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TRANSPOSABLE GENETIC ELEMENT

BY

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ZOOLOGY: SEM- V, PAPER- C12T: GENETICS, UNIT 7: TRANSPOSABLE GENETIC ELEMENTS

- A **transposable element** (TE, transposon, or jumping gene) 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 discovered the first TEs in maize (*Zea mays*) at the Cold Spring Harbor Laboratory in New York for which she earned her a Nobel Prize in 1983.

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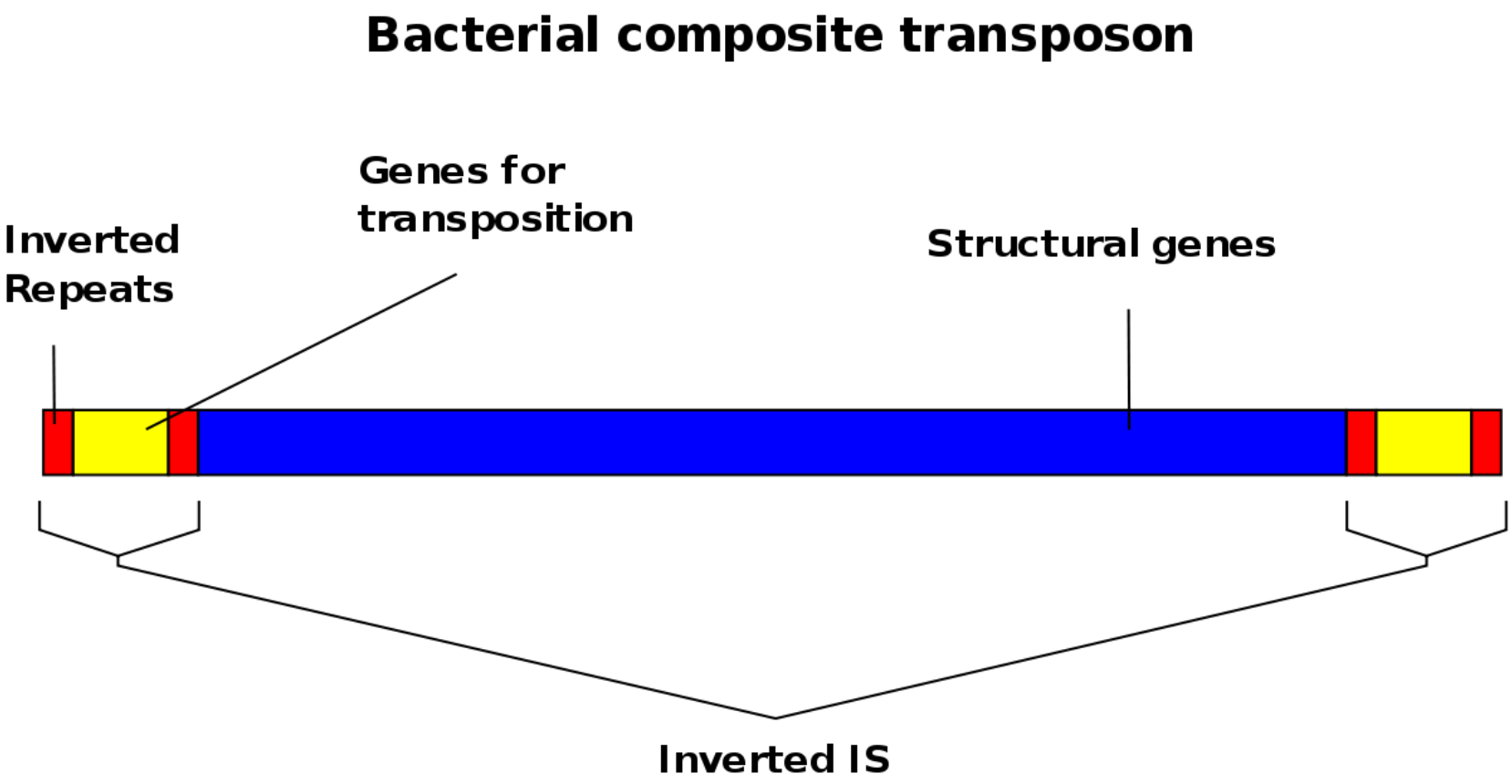

Classification of Transposable Elements:

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 represent one of several types of mobile genetic elements. TEs are assigned to one of two classes according to

their mechanism of transposition, which can be described as either copy and paste (Class I TEs) or cut and paste (Class II TEs).

Retrotransposon:

- Class I TEs are copied in two stages: first, they are transcribed from DNA to RNA, and the RNA produced is then reverse transcribed to DNA.

- This copied DNA is then inserted back into the genome at a new position.
- The reverse transcription step is catalyzed by a reverse transcriptase, which is often encoded by the TE itself.
- The characteristics of retrotransposons are similar to retroviruses, such as HIV.

Retrotransposons are commonly grouped into three main orders:

- Retrotransposons, with **long terminal repeats (LTRs)**, which encode reverse transcriptase, similar to retroviruses.
- Retroposons, **Long interspersed nuclear elements (LINEs, LINE-1s, or L1s)**, which encode reverse transcriptase but lack LTRs, and are transcribed by RNA polymerase II.
- Retroposons, **Short interspersed nuclear elements (SINEs)** do not encode reverse transcriptase and are transcribed by RNA polymerase III.

DNA transposons:

- The cut-and-paste transposition mechanism of class II TEs does not involve an RNA intermediate.

- The transpositions are catalyzed by several transposase enzymes.

- Some transposases non-specifically bind to any target site in DNA, whereas others bind to specific target sequences.

- The transposase makes a staggered cut at the target site producing sticky ends, cuts out the DNA transposon and ligates it into the target site.

- A DNA polymerase fills in the resulting gaps from the sticky ends and DNA ligase closes the sugar-phosphate backbone.

- This results in target site duplication and the insertion sites of DNA transposons may be identified by short direct repeats (a staggered cut in the target DNA filled by DNA polymerase) followed by inverted repeats.

- Class II TEs comprise less than 2% of the human genome, making the rest Class I.

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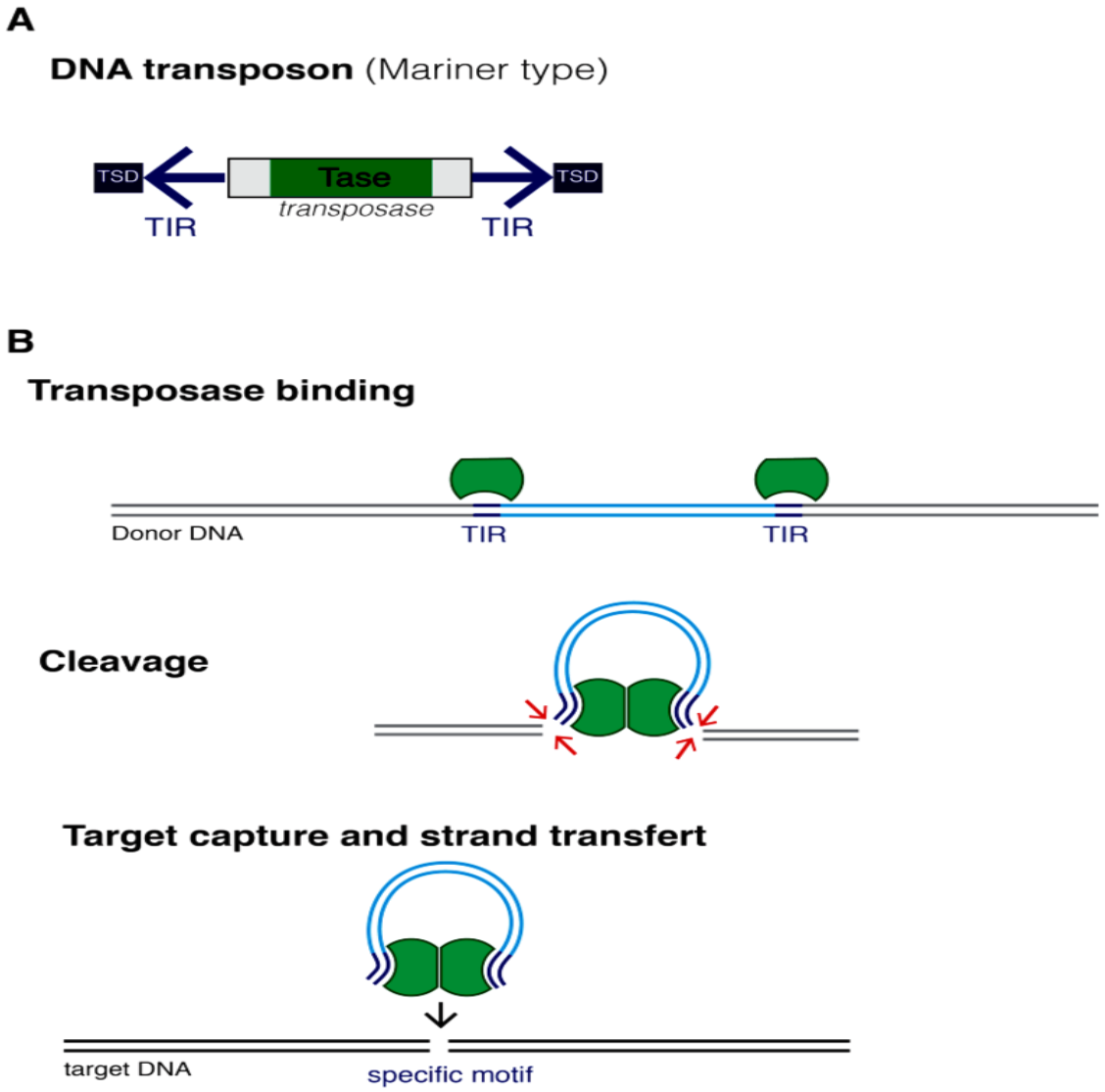

A. Structure of DNA transposons: Two inverted tandem repeats (TIR) flank the transposase gene. Two short tandem site duplications (TSD) are present on both sides of the insert.

B. Mechanism of transposition: Two transposases recognize and bind to TIR sequences, join together and promote DNA double-strand cleavage. The DNA-transposase complex then inserts its DNA cargo at specific DNA motifs elsewhere in the genome, creating short TSDs upon integration.

Autonomous and non-autonomous:

Transposition can be classified as either "autonomous" or "non-autonomous" in both Class I and Class II TEs. Autonomous TEs can move by themselves, whereas non-autonomous TEs require the presence of another TE to move. This is often because dependent TEs lack transposase (for Class II) or reverse transcriptase (for Class I). Activator element (Ac) is an example of an autonomous TE, and dissociation elements (Ds) is an example of a non-autonomous TE. Without Ac, Ds is not able to transpose.

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THANK YOU

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