From infection to co-optation: Long term dynamics of transposable elements and host genomes

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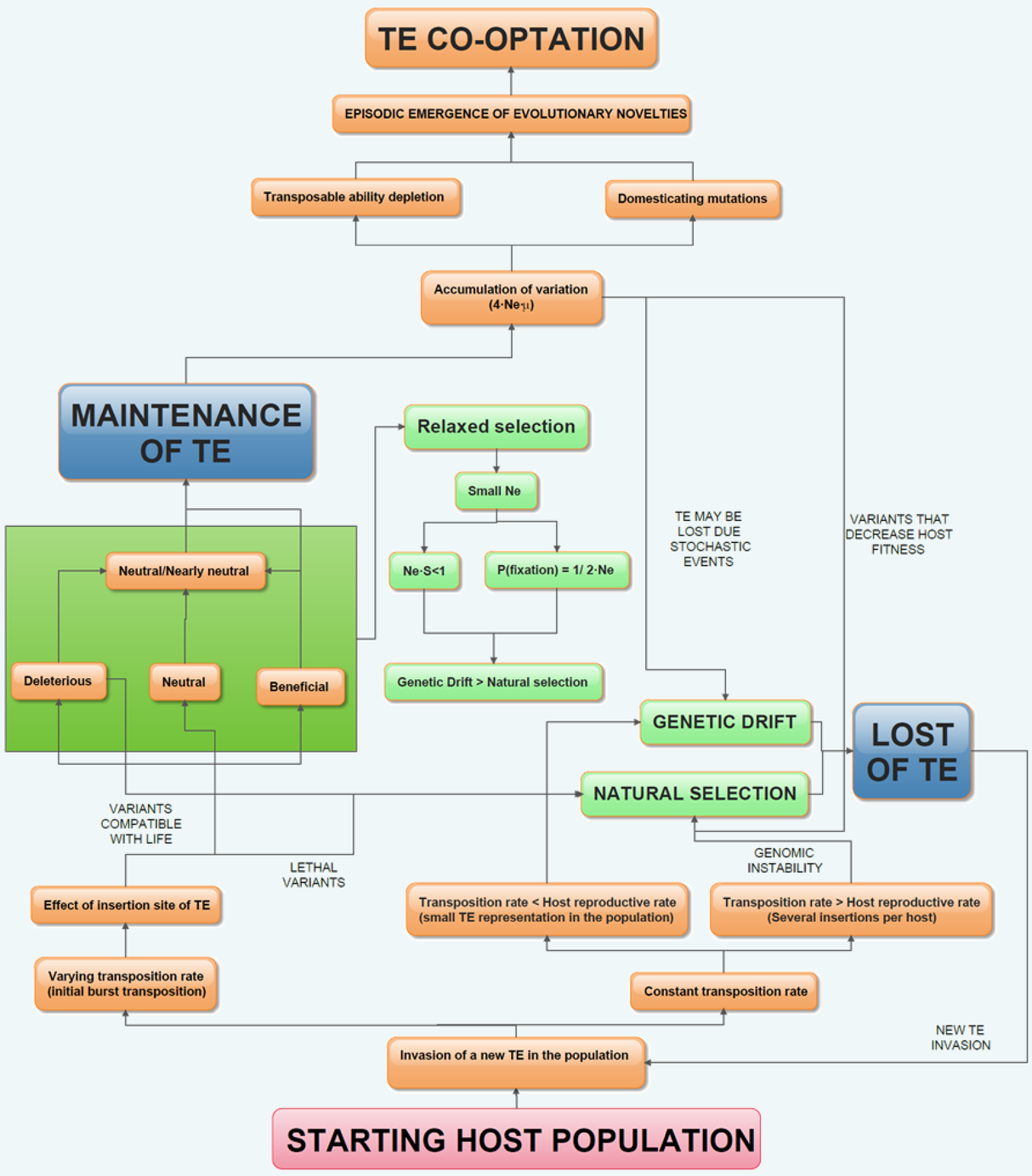
Introduction

The aim of this essay is to explain the importance of transposable elements (TEs) for host genome evolution. TEs contribute to genomic evolution by host co-optation of their codificant and regulatory sequences. In order to set forth this topic, an hypothetical evolutive dynamic is proposed, regarding since the infection of transposable elements into the population, until the elements are lost or co-opted. Also, a some examples will be provided, in an attempt to show different molecular systems that had been formed by molecular co-optation of transposable elements.

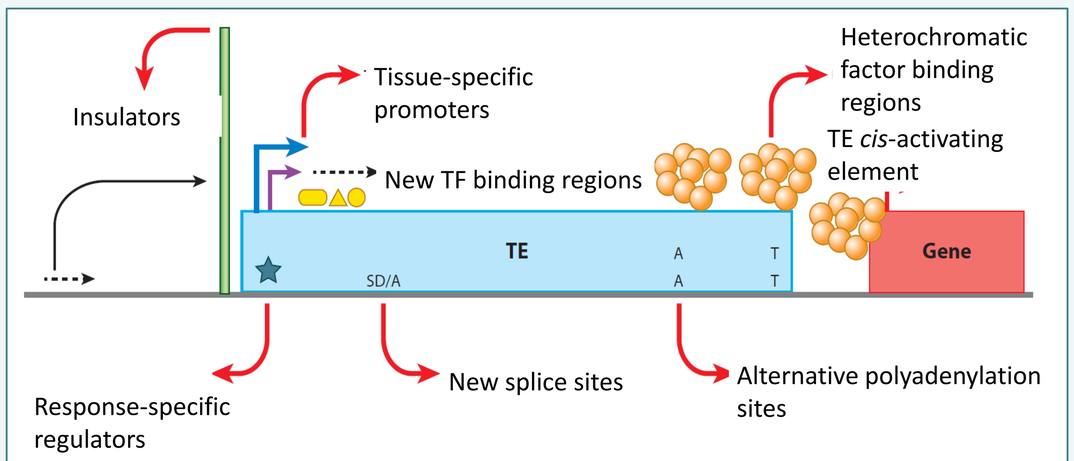
Backtracking of co-opted TEs (2,3)



Co-optation

Co-optation is defined as the process by which a structure or system with an original function adds or changes a new function towards the nucleus, cell or organism. Concretely, in this context, co-optation is the processes by a TE sequence become part of a pre-existent system of the host genome, giving rise to an evolutionary novelty (1).

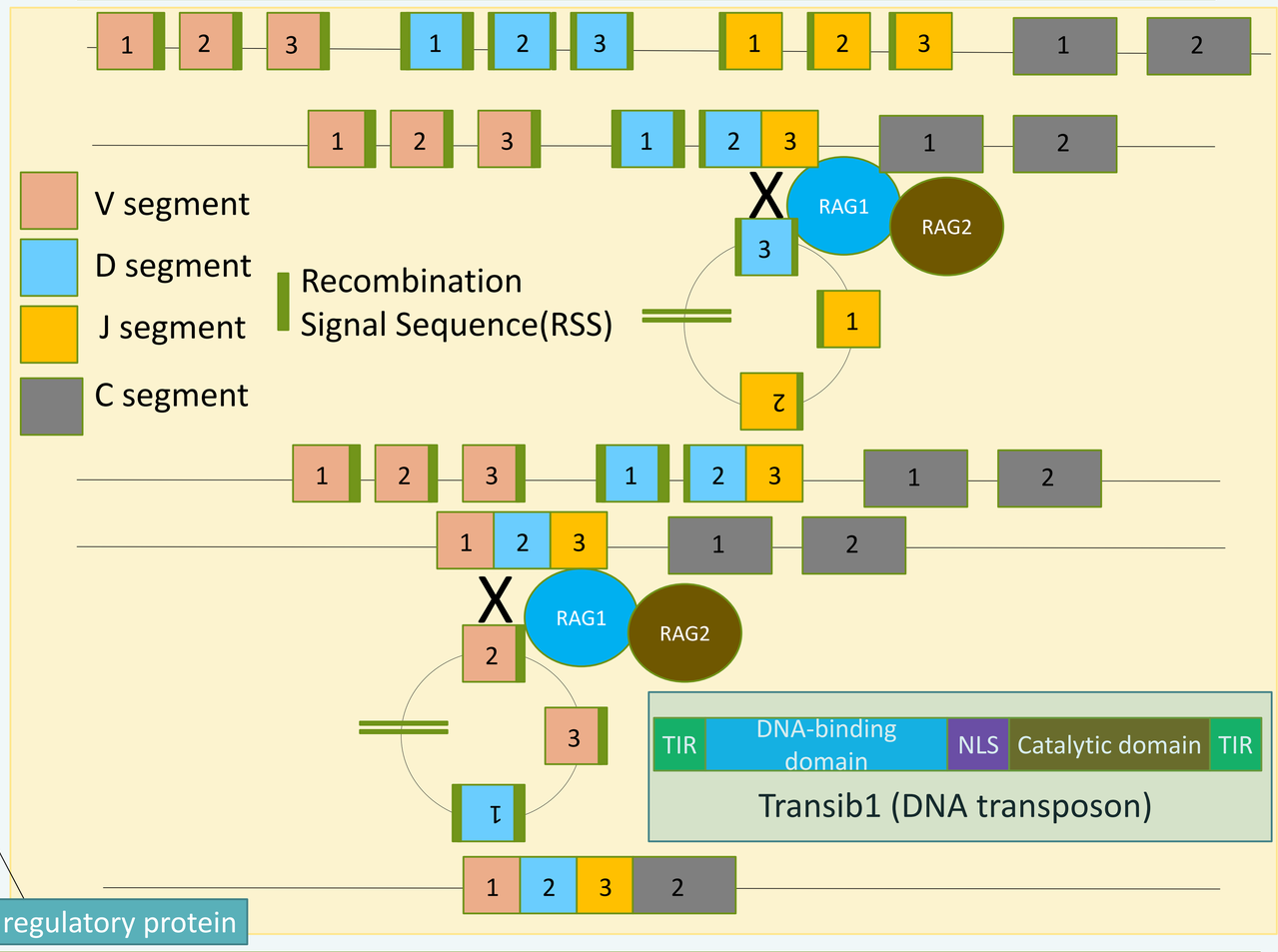
Molecular co-optation of a TE: Concepts (4)



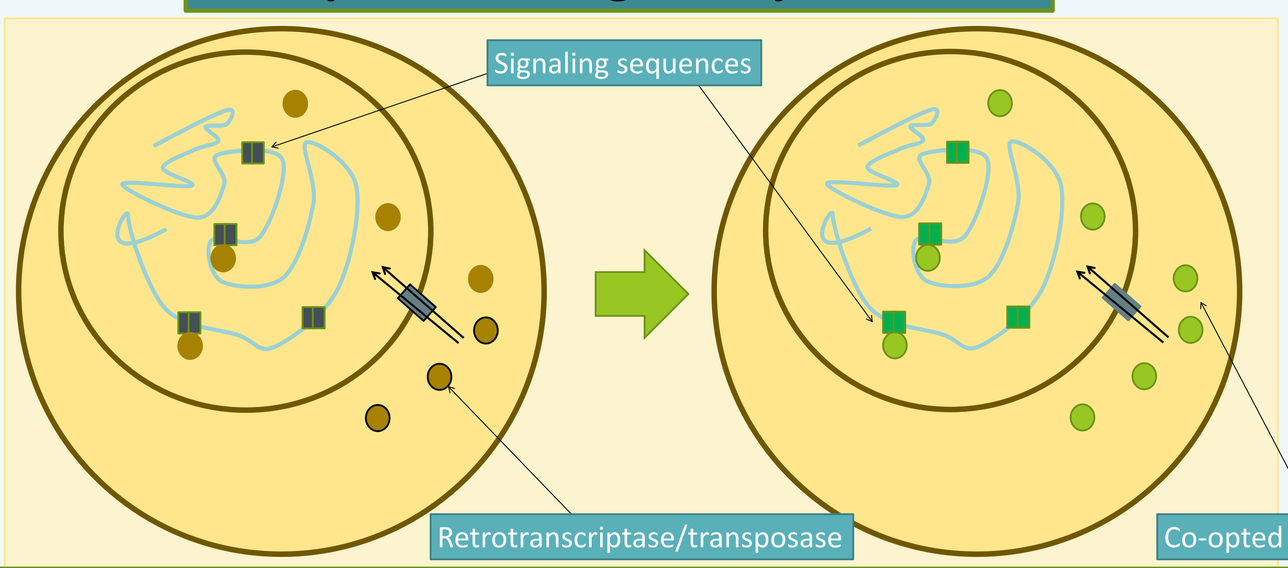
	POL II	POL III	Enhancer	Transcription factor	Environment response elements	Insulators	Heterochromatin	Poly(A) sites	Termination site (POL III)	Splice sites
								A A	T T	SD/A
LTR	✓		✓	✓	✓	✓	✓	✓		✓
LINE	✓		✓	✓				✓	✓	✓
SINE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
DNA	✓		✓	✓	✓			✓		✓

Modified from Rebollo, et al. (4)

Molecular co-optation of a TE: the V(D)J system (5)



Co-optation of regulatory networks



Conclusions

This are the concluding remarks:

- TEs have been recurrently recruited into genomes and hence, TEs have formed or rewired new gene regulatory networks.
- Molecular dynamics of TEs are complex, and different processes happen during their so-called "struggle-for-life": Infection of host populations, burst transposition, maintenance into the population, accumulation of variation, depletion of transposable ability and domesticating mutations between others.
- Co-optation of TEs is broad. TEs can be co-opted into different roles: efficiency binding site for the POL II, POL III, for binding activator elements (enhancers) transcriptional factors, heterochromatic factors (insulators or heterochromatin extenders), alternative splice sites and different polyadenylation sites.
- Co-optation of transposase DNA-binding domains may lead to retain a group of unlinked binding sites, dispersed in the genome, and/or co-opt their interactions with host regulatory proteins.
- Every transposase has *cis*-preference for its related TIR sequence (or close-related TIR sequences) therefore, determining the future specificity .
- Modular evolution of proteins plays a special role with co-optation of TEs. TEs ORFs can be combined and shuffled with host domains, leading to the formation of new protein domains, new combinations and therefore, novel functions.

Bibliography

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