LS1201 Assignment – 04

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Q1. What do you mean by “transposons”?

Ans. Transposons are small pieces of DNA (500–1500 bp long) capable of moving themselves from one place to another within a genome. These mobile genetic elements were first recognized in maize (corn) but are now known to be present in essentially all organisms. There are two types of transposons, what may be termed true transposons, i.e., DNA Transposons (Class II TE’s) and Retrotransposons (Class I TE’s) (TE: Transposable Elements). Transposons usually have repetitive DNA sequences at each end to facilitate their excision from the genome and include a gene for the enzyme (transposase) that catalyzes excision. Once excised, transposons reenter the genome at random positions and usually do not disrupt the general architecture of the genome. However, transposons often have dramatic effects on gene expression. They may cause deleterious gene rearrangements if their integration disrupts important regulatory or protein-coding sequences or if pieces of the genome surrounding the transposon are inadvertently deleted during transposon excision. They are also referred to as “Jumping Genes”.

Q2. How were transposons discovered?

Ans. Transposons were first discovered in corn (*Zea mays*) during the 1940s and ’50s by American scientist Barbara McClintock, whose work won her the Nobel Prize for Physiology or Medicine in 1983. She discovered them at the Cold Spring Habour Laboratory in New York. She found that different coloured kernels in maize cob are due to transposable elements, which cause or reverse the mutation in the pigment coding genes. Since McClintock’s discovery, three basic types of transposons have been identified. These include class II transposons, miniature inverted-repeat transposable elements (MITEs, or class III transposons), and retrotransposons (class I transposons).

Q3. Describe the different mechanisms by which transposons act.

Ans. **On the basis of their transposition mechanism, transposons may be categorized into following types:**

(i) Cut-and-Paste Transposons:
They transpose by excision (cutting) of the transposable sequence from one position in the genome and its insertion (pasting) to another position within the genome (Fig. 1).

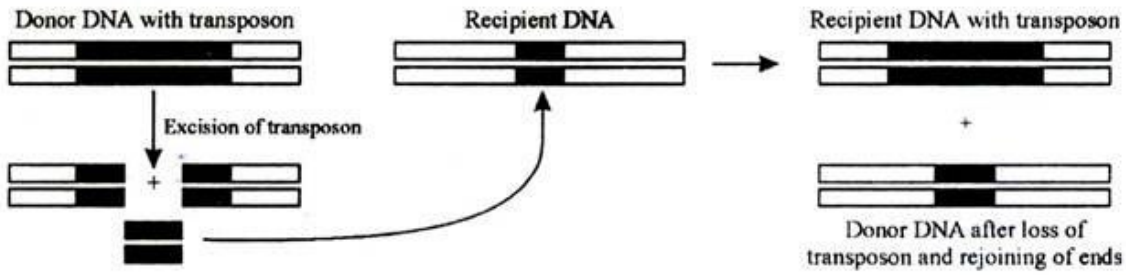

Fig. 1. Cut and Paste Transposons.

The cut-and-paste transposition involves two transposase subunits. Each transposase submit binds to the specific sequences at the two ends of transposon. These subunits of transposase protein then come together and lead to the excision of transposon.
This excised 'transposon-Transposase Complex' then gets integrated to the target recipient site. In this manner, the transposon is cut from one site and then pasted on other site by a mechanism mediated by transposase protein (Fig. 2).

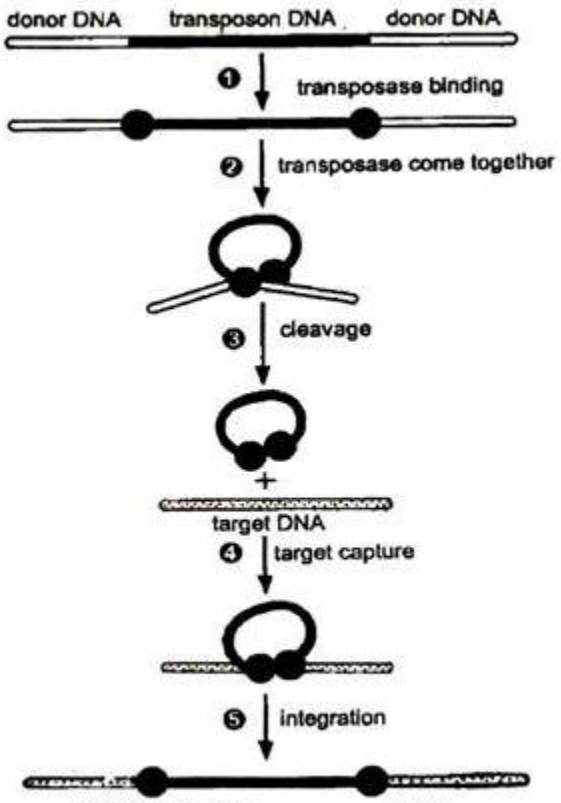

Fig. 2. Role of Transposase protein in cut-and-paste transposition.

Examples of cut-and-paste type of transposons are IS-elements, P-elements in maize, hobo-elements in Drosophila etc.

(ii) Replicative Transposons:
They transpose by a mechanism which involves replication of transposable sequence and this copy of DNA, so formed, is inserted into the target site while the donor site remains unchanged (Fig. 3). Thus, in this type of transposition, there is a gain of one copy of transposon and both-the donor and the recipient DNA molecule are having one-one transposable sequence each, after transposition.

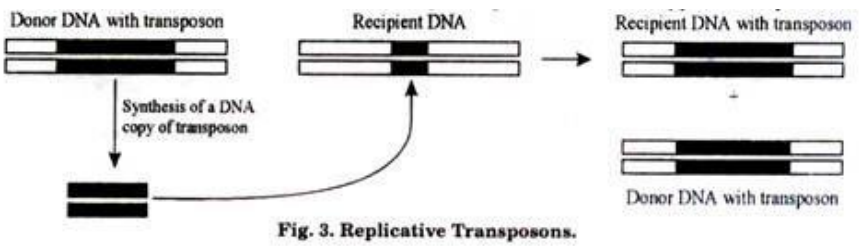

Fig. 3. Replicative Transposons.

Tn3-elements found in bacteria are good examples of such type of transposons.

(iii) Retro Elements:
Their transposition is accomplished through a process which involves the synthesis of DNA by reverse transcription (i.e. RNA DNA) by using elements RNA as the template (Fig. 4). This type of transposition involves an RNA intermediate, the transposable DNA is transcribed to produce an RNA molecule. This RNA is then used as a template for producing a complementary DNA by the activity of enzyme reverse transcriptase. This single stranded DNA copy so formed, is then made double stranded and then inserted into the target DNA site. The transposable elements which require reverse transcriptase tor their movement are called retro transposons.

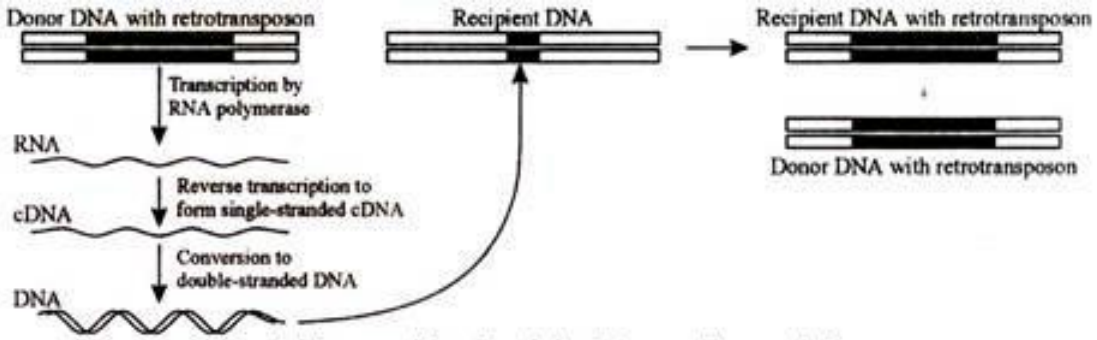

Fig. 4. Transposition Involving Reverse Transcription.

The Retro elements may be viral or non-viral. Out of these two, the non-viral retro elements are important and may further be classified.