Transposon

A **transposon**, also known as a **jumping gene**, is a segment of DNA capable of moving from one location to another within a genome. This process, called **transposition**, can occur through either a copy-and-paste or a cut-and-paste mechanism. Transposons are found in the genomes of nearly all organisms, including bacteria, plants, and animals.

Types of Transposons 1. **DNA Transposons (Type II Transposons)**:

1. Move directly as DNA via a cut-and-paste mechanism.
2. Require a specific enzyme called **transposase** to facilitate the cutting of the transposon from its original location and its reintegration elsewhere in the genome.

2. **Retrotransposons (Type I Transposons)**:

1. Use an RNA intermediate for movement.
2. The transposon is transcribed into RNA, which is then reverse-transcribed into DNA and inserted into a new genomic location. This process requires the enzyme **reverse transcriptase**.

Biological Significance - **Genomic Diversity**: Transposons contribute to genetic variation and evolution by reshuffling genetic material. - **Gene Regulation**: They can influence gene expression by inserting themselves near or within genes. - **Mutagenesis**: Transposons can disrupt genes or regulatory regions, leading to mutations, some of which may result in diseases.

Applications in Research - **Genetic Engineering**: Transposons are used as tools in molecular biology to insert or modify genes. - **Gene Therapy**: Certain transposon systems, like the Sleeping Beauty transposon, are being explored for therapeutic applications to deliver genes into human cells.

Transposons illustrate the dynamic nature of genomes and their capacity for self-reorganization over evolutionary timescales.

A transposable element (TE or transposon) is a DNA sequence that can change its position within a genome, sometimes creating or reversing mutations and altering the cell's genetic identity and genome size.

Transposition often results in duplication of the same genetic material. Barbara McClintock's discovery of these jumping genes earned her a Nobel Prize in 1983.

Transposable elements make up a small fraction of the genome and are responsible for much of the mass of DNA in a eukaryotic cell. It has been shown that TEs are important in genome function and evolution.

In Oxytricha, which has a unique genetic system, these elements play a critical role in development. Transposons are also very useful to researchers as a means to alter DNA inside a living organism.

There are at least two classes of TEs: Class I TEs or retrotransposons generally function via reverse transcription, while Class II TEs or DNA transposons encode the protein transposase, which they require for insertion and excision, and some of these TEs also encode other proteins.

Transposable elements (TEs) are dynamically expressed at high levels in multiple human tissues, but the function of TE-derived transcripts remains largely unknown. In this study, we identify numerous TE-derived microRNAs (MicroRNAs) by conducting Argonaute2 RNA immunoprecipitation followed by small RNA sequencing (AGO2 RIP-seq) on human brain tissue. Many of these MicroRNAs originated from LINE-2 (L2) elements, which entered the human genome around 100-300 million years ago. L2-MicroRNAs derived from the 3' end of the L2 consensus sequence and thus shared very similar sequences, indicating that L2-MicroRNAs could target transcripts with L2s in their 3'UTR. In line with this, many protein-coding genes carried fragments of L2-derived sequences in their 3'UTR: these sequences served as target sites for L2-MicroRNAs. L2-MicroRNAs and their targets were generally ubiquitously expressed at low levels in multiple human tissues, suggesting a role for this network in buffering transcriptional levels of housekeeping genes. In addition, we also found evidence that this network is perturbed in glioblastoma. In summary, our findings uncover a TE-based post-transcriptional network that shapes transcriptional regulation in human cells [1)].

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Petri R, Brattås PL, Sharma Y, Jönsson ME, Pircs K, Bengzon J, Jakobsson J. LINE-2 transposable elements are a source of functional human microRNAs and target sites. PLoS Genet. 2019 Mar 13;15(3):e1008036. doi: 10.1371/journal.pgen.1008036. [Epub ahead of print] PubMed PMID: 30865625.