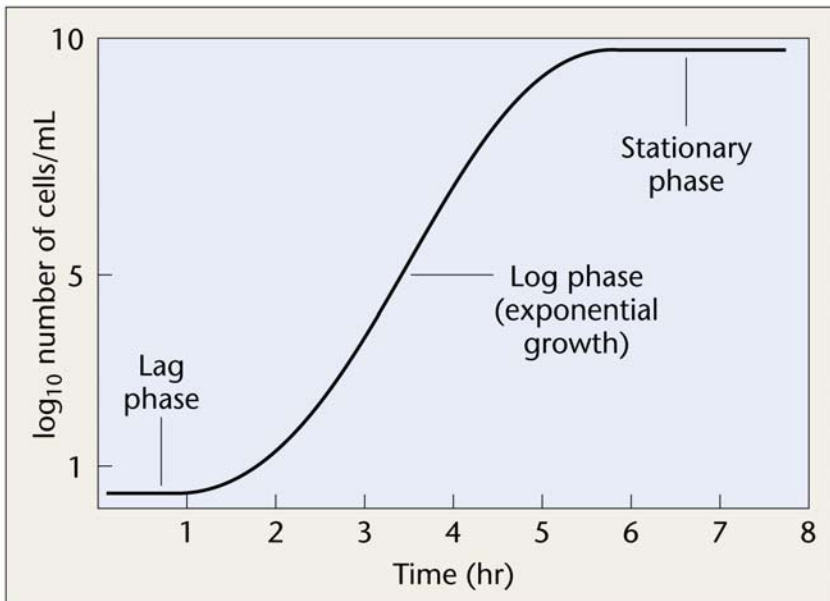


Genetic Recombination & Mapping in Bacteria

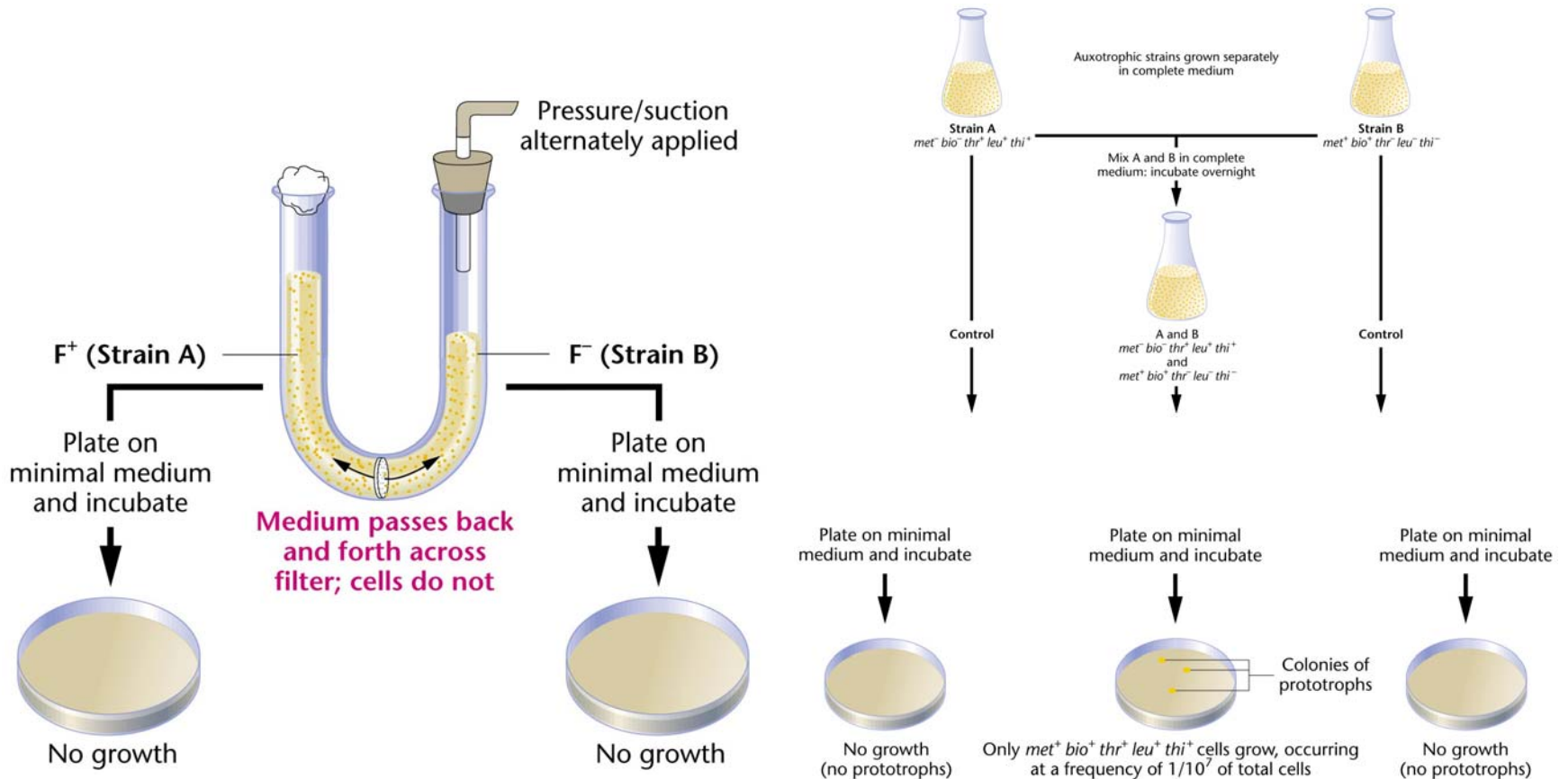
- **Three methods of Recombination in Bacteria:**
- Conjugation
- Transformation
- Transduction: Generalized transduction & Specialized transduction

Bacterial Growth



- prototrophs: synthesize all essential nutrients
- Auxotrophs: require a supplement

Conjugation



Conjugation

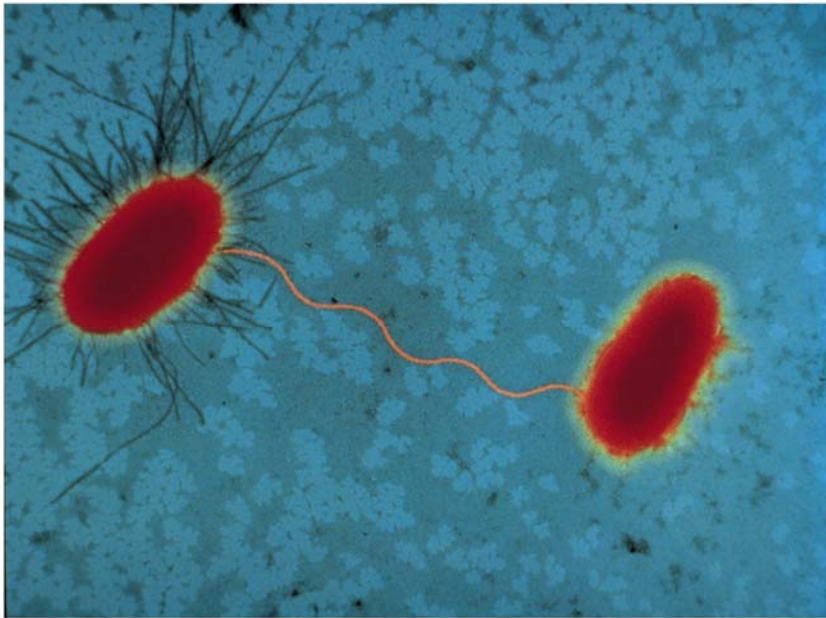
physical process

F plasmid

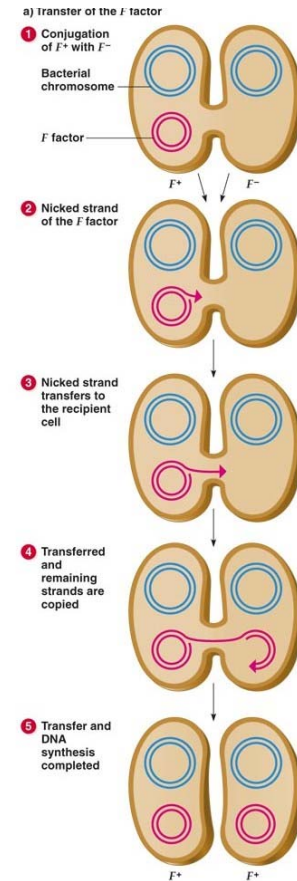
Sex pilus

F+ and F- cells

evidence for physical contact



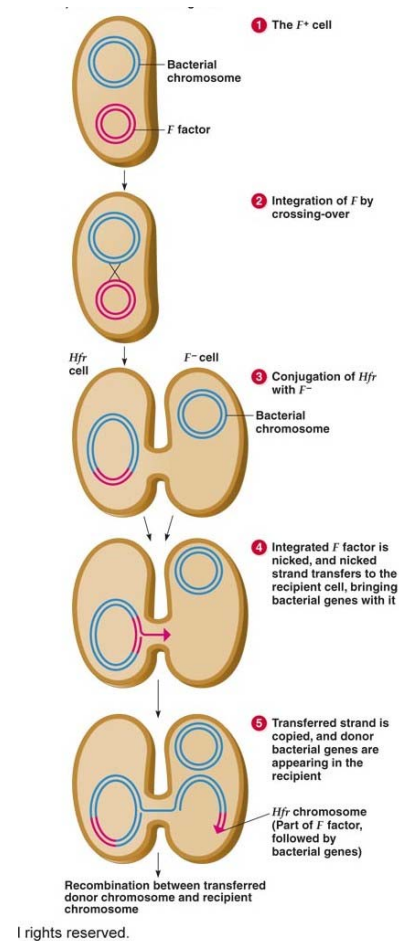
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Hfr recombination

- plasmid incorporated
- same process as F⁺ cell
- longer period, not all genes transferred
- F⁻ cell remains F⁻



Merozygotes

- Partial diploid cells (merozygotes)
- Used in gene regulation studies

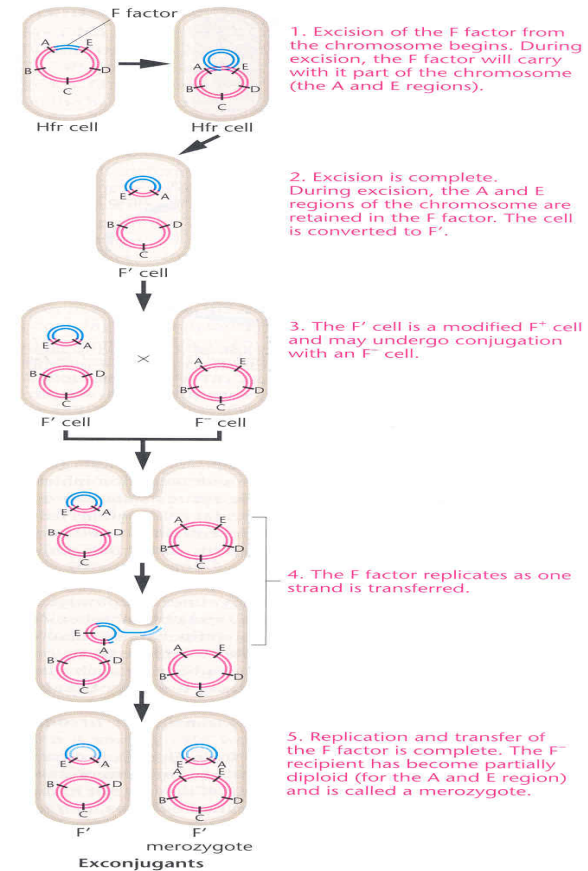
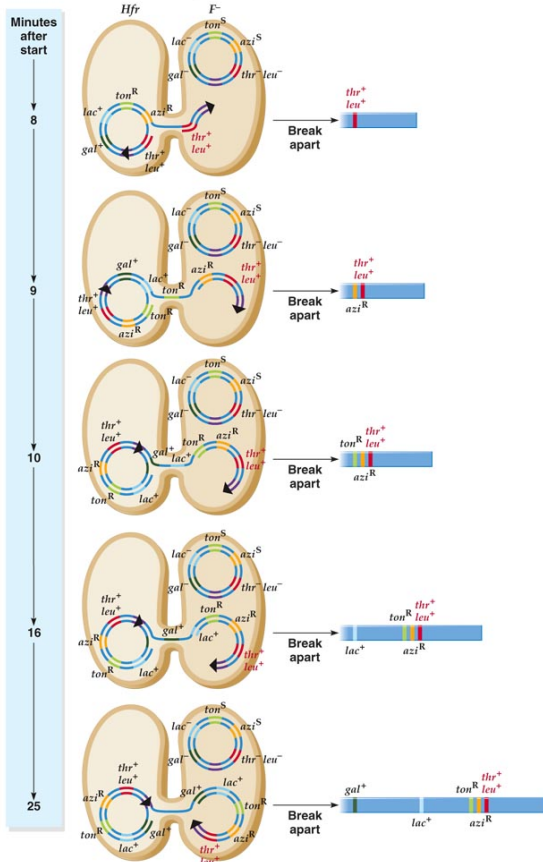


FIGURE 16-11 Conversion of an Hfr bacterium to F' and its subsequent mating with an F⁻ cell. The conversion occurs when the F factor loses its integrated status. During excision from the chromosome, the F factor may carry with it one or more chromosomal genes (A and E). Following conjugation with an F⁻ cell, the recipient cell becomes partially diploid (for the A and E region) and is called a merozygote. It also behaves as an F⁺ donor cell.

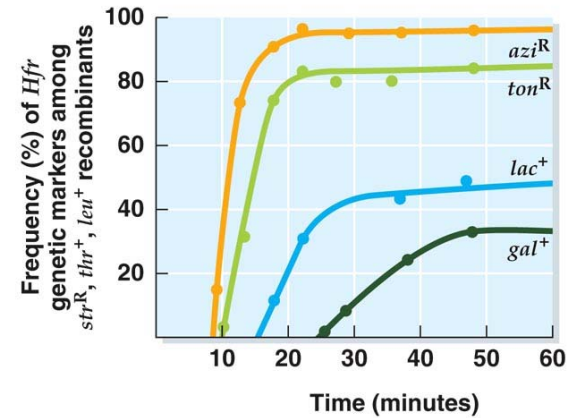
Mapping

a) Progressive transfer of donor genes to recipient during *Hfr* × *F⁻* conjugation

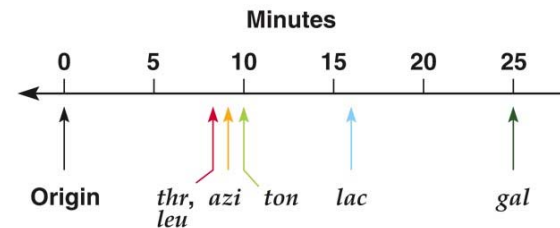


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b) Appearance of donor genetic markers in recipient as a function of time



c) Genetic map of the genes



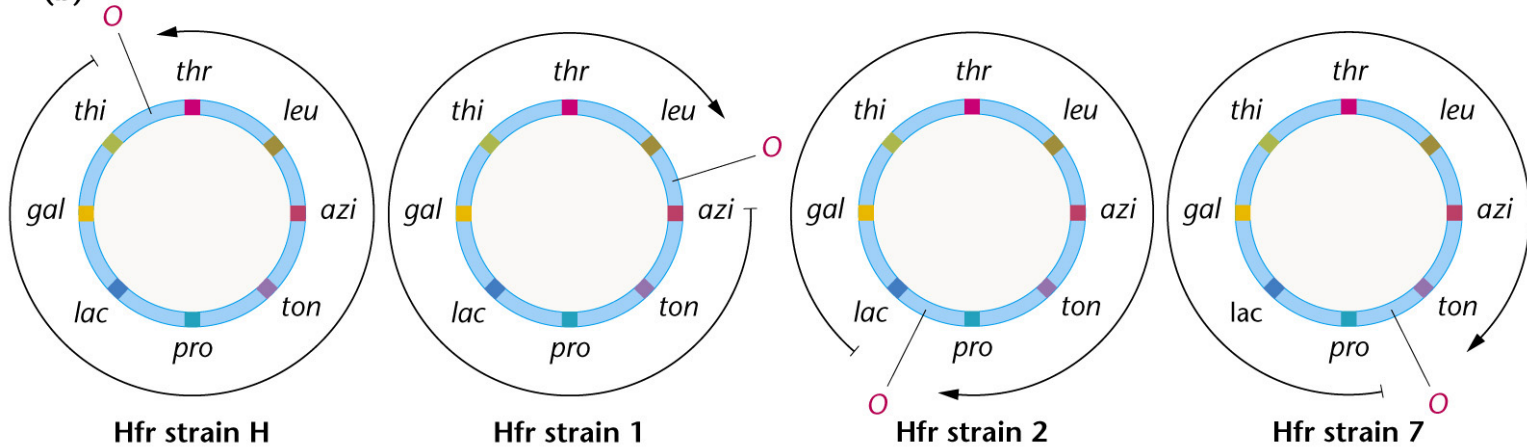
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Gene Mapping

(a)

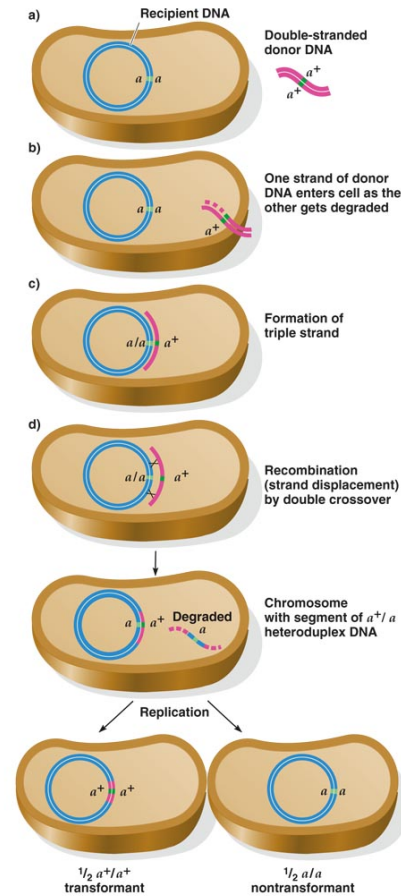
Hfr strain	Order of transfer														
	← (Earliest)										(Latest) →				
H	<i>thr</i>	-	<i>leu</i>	-	<i>azi</i>	-	<i>ton</i>	-	<i>pro</i>	-	<i>lac</i>	-	<i>gal</i>	-	<i>thi</i>
1	<i>leu</i>	-	<i>thr</i>	-	<i>thi</i>	-	<i>gal</i>	-	<i>lac</i>	-	<i>pro</i>	-	<i>ton</i>	-	<i>azi</i>
2	<i>pro</i>	-	<i>ton</i>	-	<i>azi</i>	-	<i>leu</i>	-	<i>thr</i>	-	<i>thi</i>	-	<i>gal</i>	-	<i>lac</i>
7	<i>ton</i>	-	<i>azi</i>	-	<i>leu</i>	-	<i>thr</i>	-	<i>thi</i>	-	<i>gal</i>	-	<i>lac</i>	-	<i>pro</i>

(b)



Transformation

- Exogenous DNA
- competence of cells
- linkage and gene transfer



Co-Transformation

TABLE 7.1 Results of Several Transformation Experiments That Establish Linkage between the *str* and *mtl* Loci in *Pneumococcus*

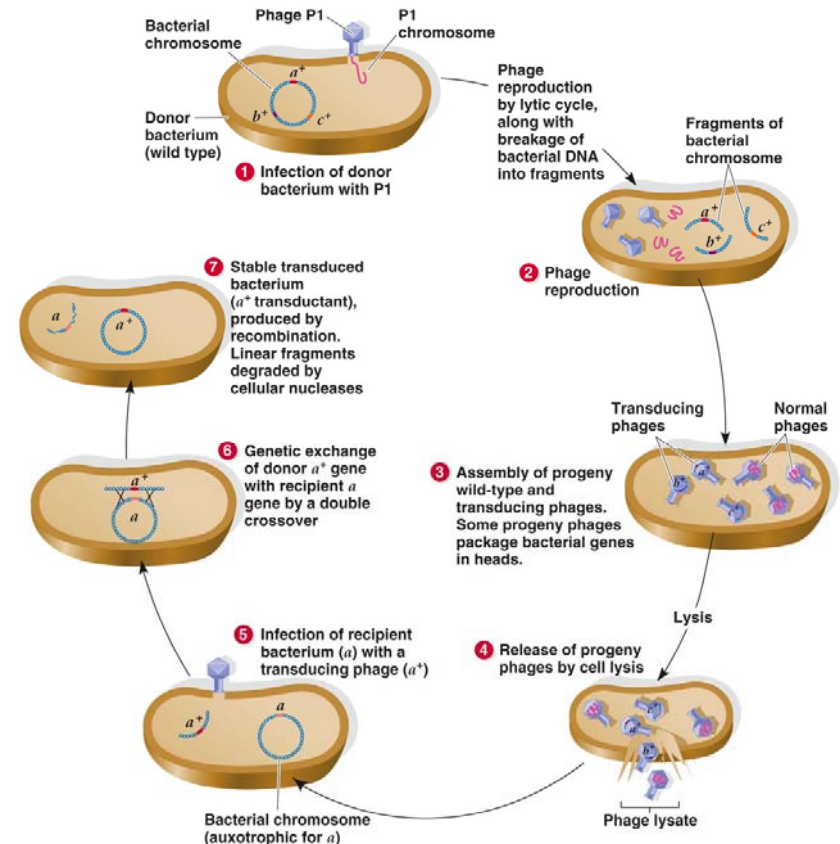
Donor DNA	Recipient Cell Genotype	Transformed Genotypes (%)		
		<i>str^r mtl⁻</i>	<i>str^s mtl⁺</i>	<i>str^r mtl⁺</i>
<i>str^r mtl⁺</i>	<i>str^s mtl⁻</i>	4.3	0.40	0.17
<i>str^r mtl⁻</i> and <i>str^s mtl⁺</i>		2.8	0.85	0.0066

Source: Data from Hotchkiss and Marmur, 1954, p. 55.

- **Linked genes**
- **Simultaneous gene transfer**
- **Second experiment using single gene mutants**
- **Double Transformation 25X fewer**

Transduction: Generalized

- Virus mediated
- lytic cycle of virus
- incorporation of bacterial DNA (random)



Transduction: Specialized

- lysogenic cycle of virus
- incorporates into bacterial genome
- excises out; can carry bacterial genes
- more specific genes

