A. Prokaryotic Transposons:
   - Are
   - Can move
   - Transposition provides

   - Are found
   - Transposon carries
     •
   - Can be lots of
     • Often they

1. Types of bacterial transposons
   a. Insertion sequences
      - Simplest
      - Found
      - *E. coli* likely to contain

      - Are autonomous units =

      - Composition of IS elements:
        i. Inverted
           - repeats are
        ii. Direct repeats
           - Target sequence that

           - Usually
iii. Transposase
- enzyme
- creates
- recognizes the
- only inverted repeats

- most IS elements
- IS1 has 2 ORFs =

<table>
<thead>
<tr>
<th>Transposon</th>
<th>Target repeat (bp)</th>
<th>Inverted repeat (bp)</th>
<th>Overall length</th>
<th>Target selection</th>
</tr>
</thead>
<tbody>
<tr>
<td>IS1</td>
<td>9</td>
<td>23</td>
<td>768</td>
<td>Random</td>
</tr>
<tr>
<td>IS2</td>
<td>5</td>
<td>41</td>
<td>1327</td>
<td>Hotspots</td>
</tr>
<tr>
<td>IS4</td>
<td>11–13</td>
<td>18</td>
<td>1428</td>
<td>AAAN20TTT</td>
</tr>
<tr>
<td>IS5</td>
<td>4</td>
<td>16</td>
<td>1195</td>
<td>Hotspots</td>
</tr>
<tr>
<td>IS10R</td>
<td>9</td>
<td>22</td>
<td>1329</td>
<td>NGTNASCN</td>
</tr>
<tr>
<td>IS50R</td>
<td>9</td>
<td>9</td>
<td>1531</td>
<td>Hotspots</td>
</tr>
<tr>
<td>IS903</td>
<td>9</td>
<td>18</td>
<td>1057</td>
<td>Random</td>
</tr>
</tbody>
</table>
b. Composite transposons
- Some transposons
- Often these are
- Called
- Are composite elements because
- Arms may be

- In some cases

- Other cases
  - Functional IS arm can
  - Explains how
c. TnA-family transposons
   - Large
   - Are not
   - Carry genes for
   - Have unusual ends =
   - Transposition requires

2. Movement (transposition) mechanisms
   a. Replicative mechanisms
      - Element is
        • One element
        • Copied element
      - Stages of insertion
        i. Staggered nicks
        ii. Transposon joined
      iii. Single stranded end gaps

      - explains how
      - Replicative element
      i. Transposase acts
      ii. Resolvase acts
b. Nonreplicative transposition
   - Element moves
     - Stages
       i. Transposon
          - requires only
       ii. Transposon
       iii. Gapped donor site
c. Target sequences
   - Choice of target
   - In some cases,
   - Other cases =
     i. Consensus
     ii. DNA
     iii. Protein
       - Explains why

3. Consequences of transposition
   a. DNA rearrangements
      - When one transposon
        - Consequences depend on
          i. Oriented as direct repeats
             - intervening region
          - one complete element
ii. Oriented as inverted repeats
   - region between

b. Excision of an element
   - Precise excision occurs

   - Very rare event =

   - Most excision events are imprecise =

4. Transposition details
   a. Common mechanisms
      - Target and transposon

      - Nicked ends

      - Phage Mu is
- Phage uses transposition in 2 ways
  i. Integrates into
  ii. During lytic cycle,

- Early stages of Mu transposition
  i. MuA transposase binds
    - Also bind
    - MuA binding
  ii. Tetramer of MuA
    - L3 and R3
  iii. MuA cleaves DNA
    - MuA bond
  iv. MuB selects

- What happens next
b. Replicative transposition
   i. Starts with formation
      - element and
      - each end of the transposon
   ii. Replication extends
      - replication accomplished
   iii. Cointegrate formed
      - has direct repeats
   iv. Homologous recombination at transposons
c. Nonreplicative transposition
   - Can occur
     i. Crossover complex
        - no replication
        - another set
        - single-stranded regions

ii. Double-stranded breaks formed in transposon DNA
    - Single-stranded
    - Double-stranded breaks
    - Reaction is catalyzed
    - Transposon released
d. Transposition in TnA transposons
   - Uses replicative
   - Requires transposase

   - TnpA binds
   - *E. coli* host factor
   - TnpA recognizes
   - TnpB involved in
   - TnpB promotes
   - *res* site contains
   - TnpB breaks DNA

- Reaction is a
- Similar to
B. Eukaryotic Transposons:
- Transposable elements
  1. Transposable elements of Corn (Maize)
     a. Genetic considerations
        - Transposons first

- Observed

- Occurred because

b. Molecular considerations
- Corn genetic nomenclature
  =

- Recessive alleles

- Ds =

- All genes downstream
c. Types of elements in Corn

- Autonomous =
- Nonautonomous =
  - Still have
  - Can be

### Maize transposon families

<table>
<thead>
<tr>
<th>Transposes are autonomous or nonautonomous</th>
</tr>
</thead>
<tbody>
<tr>
<td>Autonomous</td>
</tr>
<tr>
<td>Transposes independently</td>
</tr>
<tr>
<td>Moves to new site</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ac (activator)</th>
<th>Da (dissociation)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mm (modulator)</td>
<td></td>
</tr>
<tr>
<td>Spm (suppressor-mutator)</td>
<td>dSpm (defective Spm)</td>
</tr>
<tr>
<td>En (enhancer)</td>
<td>l (inhibitor)</td>
</tr>
<tr>
<td>Dotted</td>
<td>Unnamed</td>
</tr>
<tr>
<td>MuDR (mutator)</td>
<td>Mu</td>
</tr>
</tbody>
</table>

### 2. P-elements of Drosophila
   a. General characteristics
      - Drosophila stocks have

      - Lab stocks are
      - Flies caught in wild today
      - Within 100 years,
      - P-elements produce
        - P-elements can translate
b. Splicing in P-elements

i. In somatic tissues =
   - 3rd intron is

ii. Germline =
   - 3rd intron

- host factor in germline

c. Consequences of having P-elements:
   i. Hybrid dysgenesis
      - strains with P-elements
      - effects depend on
      - are flies with

- P male x M female crosses are infertile
  - Hybrid appears normal, but is sterile
  - No progeny
- hybrid dysgenesis occurs

ii. P-elements are used to make transgenic flies
   - in a test tube,
   - clone
   - inject “recombinant” plasmid
   - recombinant element
   - cross out the