. Conjugation forms a bridge between two bacterial cells called a plasmid.
iii. Conjugation involves the transfer of genetic information via bacteriophages.

a) i only.
b) ii only.
c) iii only.
d) i and ii only.
e) ii and iii only.
f) i and iii only.

PRACTICE: For a bacterium to be able to conjugate it must possess a _____ with genes that encode a _____.

a) Nucleoid; plasmid.
b) Plasmid; pilus.
c) Nucleoid; pilus.
d) Pilus; plasmid.

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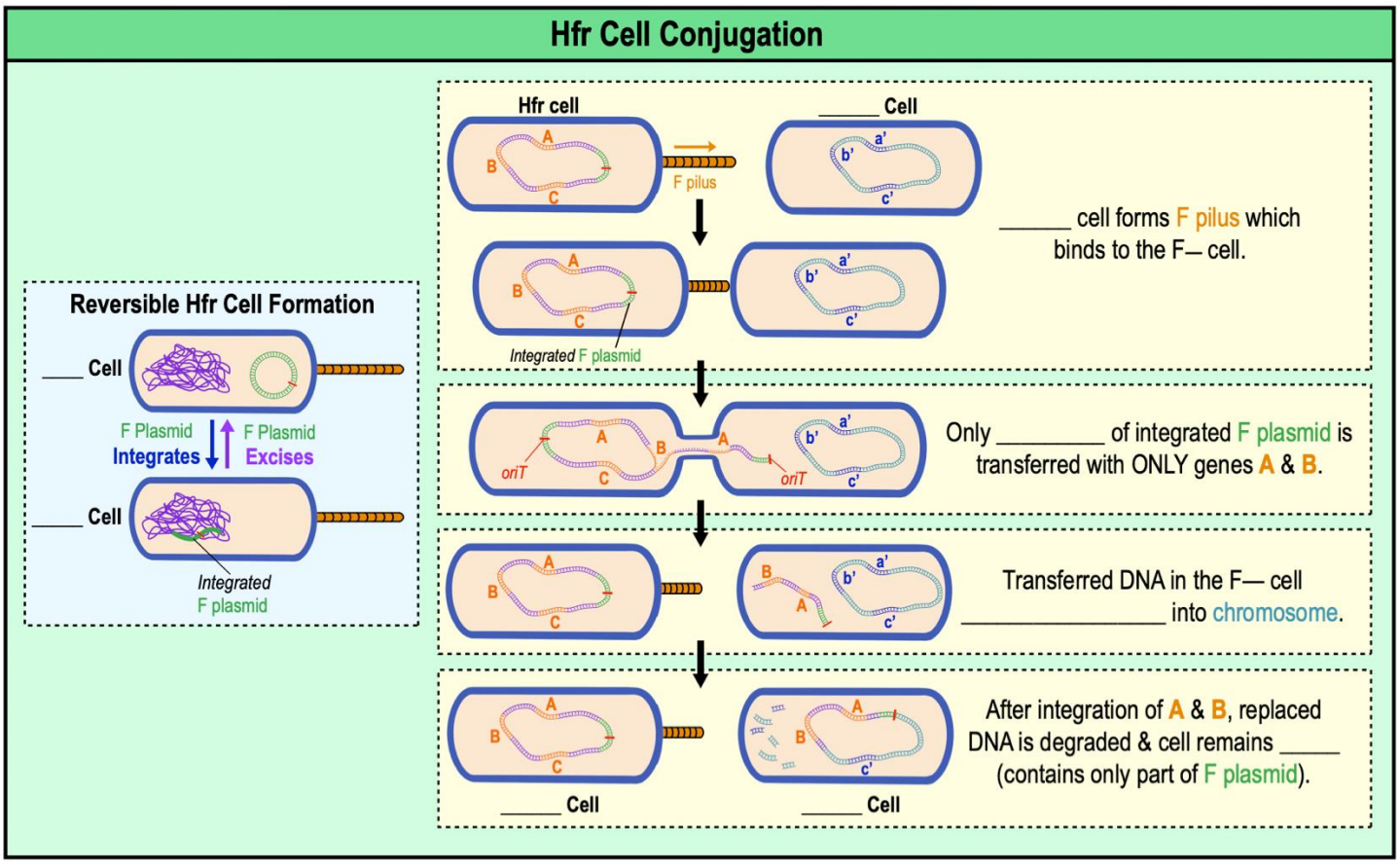
Hfr Cell Conjugation

- F plasmids have the _____ ability to *integrate* & *excise/remove* itself from the host chromosome.
- **Hfr** (***H****igh* ***F****requency of* ***R****ecombination)* **cells:** have an F plasmid _____ into their chromosome.
  - □ *Hfr cells* are the *donor* cells in the transfer of _____ DNA via conjugation.
- Conjugation of an Hfr cell's chromosomal DNA is SIMILAR to F plasmid conjugation in *E. coli.*
- Hfr cells make F pilus to conjugate with F– cells, BUT entire integrated plasmid is NOT transferred (*recipient* stays _____).
  - □ Only small _____ of the donor Hfr cell's chromosomal DNA & F plasmid are transferred.
  - □ Transferred DNA in F– *recipient* cell is either _____ into the chromosome or *degraded*.



PRACTICE: Hfr strains of bacteria:

a) Do not have an F plasmid.

b) Have an F plasmid.

c) Have an F factor integrated in the bacterial chromosome.

d) Have a partial F plasmid as a linear fragment in the cytoplasm.

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PRACTICE: What is transferred between two bacterial cells in Hfr conjugation?

a) A small portion of the integrated F plasmid from the Hfr donor cell.

b) A small, random portion of the Hfr donor's cells chromosome.

c) A small portion of the Hfr donor cell's chromosome and integrated F plasmid.

Plasmids

●_____: circular double-stranded DNA molecules with an origin of replication allowing them to replicate in a cell.

□ *High copy-number* plasmids replicate _____ in a cell & *low-copy-number* plasmids replicate _____.

□ Carry various genes, some of which provide cells the ability to _____ a particular environment.

●**Resistance Plasmids (____ Plasmids):** encode genes that confer resistance to antibiotics (R genes).

□ Most are *conjugative* plasmids containing genes required for DNA transfer by conjugation.