A

Seminar report

on

"Genetic Engineering"

Submitted in partial fulfillment of the requirement for the award of degree of Bachelor of Technology in Computer Science

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SUBMITTED BY:
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Introduction

What is genetics?

Genetics is the scientific study of genes, i.e. variations in the characteristics -- resemblances and differences -- of organisms and how these characteristics are inherited from generation to generation. Modern genetics is as much concerned with the organism level of this process as it is with the cellular and molecular levels.

What are genes?

A gene is a fuzzy concept which depends upon who is using the term and in what context. For the earliest geneticists, genes were fairly distinct traits or characteristics which could be observed in the whole organism. For the modern molecular biologist or molecular geneticist a more chemical definition of a gene is used which brings in a number of additional concepts. The molecular gene is a definite sequence of bases in the DNA chain which together code for the production of a particular protein.

What is genetic engineering?

Engineering is the technological manipulation of the objects of the natural world in a way that is perceived to be beneficial to people. Traditionally we used the word in the context of inanimate nature: bridges, railways and machines etc. But the term can be used and is used in the context of biology, namely for bioengineering, i.e. modifying or manipulating living organisms. Another term used in place of the term 'genetic engineering' is 'biotechnology'.

Definition of Genetic Engineering

“Genetic engineering is the technology for modifying the genetic information in a plant, animal or human in order to produce some desired trait or characteristic”

History of Genetic Engineering

Modern genetic engineering began in 1973 when Herbert Boyer and Stanley Cohen used enzymes to cut a bacteria plasmid and insert another strand of DNA in the gap. Both bits of DNA were from the same type of bacteria, but this milestone, the invention of recombinant DNA technology, offered a window into the previously impossible -- the mixing of traits between totally dissimilar organisms. To prove that this was possible, Cohen and Boyer used the same process to put a bit of frog DNA into bacteria.

Since 1973, this technology has been made more controllable by the discovery of new enzymes to cut the DNA differently and by mapping the genetic code of different organisms. Now that we have a better idea of what part of the genetic code does what, we have been able to make bacteria that produce human insulin for diabetics (previously came from livestock), as well as EPO for people on kidney dialysis (previously came from urine of people in third world countries with ringworm).

In 1990, a young child with an extremely poor immune system received genetic therapy. Some of her white blood cells were genetically manipulated and re-introduced into her bloodstream while she watched Sesame Street. These new cells have taken over for the original, weak white cells, and her immune system now works properly. Although relatively few people have had their cells genetically altered, these advances have made the prospect of mainstream genetic medicine seem more likely.

As of late summer of 1998, scientists are able to add simple traits to organisms. They cannot create custom-made animals. They cannot always predict how traits will interact. Before phenomenally new advances can be made, scientists have to learn how to affect cells' DNA with pin-point accuracy, without affecting other traits. Advances like genetic correction for nearsightedness are a long way off. The power of science is limited to knowledge about genetics, gene locations, and trait interactions, but as knowledge grows, so will scientists' abilities to manipulate life.

Techniques of Genetic Engineering

Recombinant DNA techniques use biological vectors like plasmids and viruses to carry foreign genes into cells. Plasmids are small circular pieces of genetic material found in bacteria that have the ability to cross species boundaries. The circles can be broken and new genetic material added to them. Plasmids augmented with new genetic material can move across microbial cell boundaries and place the new genetic material next to the bacterium's own genes. Often the bacteria will take up the gene and begin to produce the protein for which the gene codes. Where the new gene codes for insulin, for example, the bacterium will begin to produce insulin along with its other gene products. A large vat of bacteria engineered to produce insulin can then become a sort of pharmaceutical factory.

Viruses can also act as vectors in genetic engineering. Viruses are infectious particles that contain genetic material to which a new gene can be added. The virus can carry the new gene into a recipient cell in the process of infecting that cell. The virus can also be disabled so that while it can carry a new gene into a cell, it cannot redirect the cell's genetic machines to make thousands of copies of itself.

Transformation: - Transformation is a process by which a cell takes up naked DNA fragment from the environment, incorporates it into its own chromosomal DNA, and finally expresses the trait controlled by the incoming DNA.

Transduction: - Transfer of DNA from one organism to another through a bacteriophage is called transduction.

Examples

1. Transduction from bacterium to bacterium.
2. Transduction from bacteria to Human cells.

Prospects for Genetic Engineering

Transgenic Engineering:-

Putting genetic information from one type of plant or animal into another

Plants:-

Transgenic plants possess a gene or genes that have been transferred from a different species. Although DNA of another species can be integrated in a plant genome by natural processes, the term "transgenic plants" refers to plants created in a laboratory using recombinant DNA technology. The aim is to design plants with specific characteristics by artificial insertion of genes from other species or sometimes entirely different kingdoms.

The intentional creation of transgenic plants by laboratory based recombinant DNA methods is more recent (from the mid-70s on) and has been a controversial development in the field of biotechnology opposed vigorously by many NGOs, and several governments, particularly within the European Community. These transgenic recombinant plants (biotech crops, modern transgenics) are transforming agriculture in those regions that have allowed farmers to adopt them, and the area sown to these crops has continued to grow globally in every years since their first introduction in 1996.

Transgenic recombinant plants are generated in a laboratory by adding one or more genes to a plant's genome,and the techniques frequently called transformation. Transformation is usually achieved using gold particle bombardment or through the process of Horizontal gene transfer using a soil bacterium, Agrobacterium tumefaciens, carrying an engineered plasmid vector, or carrier of selected extra genes.

Transgenic recombinant plants are identified as a class of genetically modified organism(GMO); usually only transgenic plants created by direct DNA manipulation are given much attention in public discussions.

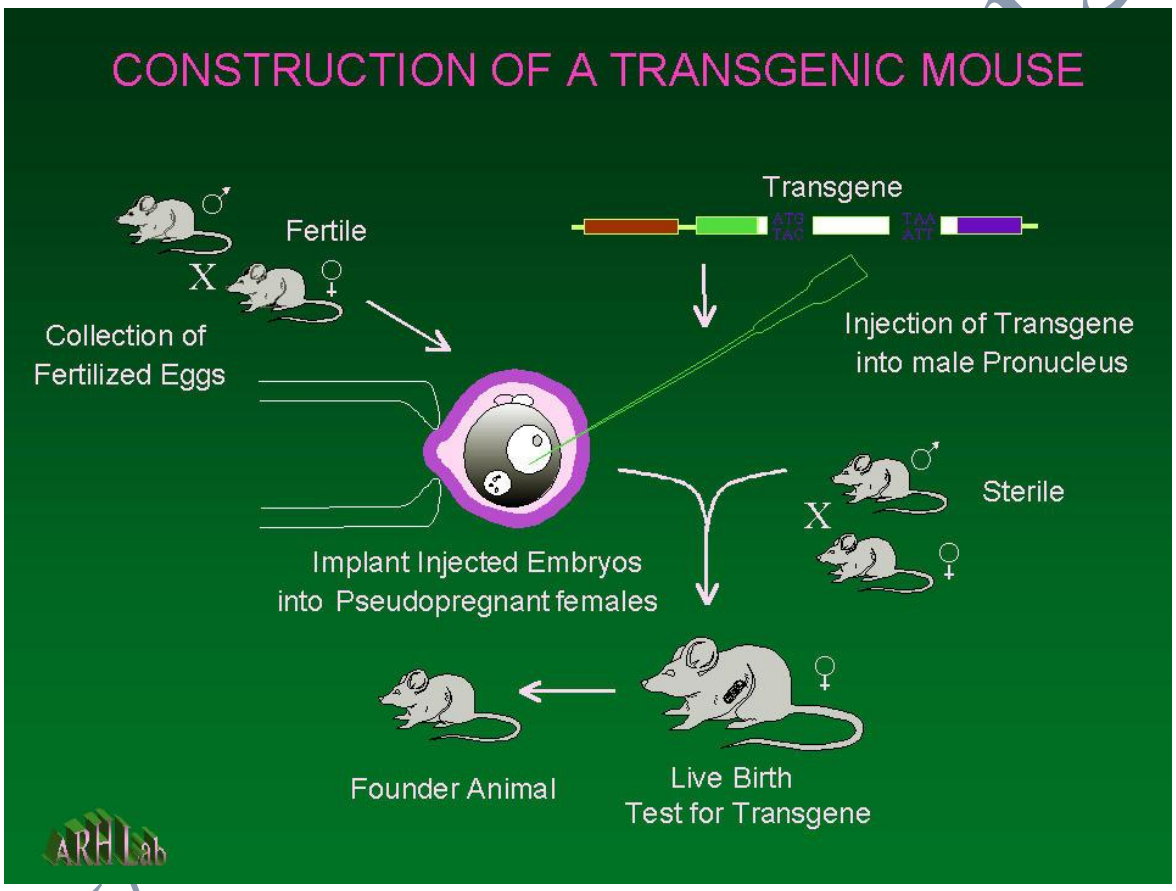
Transgenic Animal:-

Transgenic mice contain additional foreign DNA in every cell allowing them to be used to study gene function or regulation and to model human diseases. Transgenic mouse contains additional, artificially-introduced genetic material in every cell. This often confers a gain of function, for example the mouse may produce a new protein, but a loss

of function may occur if the integrated DNA interrupts another gene. A transgenic mouse a very useful system for studying mammalian gene function and regulation because analysis is carried out on the whole organism.

Transgenic mice are also used to model human diseases that involve the over expression or misexpression of a particular protein.

Making Transgenic Mice:-



Cloning:-

Making genetic copies of an existing human plant or animal.
Asexual breeding in plants & lower animals.

Human:-

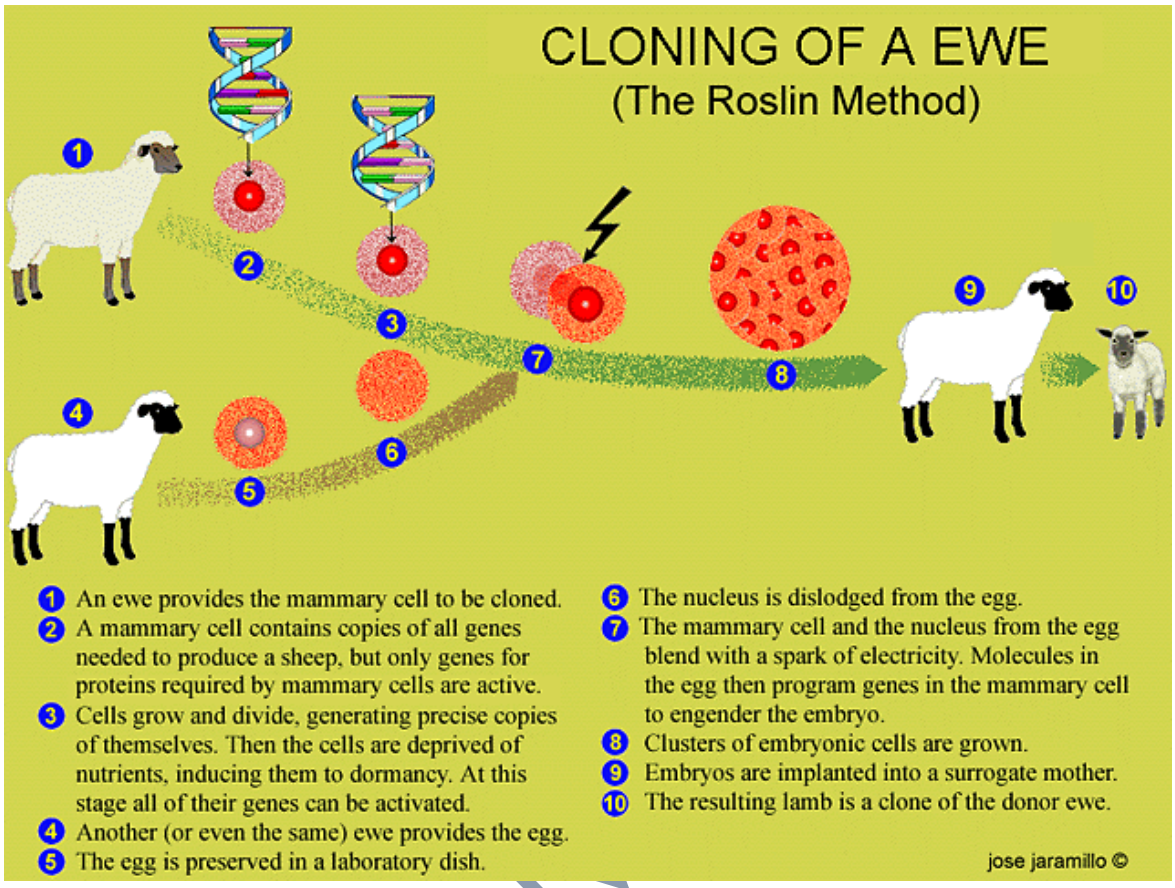
Human cloning is the creation of a genetically identical copy of a human being, human cell, or human tissue. The term is generally used to refer to *artificial* human cloning; human clones in the form of identical twins are commonplace, with their cloning part of the natural process of reproduction.

Although genes influence behavior and cognition, "genetically identical" does not mean altogether identical; identical twins, despite being natural human clones with nearly identical DNA, are separate people, with separate experiences and personalities. The relationship between an "original" and a clone is rather like that between identical triplets raised apart; they share nearly all of the same DNA, but little of the same environment. A lively scientific debate on this topic occurred in the journal Nature in 1997. Ultimately, the question of how similar an original and a clone would be boils down to how much of personality is determined by genetics, an area still under active scientific investigation.

DOLLY-1960

Dolly (July 5, 1996 – February 14, 2003), a female sheep or ewe, was the first animal to be cloned from an adult somatic cell, using the process of nuclear transfer. She was cloned by Ian Wilmut, Keith Campbell and colleagues at the Roslin Institute in Edinburgh, Scotland. Her birth was announced on February 22, 1997 and she lived until the age of six.

The cell used as the donor for the cloning of Dolly was taken from a mammary gland, and the production of a healthy clone therefore proved that a cell taken from a specific body part could recreate a whole individual. More specifically, the production of Dolly showed that mature differentiated somatic cells in an adult animal's body could under some circumstances revert back to an undifferentiated pluripotent form and then develop into any part of an animal. As Dolly was cloned from part of a mammary gland, she was named after the famously curvaceous country western singer Dolly Parton.



Cloning since Dolly:-

Cloning of this sort has now been done on cattle, pigs and mice also. The success rate has improved considerably.Cloning humans begins to show up in science fiction in 1970s.This is now a realistic possibility.

Concerns re/ Cloning

- The success rate from adult animal cells is still rather low.
- This would be unacceptable for cloning humans in most societies.
- The evidence suggests that the clones which survive are still not right.
- The genetic program has probably not been completely reset.
- We still don't understand what we are doing in cloning from adult cells.

Advantages of Cloning:-

With an adult plant or animal, the breeder knows what its traits are; this is not the case with fetal cell cloning.
Cloning allows making a genetically identical copy of the desired plant or animal.

Dangers related to Genetic Engineering

- **Imprecise Technology**—a genetic engineer moves genes from one organism to another. A gene can be cut precisely from the DNA of an organism, but the insertion into the DNA of the target organism is basically random. As a consequence, there is a risk that it may disrupt the functioning of other genes essential to the life of that organism.

- **Side Effects**—Genetic engineering is like performing heart surgery with a shovel. Scientists do not yet understand living systems completely enough to perform DNA surgery without creating mutations which could be harmful to the environment and our health. They are experimenting with very delicate, yet powerful forces of nature, without full knowledge of the repercussions.

- **Widespread Crop Failure**—Genetic engineers intend to profit by patenting genetically engineered seeds. This means that, when a farmer plants genetically engineered seeds, all the seeds have identical genetic structure. As a result, if a fungus, a virus, or a pest develops which can attack this particular crop, there could be widespread crop failure.

- **Threatens Our Entire Food Supply**—Insects, birds, and wind can carry genetically altered seeds into neighboring fields and beyond. Pollen from transgenic plants can cross-pollinate with genetically natural crops and wild relatives. All crops, organic and non-organic, are vulnerable to contamination from cross-pollinatation.

- **No Long-Term Safety Testing**—Genetic engineering uses material from organisms that have never been part of the human food supply to change the fundamental nature of the food we eat. Without long-term testing no one knows if these foods are safe.

- **Allergic Reactions**—Genetic engineering can also produce unforeseen and unknown allergens in foods.)

- **Decreased Nutritional Value**—transgenic foods may mislead consumers with counterfeit freshness. A luscious-looking, bright red genetically engineered

Advantages

1. Creating new types of human beings with advantageous traits.
2. GM animals can generate pharmaceutical proteins.
3. Quicker, more predictable way to generate new cultivars.
4. Sustainable agriculture

Conclusion

Engineering is the technological manipulation of the objects of the natural world in a way that is perceived to be beneficial to people. With this technology we modify the genetic information in a plant, animal or human in order to produce some desired trait or characteristic which are very beneficial for us.

References

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