DNA transposons in Eukaryotes

P-elements in *Drosophila*

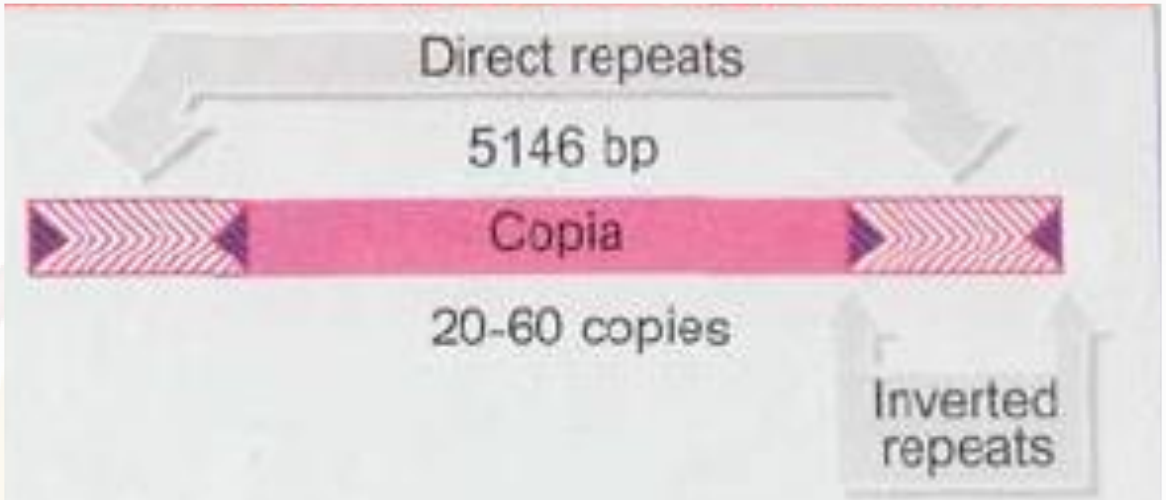
Transposable elements in *Drosophila*

Three types of transposable elements have been characterized in *Drosophila melanogaster*

1. ***copia*-like elements**: These elements carry long direct terminal repeats.
2. **fold-back (FB) elements, :** element characterised by presence of long terminal inverted repeats.
3. **P elements**: P elements are characterized by presence of perfect terminal inverted repeats of 31 bp

Three types of transposable elements of *Drosophila*

1.



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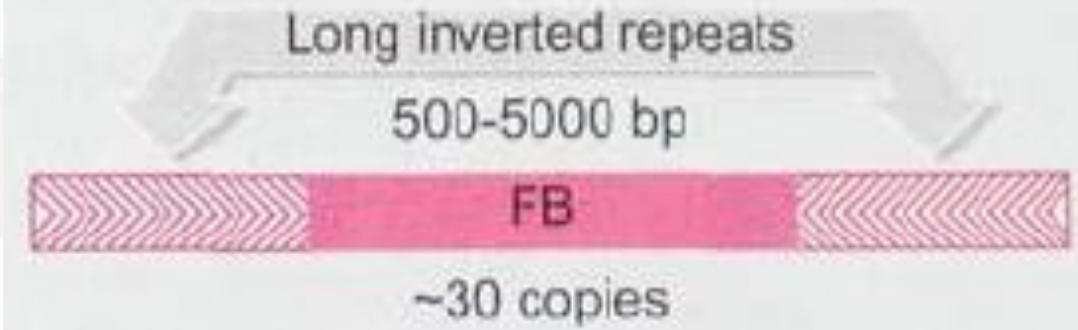

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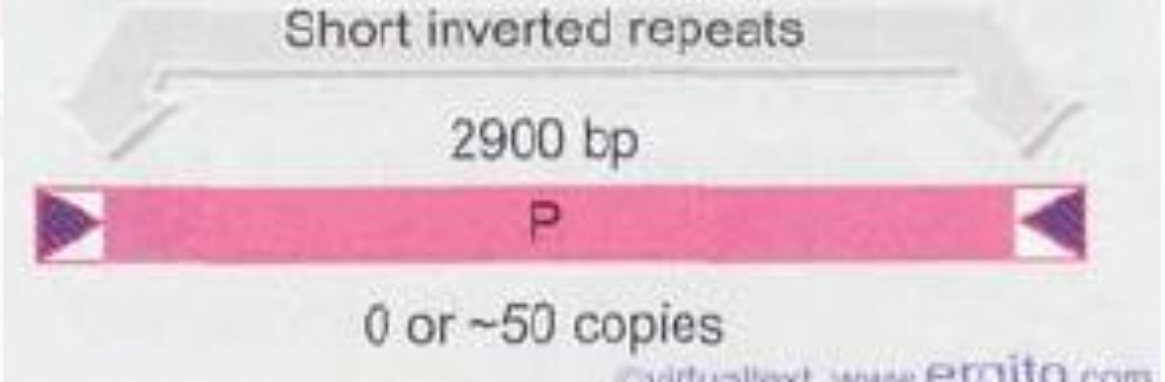


Characteristics of P elements of *Drosophila*

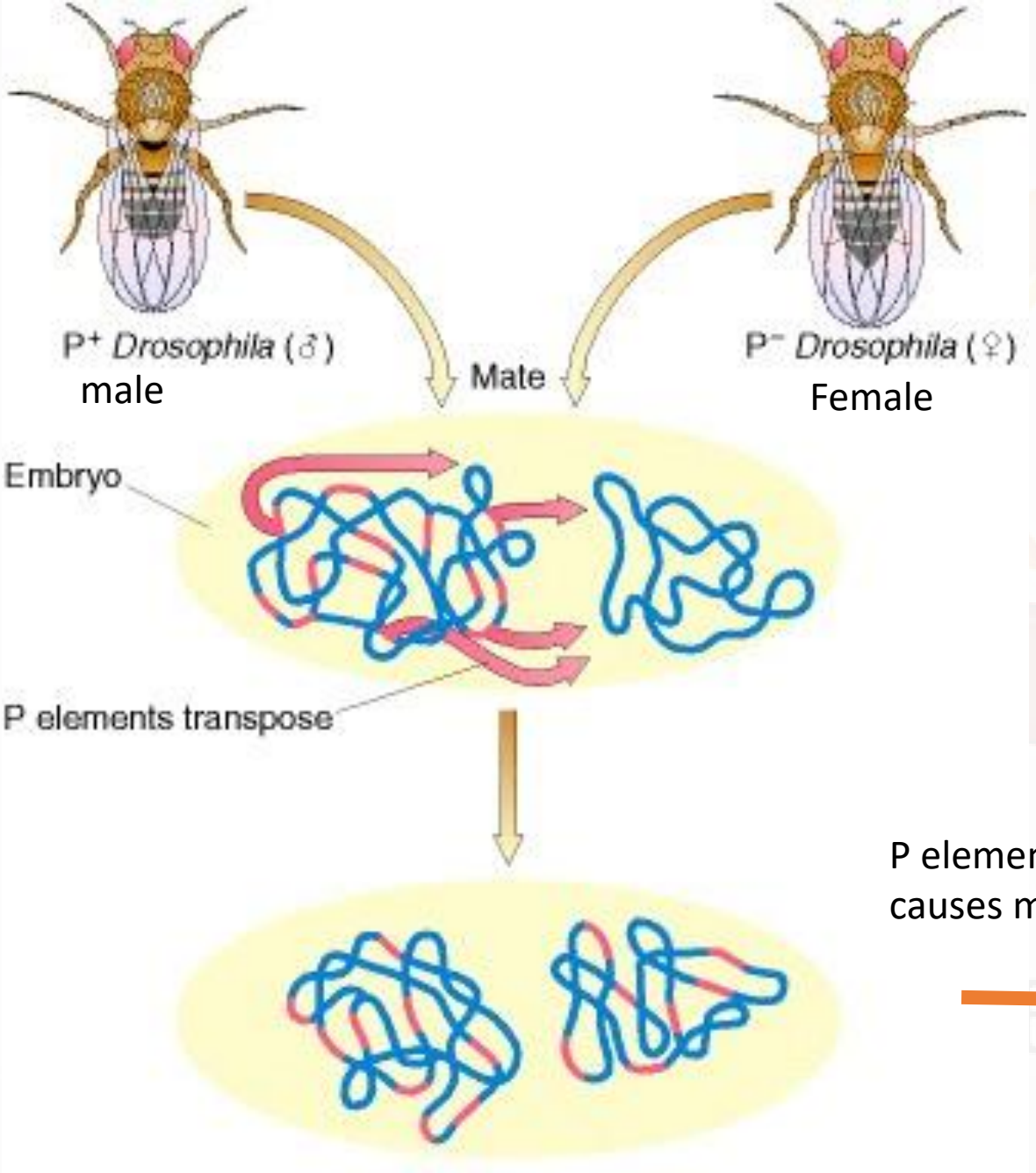
- Size : from 0.5 to 2.9 kb in length. Number: a few to ~50 copies pr individual
- All P elements carry perfect terminal inverted repeats of 31 bp.
- P element has 4 open reading frames, separated by introns.
- Splicing of the first 3 ORFs generates a 66 kD repressor, and occurs in all cells.
- Splicing of all 4 ORFs to generate the 87 kD transposase occurs only in the germline, by a tissue-specific splicing event.
- The burst of P-element transposition events inactivates the genome by random insertions.

Hybrid dysgenesis in Drosophila

The mobilization of P-element DNA sequences in *Drosophila* embryos causes the phenomenon of Hybrid dysgenesis

- When a sperm from a P-carrying male strain fertilizes an egg from a non-P-carrying female strain, the P elements transpose throughout the genome, usually disrupting vital genes.
- The progeny show a range of phenotypes that are manifested in the germ line, including sterility, a high mutation rate, and a high frequency of chromosomal aberration and nondisjunction.
- These hybrid progeny are “dysgenic” or biologically deficient

Hybrid dysgenesis in Drosophila



P element insertion causes muattions

Progeny sterile at high temperature

https://biocyclopedia.com/

Hybrid dysgenesis is determined by the interactions between P elements in the genome and 66 kD repressor in the cytoplasm

- Cross between a male non-P strain (P^- type) and a female P strain (P^+ type) gives normal progeny, but when a male a P-strain mates with non-P female strain, the offspring are sterile.
- The cytoplasm of flies with P element (P^+ type) contains a repressor that prevents P element transposition.
- In any cross involving a P^+ female, presence of repressor prevents either synthesis or activity of the transposase.
- But when the female parent is non-P strain (P^-) type, there is no repressor in the egg, and the introduction of a P element from the male parent results in activity of transposase in the germline.

Application of P elements

The P elements have become major tools of the modern *Drosophila* geneticist, being used to :

- **Gene tagging for cloning**: genes mutated by P element insertion can be isolated and "discovered" by using the P element sequence as a "tag”

- **Transformation vectoring**: genes or sequences of interest are "vectored" into a chromosomal location by putting the gene/sequence of interest into an incomplete P element (no transposase) and carrying out a mixed infection (transformation or electroporation) with a complete P element.

P-element-mediated germ line transformation

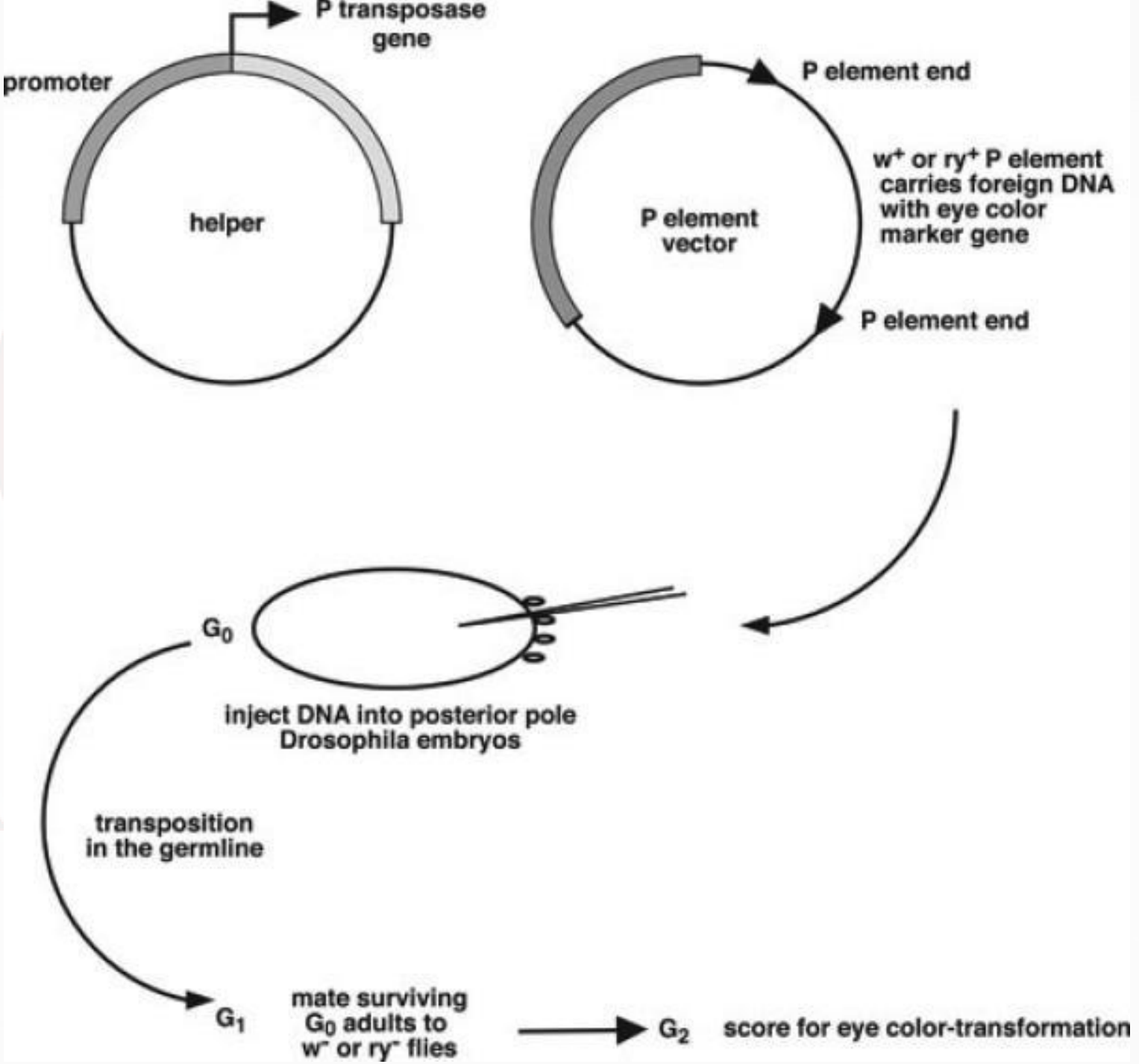


Figure reference Majumdar and Rio 2014

References

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