Topic C
Dynamic DNA - Mobile DNA

Simple sequences (minisatellite)

Unique DNA (<5% in eukaryotes)

Gene family (globin)

Tandem genes (rRNA..)

9.3 Mobile DNA moderately repeated

Mostly in Eukaryotes
Process of moving - Transposition
“molecular parasites” Selfish DNA
Very slow process for elimination

9.3 Mobile DNA

First found in corn (1940, B. MaClintock)
Weak similarity to bacterial elements

Transposition is in 2 modes:

DNA only
RNA intermediate

9.3 The two classes of mobile elements

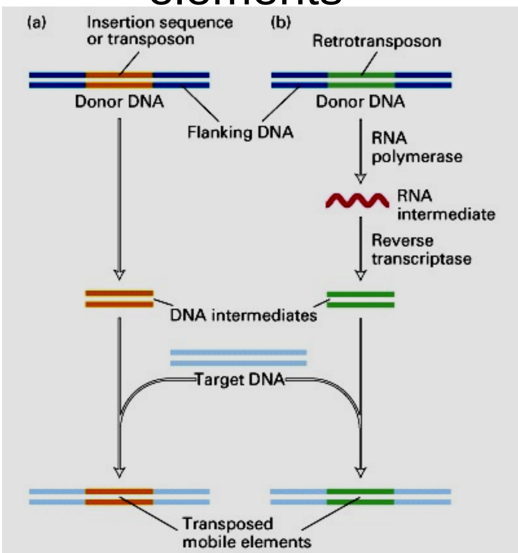


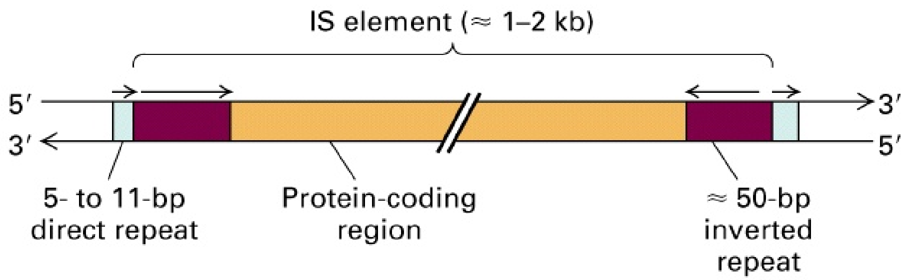
Figure 9-10

9.3 Mobile elements may move as

TABLE 9-3 Major Types of Mobile DNA Elements

Type	Structural Features	Mechanism of Movement	Examples
DNA-MEDIATED TRANSPOSITION			
Bacterial insertion sequences (IS elements)	≈50-bp inverted repeats flanking region encoding transposase and, in some, resolvase	Excision or copying of DNA and its insertion at target site	IS*1*, IS*10*
Bacterial transposons	Central antibiotic-resistance gene flanked by IS elements	Copying of DNA and its insertion at target site	Tn9
Eukaryotic transposons	Inverted repeats flanking coding region with introns	Excision of DNA and its insertion at target site	P element *(Drosophila)* Ac and Ds elements (corn)
RNA-MEDIATED TRANSPOSITION			
Viral retrotransposons	≈250- to 600-bp direct terminal repeats (LTRs) flanking region encoding reverse transcriptase, integrase, and retroviral-like Gag protein	Transcription into RNA from promoter in left LTR by RNA polymerase II followed by reverse transcription and insertion at target site	Ty elements (yeast) *Copia* elements *(Drosophila)*
Nonviral retrotransposons	Of variable length with a 3′ A/T-rich region; full-length copy encodes a reverse transcriptase	Transcription into RNA from internal promoter; folding of transcript to provide primer for reverse transcription followed by insertion at target site	F and G elements *(Drosophila)* LINE and SINE elements (mammals) *Alu* sequences (humans)

9.3 General structure of bacterial IS elements

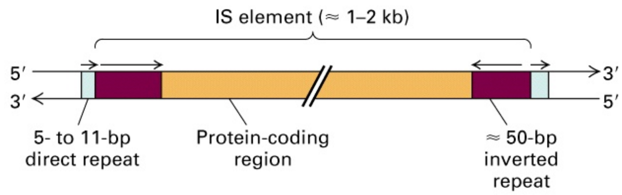


Transposase: excision and insertion

20 types in E. coli, seen in heteroduplex view

Figure 9-11

9.3 General structure of bacterial IS elements



Frequency of transposition:
1/1000-1/10000 per generation
In specific site - 10^{-5} - 10^{-7}
Reversion 10^{-6} - 10^{-10}

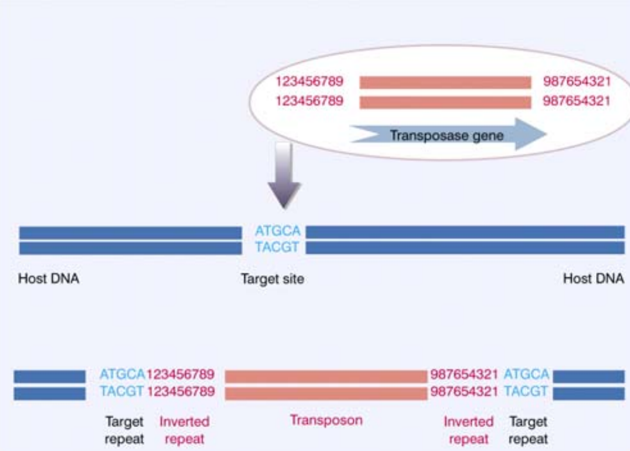
Figure 9-11

9.3 General structure of bacterial IS elements

Transposition is random site
In lysogenic virus - insertion to new cell

Transposon - basic

Figure 15.1 Overview: transposons have inverted terminal repeats and generate direct repeats of flanking DNA at the target site. In this example, the target is a 5 bp sequence. The ends of the transposon consist of inverted repeats of 9 bp, where the numbers 1 through 9 indicate a sequence of base pairs.



			Overall length	Target selection
IS1	9 bp	23 bp	768 bp	random
IS2	5 bp	41 bp	1327 bp	hotspots
IS4	11-13 bp	18 bp	1428 bp	$AAAN_{20}TTT$
IS5	4 bp	16 bp	1195 bp	hotspots
IS10R	9 bp	22 bp	1329 bp	NGCTNAGCN
IS50R	9 bp	9 bp	1531 bp	hotspots
IS903	9 bp	18 bp	1057 bp	random

9.3 General structure of bacterial transposons

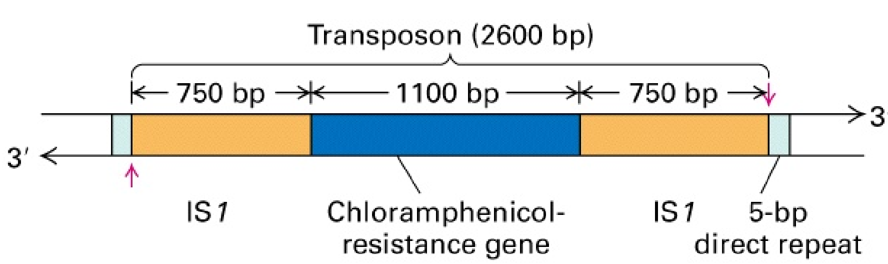
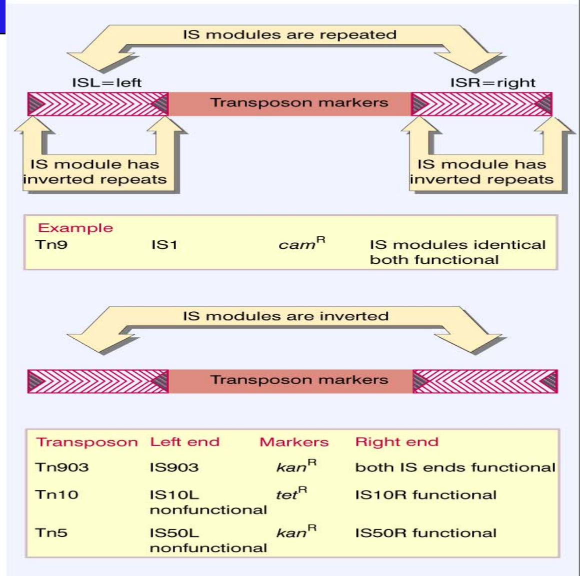


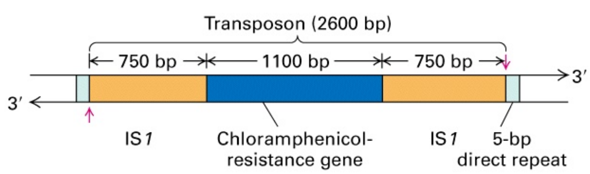
Figure 9-13

Transposon - bacterial

Figure 15.2 A composite transposon has a central region carrying markers (such as drug resistance) flanked by IS modules. The modules have short inverted terminal repeats. If the modules themselves are in inverted orientation (as drawn), the short inverted terminal repeats at the ends of the transposon are identical.



9.3 bacterial transposons - valuable tools



Easily selected (antiboitic resistant)
Act as a one site mutagen
Can be inserted into plasmid, viral etc

Figure 9-13

9.3 Eukaryotic transposons - valuable tools

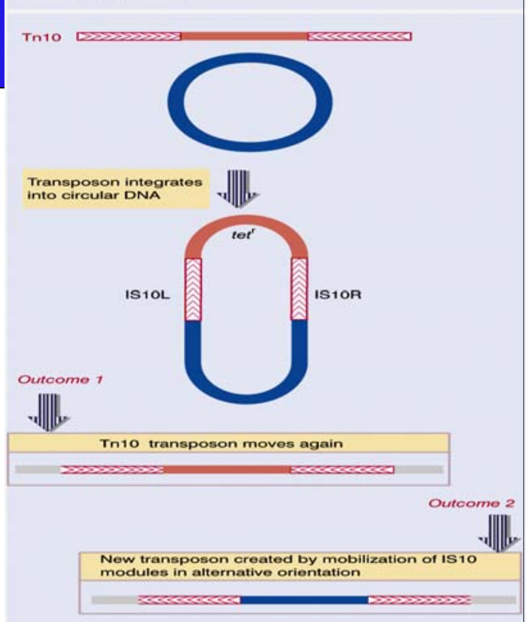
In corn
In fly
(50% of spontaneous mutation are mobile DNA)

Drosophila - P element, non replicative mechanism mode to introduce mutations

Figure 9-13

Transposon - Creating a new one

Figure 15.3 Two IS10 modules create a composite transposon that can mobilize any region of DNA that lies between them. When Tn10 is part of a small circular molecule, the IS10 repeats can transpose either side of the circle.



See you in few weeks….

Enjoy