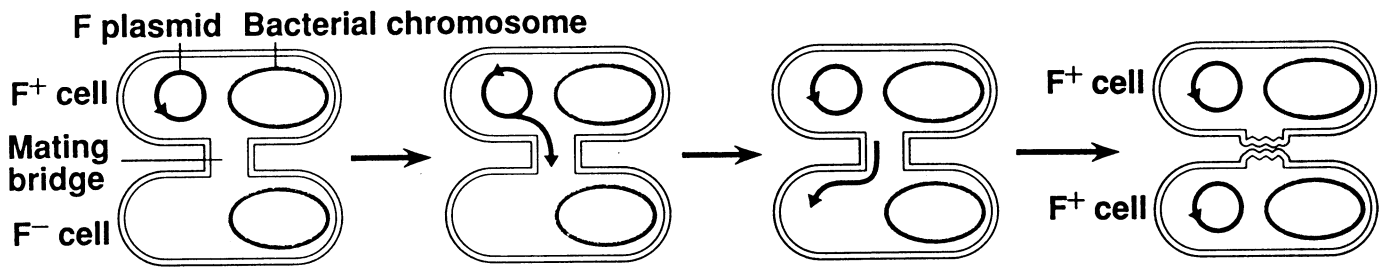


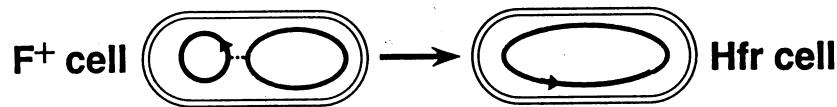
Figure 18.14 Conjugation and recombination in *E. coli*



(a) Conjugation between an F⁺ (male) and an F⁻ (female) bacterium. Cells that carry an F plasmid are called F⁺ cells. They are "male" in

that they can transfer an F plasmid to a "female" F⁻ cell. In this way, an F⁻ cell can become F⁺. The F plasmid replicates as it is transferred,

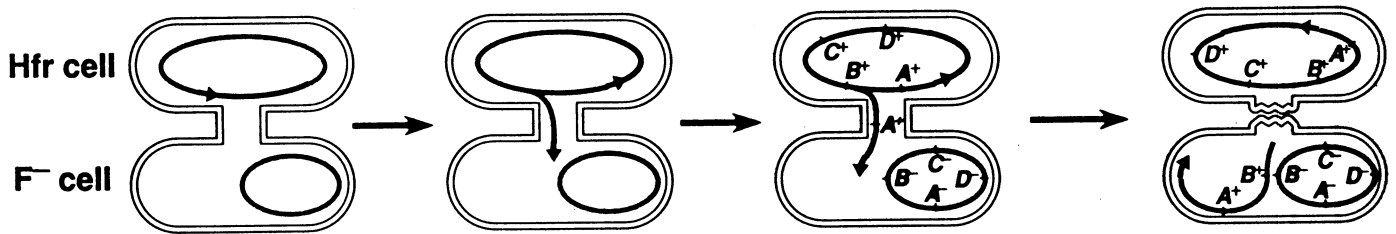
so that the donor cell remains F⁺. The arrowhead marks the point where replication and transfer begin.



(b) Conversion of an F⁺ male into an Hfr male by integration of the F plasmid (an episome) into the

chromosome. This process is similar to phage DNA joining the host chromosome as a prophage: Crossing over

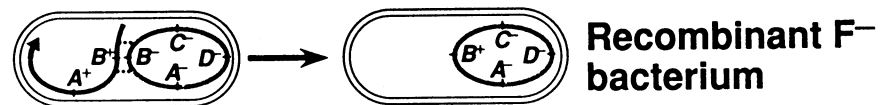
occurs between the two DNA circles at a specific site on each.



(c) Conjugation between an Hfr and an F⁻ bacterium. Replication and transfer of the "male's" chromosome begins at a fixed point (arrowhead) within the F episome. The location and

orientation of the F factor in the chromosome determine the sequence in which genes are transferred during conjugation. In this *E. coli* strain, the transfer sequence for four genes is A-B-C-D. The

conjugation bridge usually breaks before the entire chromosome and the tail end of the F episome are transferred.



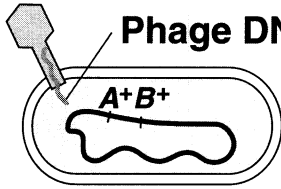
(d) Recombination between the Hfr chromosome fragment and the F⁻ chromosome. Crossing over can occur between genes on the fragment of

bacterial chromosome transferred from the Hfr cell and the same (homologous) genes on the recipient (F⁻) cell's chromosome. A recombinant F⁻ cell will result.

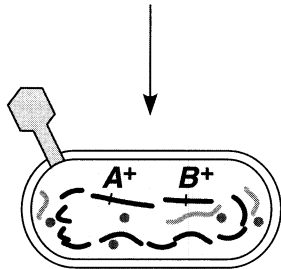
Pieces of DNA ending up outside the bacterial chromosome will eventually be degraded by the cell's enzymes or lost in cell division.

Figure 17.10 Transduction

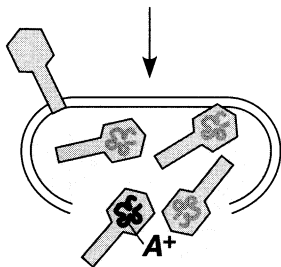
(a) Generalized transduction



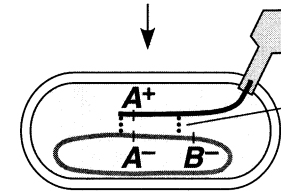
Phage infects bacterial cell.



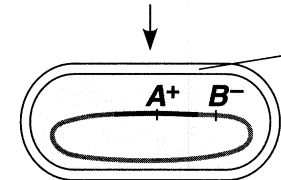
Host DNA is hydrolyzed into pieces, and phage DNA and proteins are made.



Occasionally, bacterial DNA fragments are packaged in a phage capsid.



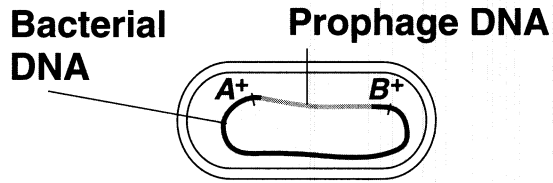
Transducing phages infect new host cells, where recombination due to crossing over can occur.



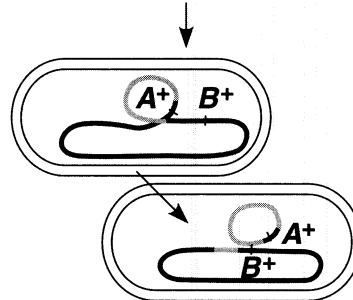
Recombinant bacteria

The recombinants have genotypes ($A^+ B^-$) different from either the donor ($A^+ B^+$) or recipient ($A^- B^-$).

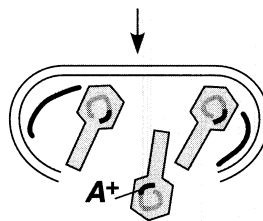
(b) Specialized transduction



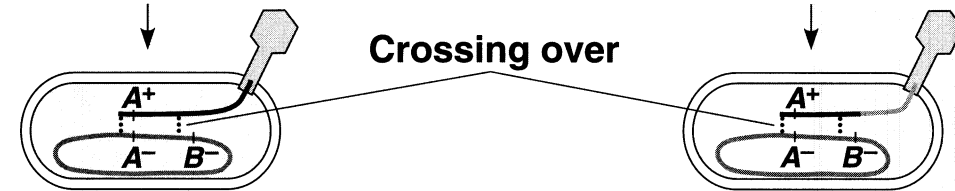
Bacterial cell has prophage integrated between genes *A* and *B*.



Occasionally, prophage DNA exits incorrectly, taking adjoining bacterial DNA with it.



Phage particles carry bacterial DNA (here, gene *A*) along with phage DNA.



Transducing phages infect new host cells, where recombination due to crossing over can occur.

