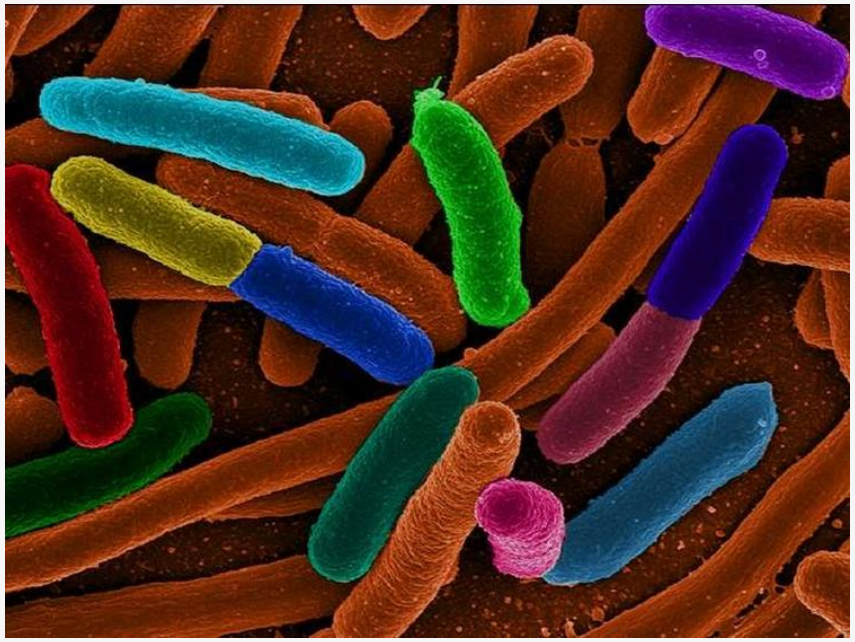
Role of Genetically modified organisms in Environmental Pollution



Super-Bug

Ananda Mohan Chakrabarty, Ph.D. (4 April 1938– 10 July 2020) was an Indian American Microbiologist, scientist, and researcher, most notable for his work in directed evolution and his role in developing a genetically engineered organism using plasmid transfer while working at GE, the patent for which led to landmark Supreme Court case, Diamond V. Chakrabarty.

- Prof. Chakrabarty genetically engineered a new species of Pseudomonas bacteria ("the oil-eating bacteria") in 1971 while working for the Research & Development Center at General Electric Company in Schenectady , New York.

- At the time, four known species of oil-metabolizing bacteria were known to exist, but when introduced into an oil spill, they competed with each other, limiting the amount of crude oil that they degraded.
- The genes necessary to degrade oil were carried on plasmid, which could be transferred among species.

By irradiating the transformed organism with UV light after plasmid transfer, Prof. Chakrabarty discovered a method for genetic cross-linking that fixed all four plasmid genes in place and produced a new, stable, bacterial species (now called *Pseudomonas putida*) capable of consuming oil one or two orders of magnitude faster than the previous four strains of oil-eating microbes.

The new microbe, which Chakrabarty called "multiplasmid hydrocarbon-degrading *Pseudomonas*," could digest about two-thirds of the hydrocarbons that would be found in a typical oil spill.

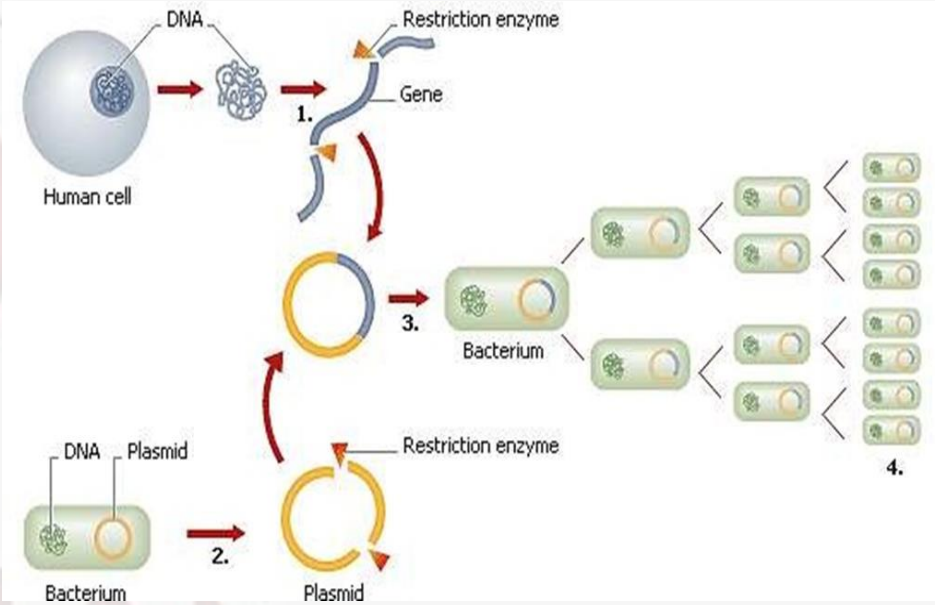
- The bacteria drew international attention when he applied for a patent -the first U.S. patent for a genetically modified organism.

- He was initially denied the patent by the Patent Office because the patent code was thought to preclude patents on living organisms.

- The US Court of Customs and Patent Appeals overturned the decision in Chakrabarty's favor, writing: ...the fact that micro-organisms are alive is without legal significance for purposes of patent law.

What is genetically Engineered Microorganism?

These are the **microorganisms** which genetic makeup has been changed through biotechnology process and use for betterment of human life.



Way of genetically engineered microorganism for pollution control

- Involves the use of microorganisms genetically modified by recombinant DNA technology.
- GEM is a powerful tool in creating environment friendly alternatives for products and processes

For e.g. :

- Production of enzymes
- Amylose free potato
- Indigo producing bacterium

Genes responsible for control of environmental pollutants

- Genes responsible for control of environmental pollutants, for example, toluene, chlorobenzene acids, and other halogenated pesticides and toxic wastes have been identified. For every compound, one separate plasmid is required.
- It is not like that one plasmid can degrade all the toxic compounds of different groups.

The plasmids are grouped into four categories:

1) OCT plasmid which degrades, octane, hexane and decane;
2) XYL plasmid which degrades xylene and toluenes,
3) CAM plasmid that decompose camphor and
4) NAH plasmid which degrades naphthalene

Genetically engineered microorganism for pollution control

- Control of environmental pollutants by genetically engineered microorganisms are focused on genetically engineered bacteria using different genetic engineering technologies:

❖ The application of genetic engineering for heavy metals removal has aroused great interest. *Alcaligenes eutrophus* AE104 (pEBZ141) was used for chromium removal from industrial wastewater.

❖ The recombinant photosynthetic bacterium, *Rhodopseudomonas palustris*, was constructed to simultaneously express mercury transport system and metallothonein for Hg++ removal from heavy metal waste water.

- Genetic engineering of endophytic and rhizospheric bacteria for use in plant associated degradation of toxic compounds in soil is considered one of the most promising new technologies for remediation of contaminated environmental sites.

- Many bacteria in the rhizosphere show only limited ability in control of organic pollutants.

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Thank you