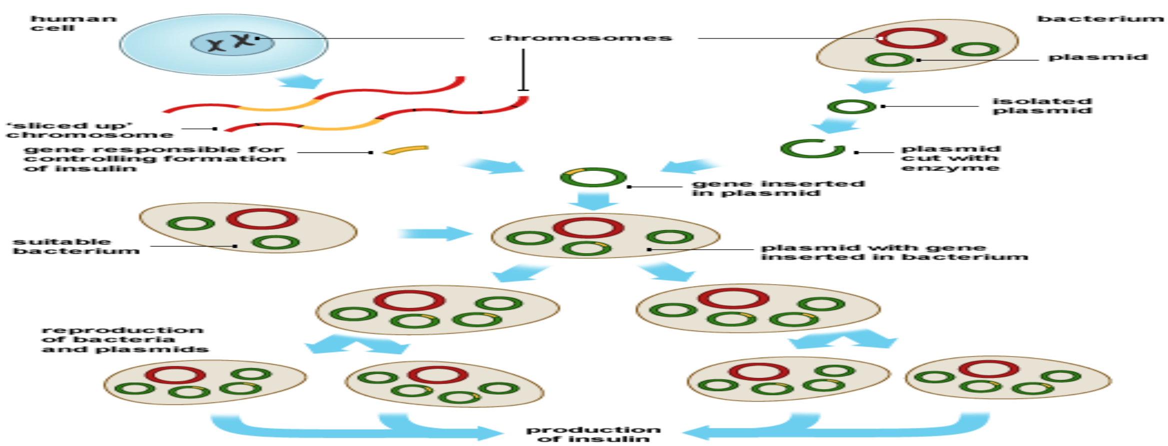
Lec.8 Red biotechnology

Applications of biotechnology in medicine (Red biotechnology)

1- Production of pharmaceutical proteins and hormones

Somatostatin was the first protein produced in 1976 by gene cloning encoded in ***E. coli***, then human insulin produced for the treatment of diabetes by genetic engineering and it's the first drug resulting from biotechnology industry.

After that, **human growth hormone (HGH**) in coliform produced, this hormone secretes from the pituitary gland and regulates the growth process. The production of growth hormone genetically engineered provides the safety, quality and quantity necessary for treatment.



An illustration of how human insulin is produced using bacteria.

2- Production of a vaccine against virus

Before r DNA technique was created, two types of vaccines against infectious diseases produced:

- **Killed vaccines.**
- **Attenuated vaccines**.

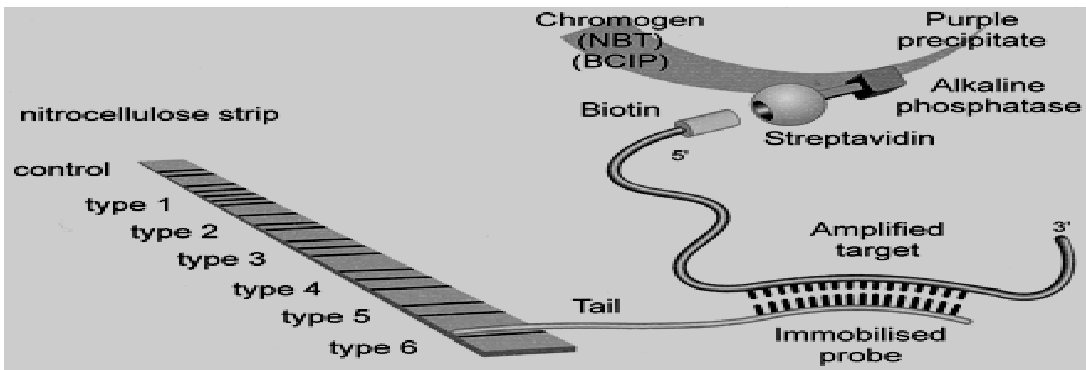
Both types of vaccines carry a degree of risk because of the possibility of contaminated organisms causing the disease, but now it can produce vaccines in a safe manner by biotechnology called **subunit vaccines or recombinant vaccines,** because it is made up of one of the pathogen proteins (the non-contagious) and therefore these vaccines have not the ability to events of the disease.

The first vaccine was produced in biotechnology against the virus of **hepatitis B (HBV),** and successful product in *Saccharomyces cerevisiae*.

3- Molecular diagnostics

It aims to identify the genes and proteins responsible for the defect in the cell, therefore analysis of components of cells in many ways to detect mutations or biochemical changes. This diagnostic was done in the areas of virology, blood screening, women's health, microbiology, genomics, and oncology.

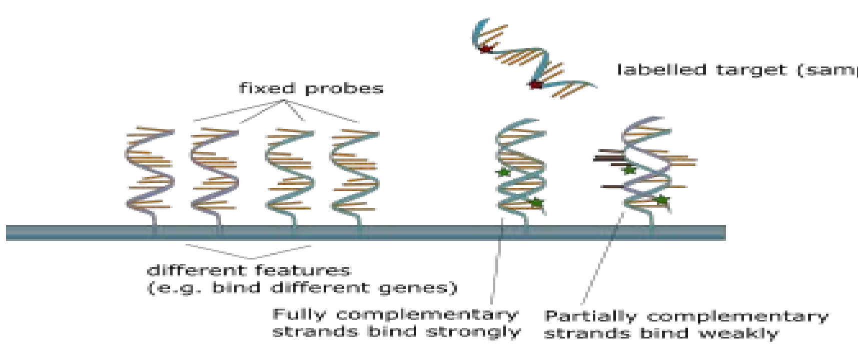
***** Researchers have developed a simplified methods rely on **sensor probes** bind to a strip of nitrocellulose and hybridization of the PCR products,.



PCR fragments are hybridized to a selection of highly specific probes

***Array technique.** It means print many sensors on the membranes which made of nylon in specific points (each point indicates a specific gene).This method has been used to compare tissue infected with lung cancer or breast tissue with normal.

DNA probe; is a single-stranded DNA molecule used in laboratory experiments to detect the presence of a complementary sequence among a mixture of other singled-stranded DNA molecules.



Hybridization of the target to the probe.

4- Gene therapy

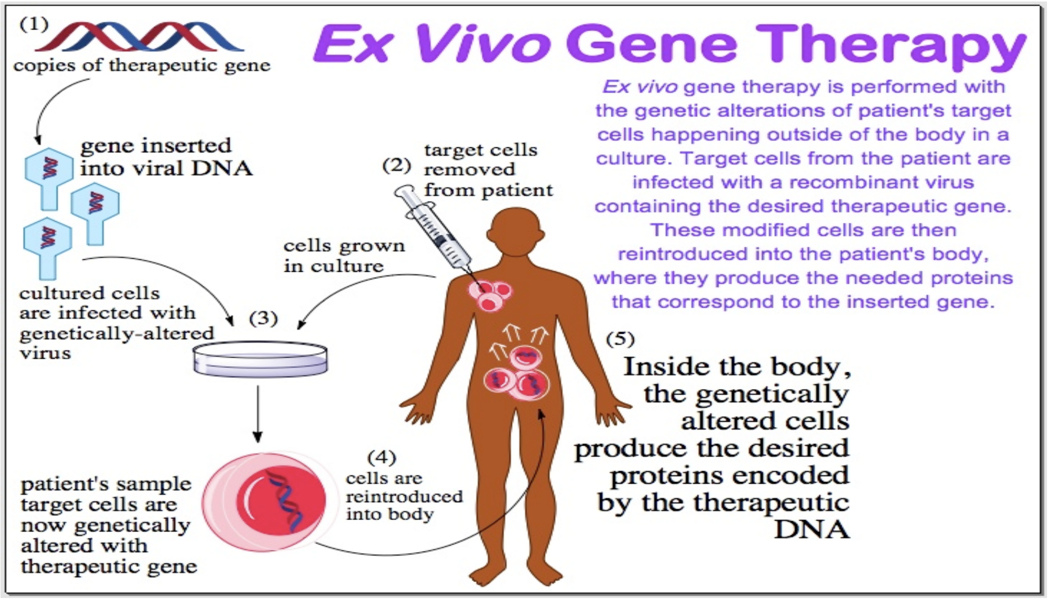
It means insert a gene into a cell or tissue to treat the disease, and usually depends on **insert a copy of the healthy gene** into the cell instead of absent gene or patient gene (variable or not doing its job). Or added a gene to **stop the work of gene** in the cell may have escaped from the control system and became works too much, or may be added in order to **produce protein** leads to cell death, or may make the cell die impact of a particular drug, this is known **suicide gene** because it leads to cell death.

Types of gene therapy

Gene therapy is divided into two types:

1) **Ex vivo gene therapy**.

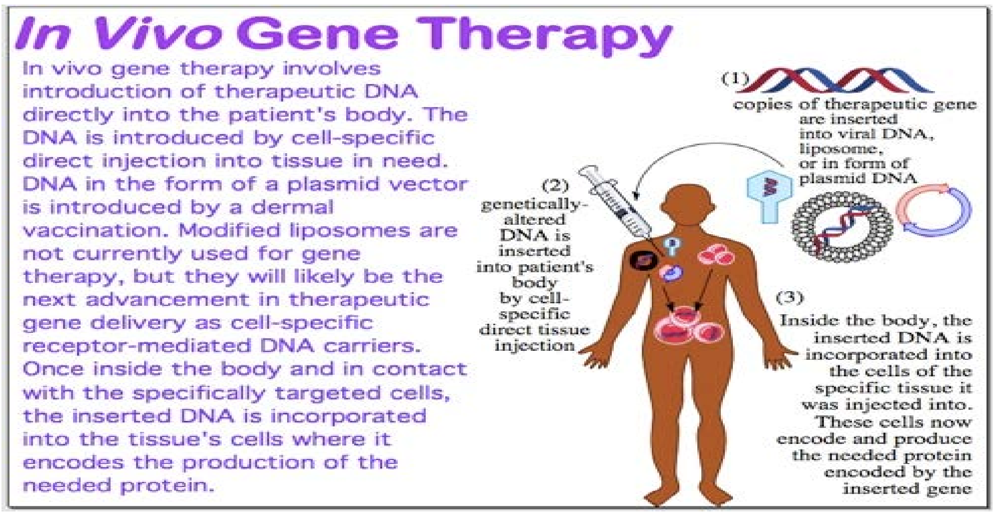
Means gene transfer happens **outside the patient's body**. For example, treatment of Severe Combined Immunodeficiency(SCID) disease, where they are pulling some white blood cells from the patient and then transfer and implantation of the gene coded for the enzyme (adenosine deaminase)ADA to the development of these cells and these cells are genetically engineered to get the millions of cells before returning again to the patient's body.



An illustration of ex vivo gene therapy.

2) In vivo gene therapy.

Here, cannot treat the target cells outside the patient's body, such as **skin cancer** cases and **gene therapy shall be within the body**. Another example is treatment of **cystic fibrosis (CF),** and the gene that causes the disease encodes a protein abnormally enters in the composition of channels passage. To remedy this situation it must move the healthy gene to the cells lining the lungs from the inside, and because these cells cannot be pulled out of the body, it must deliver the healthy gene into these cells by genetic vectors which they are usually genetically engineered viruses enter the lungs by inhalation.



An illustration of in vivo gene therapy.

<u>**Types of vectors in gene therapy**</u> : the vectors divided into two types:

• **Viruses vectors**: six main types of viruses used in gene therapy, namely:

1. **Retroviruses** - A class of viruses that can create double-stranded DNA copies of their RNA genomes. Human immunodeficiency virus **(HIV)** is a retrovirus.

2. **Adenoviruses** - A class of viruses with double-stranded DNA genomes. The virus that causes the common **cold** is an adenovirus.

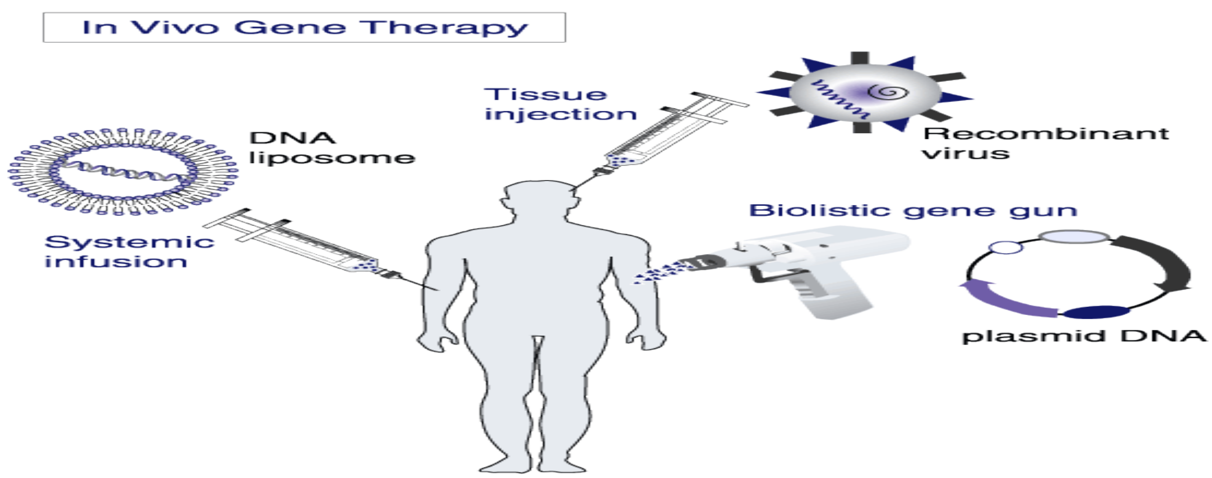
3. **Adeno- associated viruses** - A class of small, single-stranded DNA viruses.

4. **Herpes simplex viruses** - A class of double-stranded DNA viruses. **Herpes virus** causes cold sores.

5. **Alpha viruses**- a single stranded RNA.

6. **Vaccinia or pox viruses**- belonging to the poxvirus family. It has a linear, double-stranded DNA genome.

•**Non virus's vectors**: This technique has many forms, such as fatty bubbles called **liposomes** containing the gene to be transferred, and can surround by antibodies to be specific to the target in the cells. Transfer gene also can be linked to **gold or titanium** to reach the target cells using **gene gun** to push the new gene into the cells. Bacterial **plasmids** may be used also for this purpose.



5- Stem Cells

Stem cells are **un-programmed** cells or non-specialized, **undifferentiated** and can renew themselves for long cell division and can differentiate them to **unfold** in appropriate circumstances to become any other type of cells. It is believed that stem cells in our bodies represent an opportunity for the treatment of all diseases (**cure-all**).

Types of stem cells

There are two types:

• **Embryonic stem cells (ESC)**

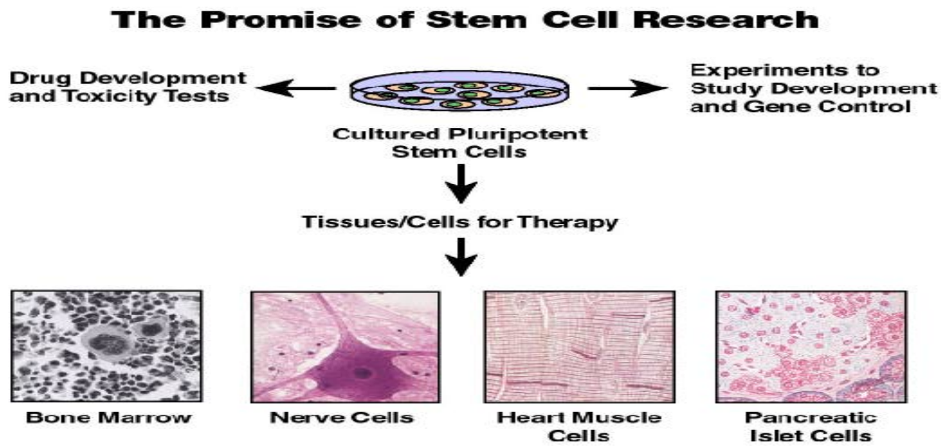
These cells are found in embryos in the early stages of embryonic unraveling. Researchers have discovered how to prepare these cells from mice embryos, and in 1998 cultivated embryonic stem cells from human embryos**.**

• **Adult stem cells (ASC)**

These are found in cells in some member for adults and is usually remain undivided, and they can differentiate to replace the lost cells which exposed to injury or disease. For examples: bone marrow, muscle, skin, liver, and blood.

Expected uses of stem cells

The most important uses of stem cells are the treatments based on the use of cells (**cell-based therapies)** which is mean push the stem cells to unfold to a certain type of sick or injured cells or tissue necessary to treat. If successful, such experiments in humans can be, for example, treatment of **diabetes type I** by push cultured stem cells in the pancreas to produce insulin, or treat diseases in bone narrow, nerve cells, heart cells and others.



<u>Conditions provided in the stem cells to be used in the treatment.</u>

- Multiplies rapidly and be a sufficient amount of cells in the laboratory.
- Unfolds into the desired cell type.
- Lives within the tissue after transplantation in the recipient.
- Operate throughout the life of man.
- Not to cause any harm to humans.