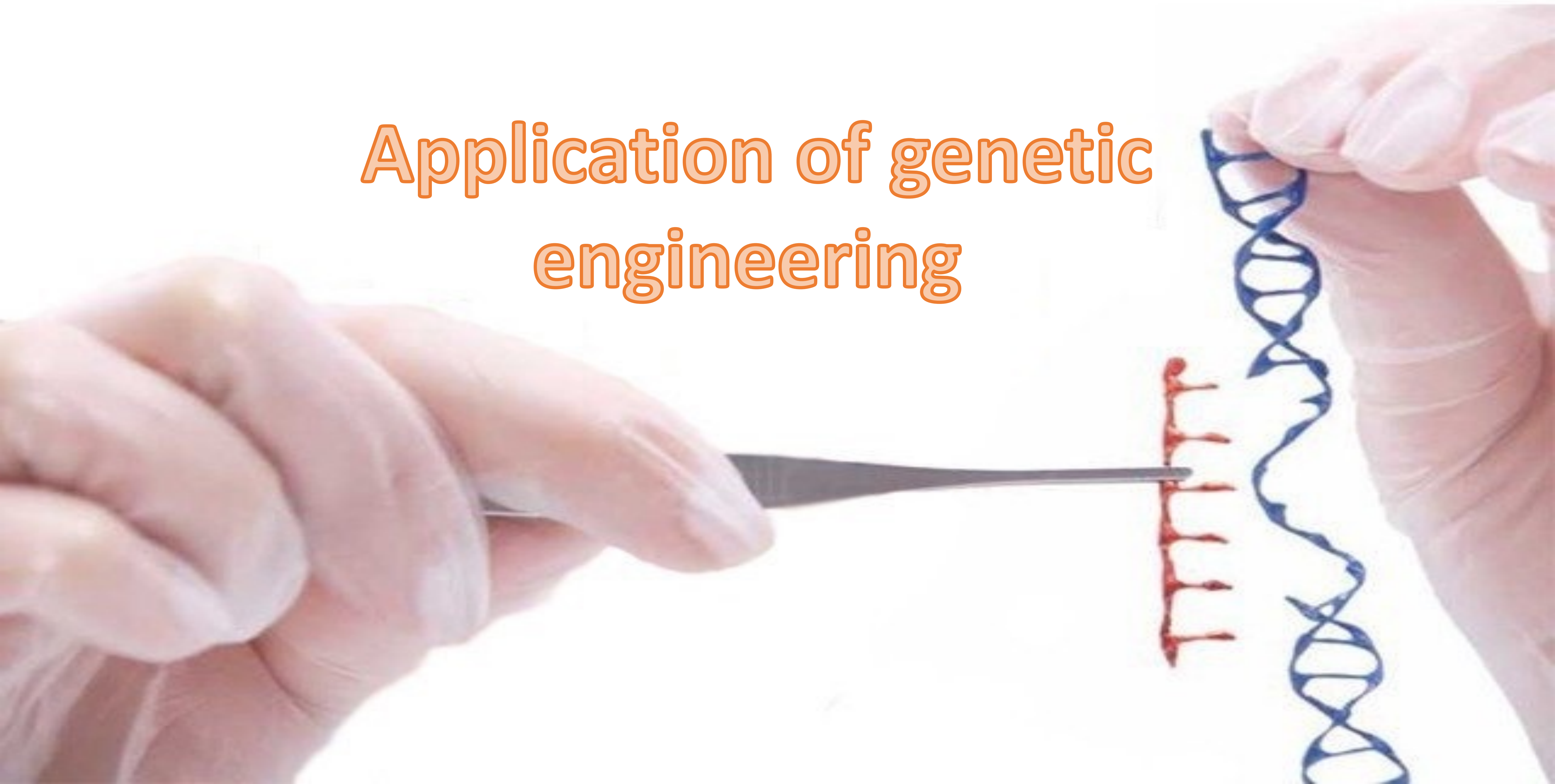
Application of genetic engineering



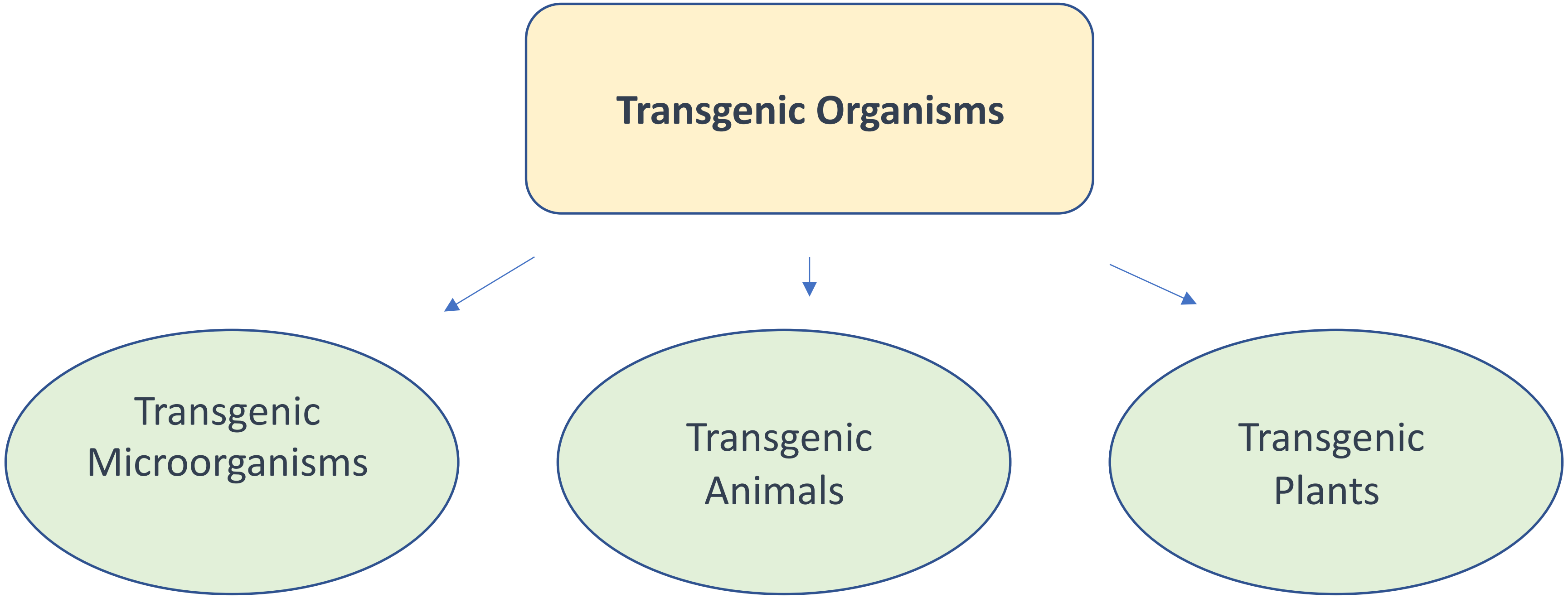
Genetic Engineering :

Genetic engineering is the manipulation of genetic material by either molecular biological techniques or by selective breeding.

- Genetic engineering has applications in medicine, research, industry and agriculture and can be used on a wide range of plants, animals and microorganisms.

Transgenic Organisms

Organisms that have genes from other species inserted into their genomes are called transgenic organisms.



Transgenic Microorganisms

- Transgenic Microorganisms Because they reproduce rapidly and are easy to grow, transgenic bacteria now produce a host of important substances useful for health and industry. The human forms of proteins such as insulin, growth hormone, and clotting factor, which are used to treat serious human diseases and conditions, were once rare and expensive. Bacteria transformed with the genes for human proteins now produce these important compounds cheaply and in great abundance. People with insulin-dependent diabetes are now treated with pure human insulin produced by human genes inserted into bacteria.

- In the future, transgenic microorganisms may produce substances designed to fight cancer, as well as the raw materials for plastics and synthetic fibers

Transgenic Animals

Transgenic animals have been used to study genes and to improve the food supply. Mice have been produced with human genes that make their immune systems act similarly to those of humans. This allows scientists to study the effects of diseases on the human immune system. Some transgenic livestock now have extra copies of growth hormone genes. Such animals grow faster and produce leaner meat than ordinary animals. Researchers are trying to produce transgenic chickens that will be resistant to the bacterial infections that can cause food poisoning. In the future, transgenic animals might also provide us with an ample supply of our own proteins. Several labs have engineered transgenic sheep and pigs that produce human proteins in their milk, making it easy to collect and refine the proteins.

Farm Animals as Models for Human Diseases

The physiology, anatomy, and life span of mice differ significantly from humans, making the rodent model inappropriate for many human diseases Farm animals, such as pigs, sheep or cattle, may be more appropriate models in which to study the treatment of human diseases such as artherosclerosis, non-insulin-dependent diabetes, cystic fibrosis, cancer and neuro-degenerative disorders, which require longer periods of obser- vation than is possible with mice

Farm Animals as Models for Human Diseases
pigs

- An important porcine model has been developed for the rare human eye disease retinitis pigmentosa (PR).
- Patients with PR suffer from night blindness early in life due to loss of photoreceptors. Transgenic pigs with a mutated rhodopsin gene have a phenotype quite similar to the human patients and effective treatments are being developed

- Genetically modified pigs hold great promise in xenotransplantation. Therefore, genetically modified pigs can become cell, tissue and organ donors, providing a solution to severe shortage of organ donors. Advances in genetic engineering have made it possible to modify the xenograft donor genome in virtually unlimited ways.

Farm Animals as Models for Human Diseases rabbit

- Researchers using rabbit models to study diverse projects such as infectious diseases, atherosclerosis, antiviral treatments, toxicology, diabetes, transplantation, eye diseases (both inherited and infectious), milk production, breed sizes, quantitative traits, immunology.

- Rabbits also are excellent models to study immune responses to various pathogens and are used extensively to make specialized antibody reagents for the research community.

Transgenic Plants

- Transgenic plants are now an important part of our food supply. In the year 2000, 52 percent of the soybeans and 25 percent of the corn grown in the United States were transgenic, or genetically modified (GM). Many of these plants contain genes that produce a natural insecticide.

- plants with resistance to pests and diseases: eg. Bt Cotton, Bt Corn . which contain a gene called Bt gene transferred from the bacterium Bacillus thuringeinsis. This gene produces a toxin called protoxin in plant cells. This toxin acts as a pesticide, protecting the plant against insect pests.

- Other crop plants have genes that enable them to resist weed-killing chemicals.

Gene Therapy

Gene therapy can be defined as the introduction of genetic material into a particular cell or tissue type to alter the pattern of gene expression to produce a therapeutic effect.

The normal genetic material will be transcribed and translated into functional genes, which will bring about a normal phenotype. In order to distribute the normal genes to the affected cell, vectors or transfer systems, such as viruses, liposomes and microinjections are used.

Gene Therapy

The use of gene therapy has been approved in more than 400 clinical trials for diseases such as cystic fibres emphysema, muscular dystrophy, adenosine deaminase deficiency. And the process of gene therapy remains complex and many techniques need further developments.

Basic Outline of Gene Therapy

The general types of vectors used in gene therapy are the retroviruses. The vectors are produced by removing the genes that allow the virus to multiply and cause disease. The human gene is cloned and inserted into the vector. After the gene is placed into the viral protein coat, the recombinant vector is used to infect the cells. The virus with the gene inside migrates to the nucleus, where it arranges itself in the chromosome, and become part of the genome. If the gene is expressed, it will produce normal gene product that may have the potential to cure any genetic disorder.

Examples of Gene therapy in Human

The first gene therapy experiment in human began in 1990 by research at the National Institute of Health. The candidate was a four year old girl, named Ashanti De Silva, who suffered from a genetic condition called Severe Combined Immunodeficiency Disease (SCID). This condition affects a gene coding for the enzyme adenosine deaminase (ADA). The mutant gene is recessive and is unable to make the enzyme adenosine deaminase (ADA). Adenosine deaminase (ADA) is needed by the white blood cells, T lymphocytes, for immunity against infection. Anyone suffering from this condition has to live in a sterile environment with no direct human contact.

In gene therapy for SCID, the T lymphocytes are isolated and added to a retroviral vector containing an inserted copy of the normal gene for the enzyme adenosine deaminase. The genetically altered T lymphocytes are injected it the patient where they migrate to the bone marrow and replicate to produce the enzyme adenosine deaminase.

Vaccines

Recombinant DNA Technology is also used in production of vaccines against diseases. A vaccine contains a form of an infectious organism that does not cause severe disease but does cause immune system of body to form protective antibodies against infective organism.

Vaccines produced by gene cloning are contamination free and safe because they contain only coat proteins against which antibodies are made. A few vaccines are being produced by gene cloning, e.g., vaccines against viral hepatitis influenza, herpes simplex virus, virus induced foot and mouth disease in animals