

Chapter 25.3 Part II: Mobile Genetic Elements

1. Conservative site-specific recombination
 - Special sequences donor and recipient DNA
 - Highly specialized roles
 - **Recombinase** enzymes
3. Transposon-mediated recombination
 - Special sequences on donor (transposable element) only
 - Ubiquitous; many different mechanisms
 - **Transposase** enzymes

Mobile Genetic Elements

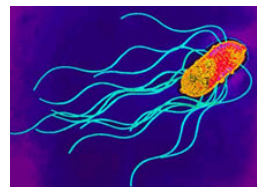


Barbara McClintock
1902–1992

Unpublished 21 p 1917
University of Wisconsin, Seventh Edition
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- "Jumping genes": sometimes called "selfish DNA"
- In contrast to homologous recombination: duplication or rearrangement of loci

Maize transposable elements



Salmonella phase variation

Conservative site-specific recombination

Specific sequences in target and donor DNA molecules

- Typical sites 14-50 bp
- Can be same or different sequences

No insertions or deletions at recombination sites

- Outcome depends on orientation of sequences

Functions:

- phage life cycle (integration and excision stages)
- eukaryotic gene manipulation (cre-lox system)
- *Salmonella* phase variation

Recombinase mechanism at a recombination site

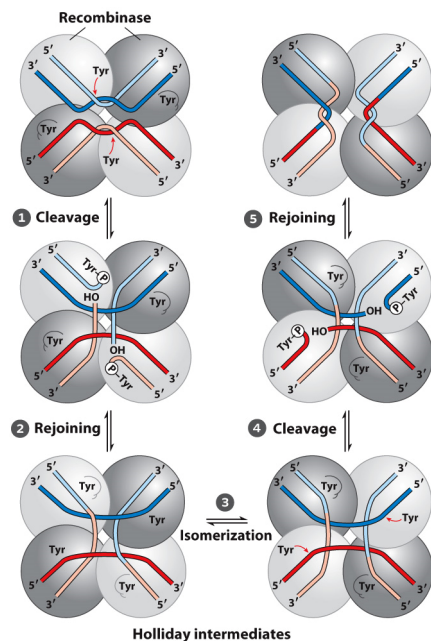


Figure 25-38a

Catalytic features:

- 1) **Phosphotyrosine bonds** form on one strand at each site (Ser too)
- 2) **Transesterification** across to other site
- 3) Repeat with second half of site (**another P-Tyr bond**)

FLP recombinase bound to recombination site

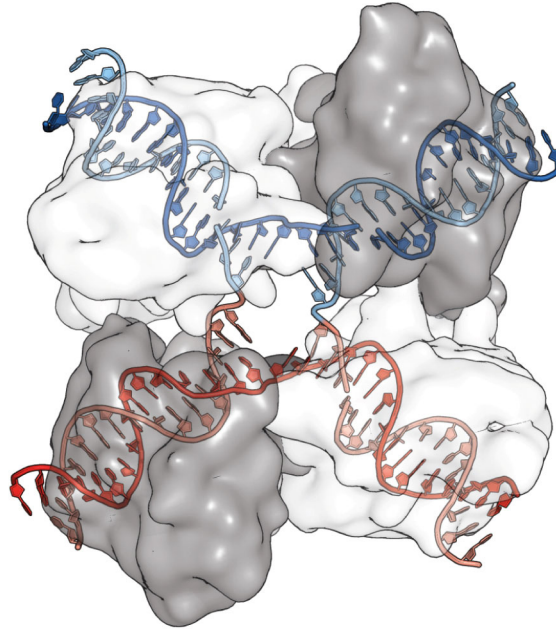
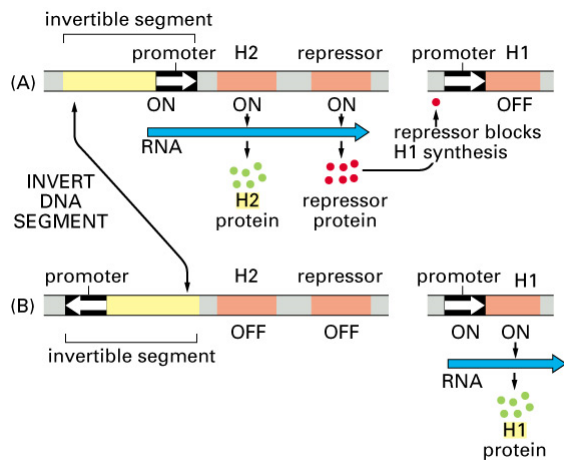


Figure 25-38b

Site-specific recombination: Phase variation in *Salmonella*



Alters type of flagellin (H1 vs. H2)

Switching occurs ~1 in 10^5 divisions

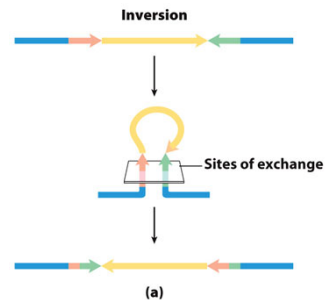


Figure 25-39
Lehninger Principles of Biochemistry, Seventh Edition
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Figure 7-64. Molecular Biology of the Cell, 4th Edition.

Transposon-mediated recombination

Specific sequences (inverted repeats) in donor DNA; more or less random insertion into target DNA (although some preferences)

- Inverted repeats of ~9-25 bp
- In between repeats: genes for transposition (transposase) and sometimes other genes

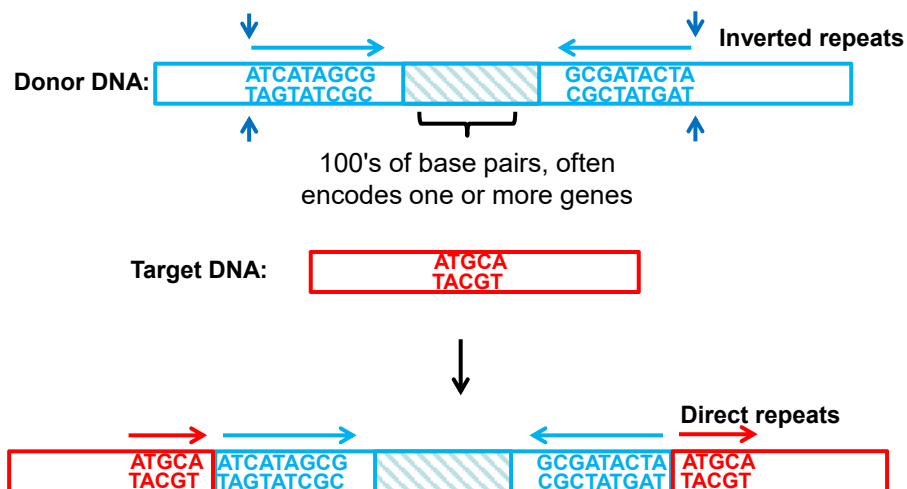
Process of (direct) transposition causes short duplications at target site

- more complicated mechanisms (retrotransposition, replicative transposition) exist

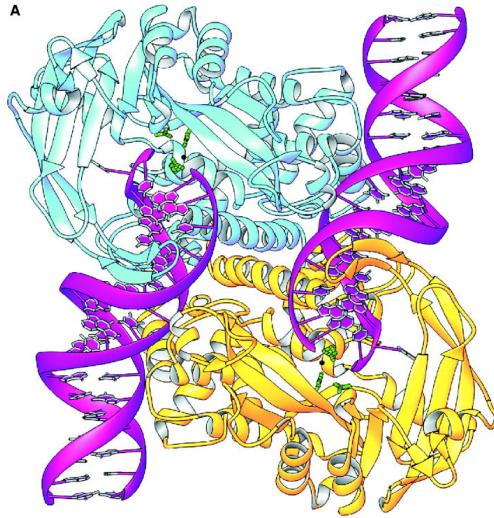
Every organism has characteristic types

- Human and plant genomes- nearly half transposable elements!

Direct (non-replicative) transposition mechanism



Tn5 transposase/DNA complex



D R Davies et al. Science 2000;289:77-85

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Recombination and GM plants

Transgenic (genetically modified or GM) plants are engineered for many reasons

- Plants with virus coat proteins/enriched nutritional value, or improved environmental properties
- Antibiotic resistance genes
- Pest resistance: Bt cry toxin
- Produce pharmaceuticals

Your next vaccination...
Eat your bananas!



A question of "false balance"

- National Academy of Sciences study:
nas-sites.org/ge-crops



- Jon Entine; geneticliteracyproject.org

