Genetic Engineering

Lecture: 3 Dr. Anwar Al Hussainy

What is genetic engineering?

Genetic engineering is the process of manipulating genes, usually outside the organism's normal reproductive process. Changing the genome enables engineers to give desirable properties to different organisms. Organisms created by genetic engineering are called genetically modified organisms (GMOs). The group of applied techniques of genetics and biotechnology used to cut up and join together genetic material and especially DNA from one or more species of organism and to introduce the result into an organism in order to change one or more of its characteristics.

Other names of Genetic engineering:

- Genetic engineering (GE),
- Recombinant DNA technology,
- Genetic Modification / Manipulation (GM)
- Gene splicing,
- All terms that are applied to the direct manipulation of an organism's genes.

Genetically modified organisms (GMOs):

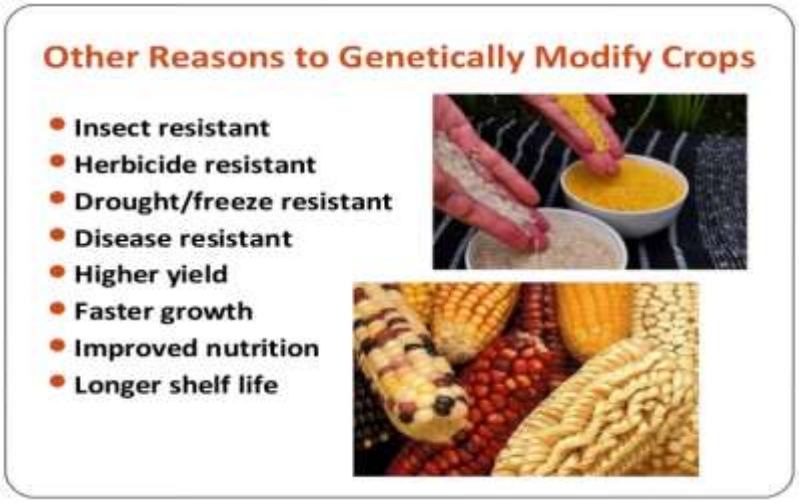
GMO is defining as "an organism with changes made within its genome such as amplification or deletion of genes".

Or

GMO is "an organism whose genetic material has been altered using the genetic engineering techniques".

- **Transgenic organisms ((**"ACROSS SPECIES".)):

A transgenic organism is define as "a genetically modified organism with extra-genome (foreign genetic) information attached to its genome".



- The first GMOs were bacteria in 1973 and GM mice were generated in 1974.
- Insulin-producing bacteria were commercialized in 1982 and genetically modified food has been sold since 1994.
- Glofish, the first GMO designed as a pet, was first sold in the United States December in 2003.

- Genetic engineering techniques have been applied in numerous fields including research, agriculture, industrial biotechnology, and medicine.

- If genetic material from another species is added to the host, the resulting organism is called transgenic.

The basic steps in DNA cloning involves the following,

1. **Isolation of donor DNA fragment or gene**
    - At first a donor DNA fragment should be isolated.

2. **Selection of suitable cloning vector:**
    - When donor DNA fragment is incorporated into a host cell, it will not replicates because the isolated gene do not have the capacity to replicated itself. So before introduction of donor fragment into host, a suitable vector should be selected.
    - Cloning vector is the DNA molecule capable of self-replication inside the host cell. The main function of cloning vector is to replicates the inserted DNA fragment inside the host cell.
    - Examples of cloning vectors: Plasmid, BAC, YAC, Λ-bacteriophage, expression vectors etc.

Characteristics of cloning vectors

1. It must be self-replicating inside host cell
2. It must possess restriction site for RE enzymes
3. Introduction of donor DNA fragment must not interfere with replication property of the vector
4. It must possess some marker gene such that it can be used for later identification of recombinant cell.

3. Incorporation of donor DNA fragment with Plasmid vector:

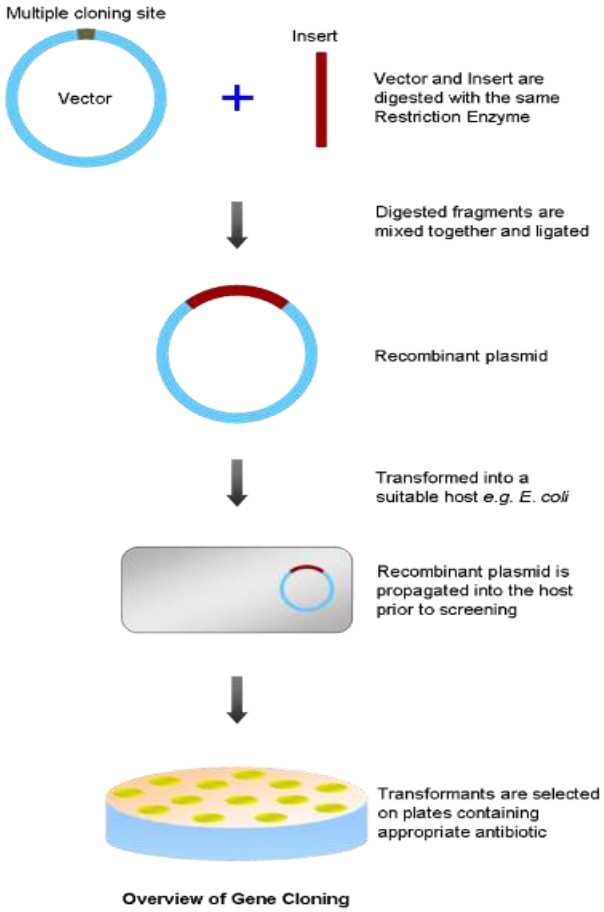
- The plasmid vector is cut open by the same RE enzyme used for isolation of donor DNA fragment
- The mixture of donor DNA fragment and plasmid vector are mixed together.
- In the presence of DNA ligase, base pairing of donor DNA fragment and plasmid vector occurs forming recombinant vector in the mixture.

4. Transformation of recombinant vector into suitable host:

- The recombinant vector is transformed into suitable host cell. ie bacterial cell
- Some bacteria are naturally transformable; they take up the recombinant vector automatically. For examples: *Bacillus, Haemophillus, Helicobacter pylori*, are naturally competent
- Some other bacteria are not naturally competent, in those bacteria recombinant vector are incorporated by artificial method such as Ca++ ion treatment, electroporation etc.

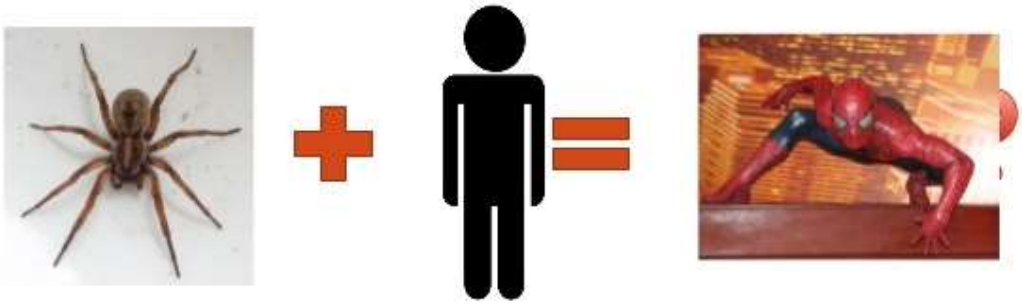
5. Isolation of Recombinant cell:

- The recombinant host cell is then grown in culture media but the culture may contains colonies both recombinant cell and non-recombinant cell.
- For isolation of recombinant cell from non-recombinant cell, marker gene of plasmid vector is employed.
- For examples, PBR322 plasmid vector contains different marker gene (Ampicillin resistant gene and Tetracycline resistant gene. When pst1 RE is used it knocks out Ampicillin resistant gene from the plasmid, so that the recombinant cells become sensitive to Ampicillin.



Overview of Gene Cloning

Could Spiderman Be Real?



Web-Producing Goats

Spider genes in goats enable the production of spider silk in goat milk