# Applications of recombinant DNA technology in Health, Agriculture,Environment, Industry

# Application of rDNA technology in health:

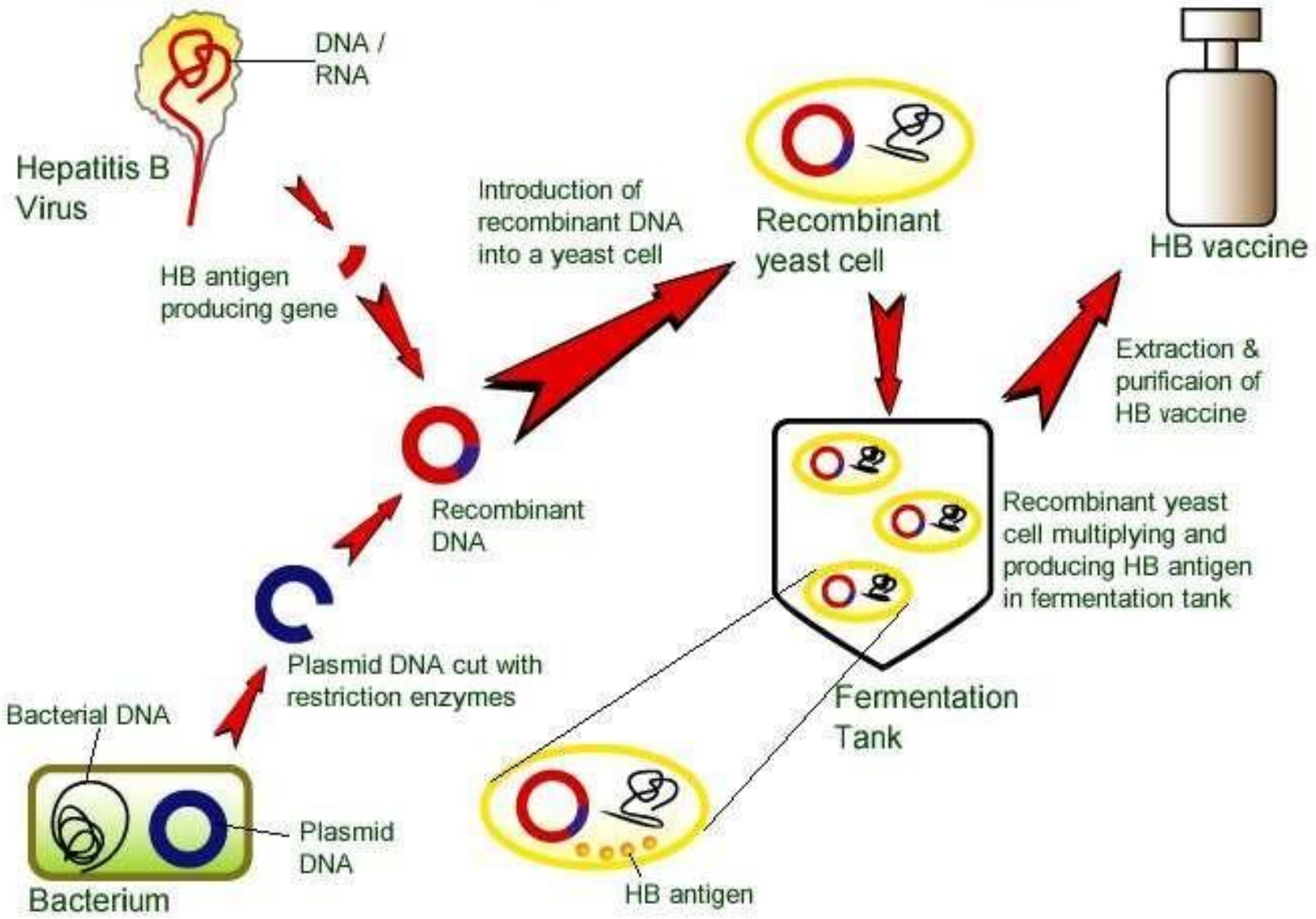
# Applications in health:

- rDna technology has a wide spectrum in improving health.
- Treat defected gene or introduce new one.
- Applications, laboratory test and parental diagnosis of genetic disease

# Production of vaccine:

- Introduction live attenuated type of dose in the recipient.
- Acquired immunity.
- rDna technology can be used to clone gene for protective antigen.
- Hepatitis B vaccine (rDNA), influenza ,HIV,etc.

# Production of Recombinant HB Vaccine

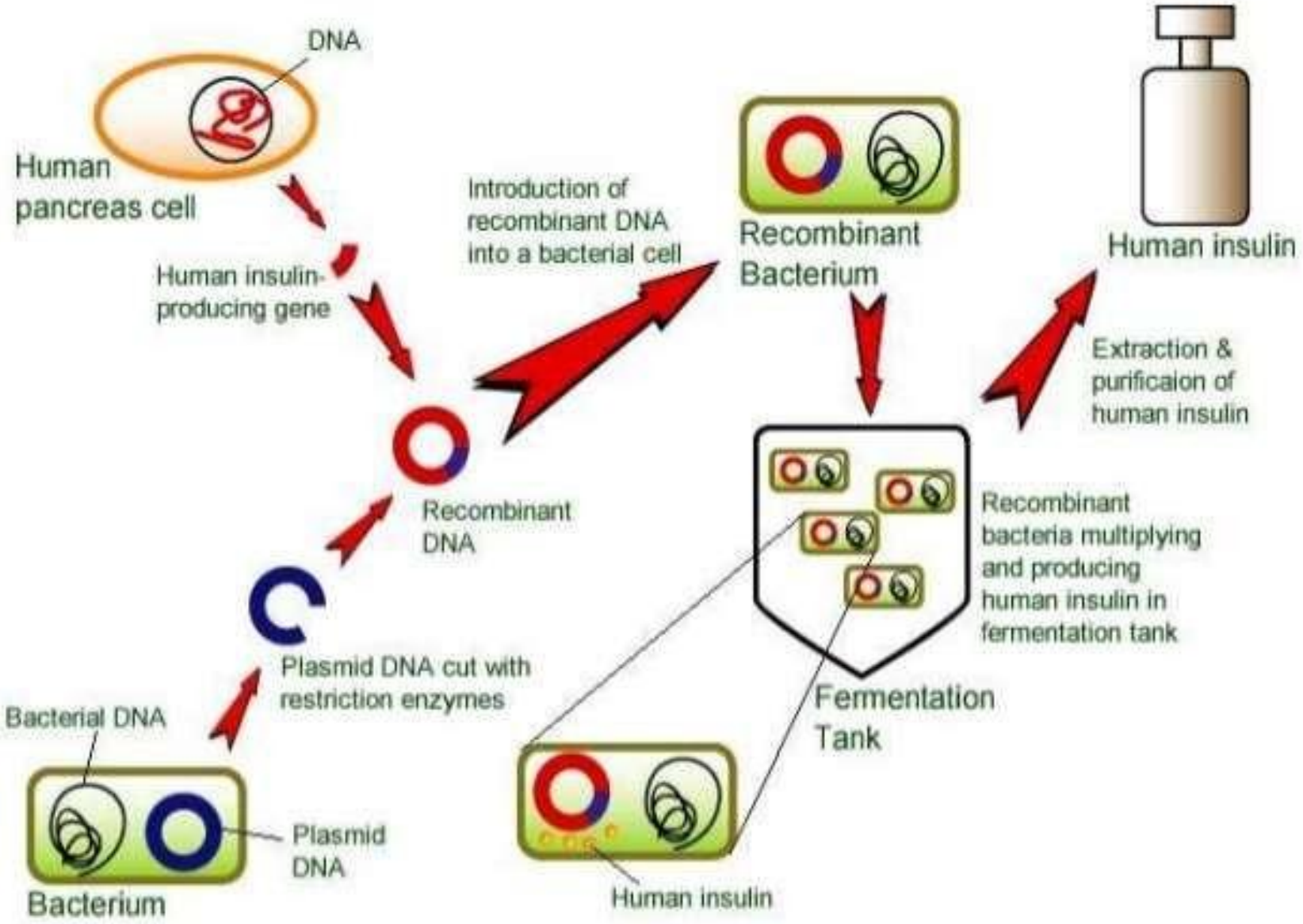


# Commercial and pharmaceutical products:

**Insulin:**

- Insulin(hormone) controls glucose level in humans.
- By rDna , done cloning of human insulin gene and put in E.coli.
- availability of insulin.
- devoid of getting byproducts by animal slaughtering.

# Human Insulin Production



# Human growth hormone:

HGH is homing polypeptide .

- 121 amino acids, 2 to 115 Dalton molecular weight.
- role in growth , regeneration or differentiation.
- E.g

dwarfism treating by injecting these.

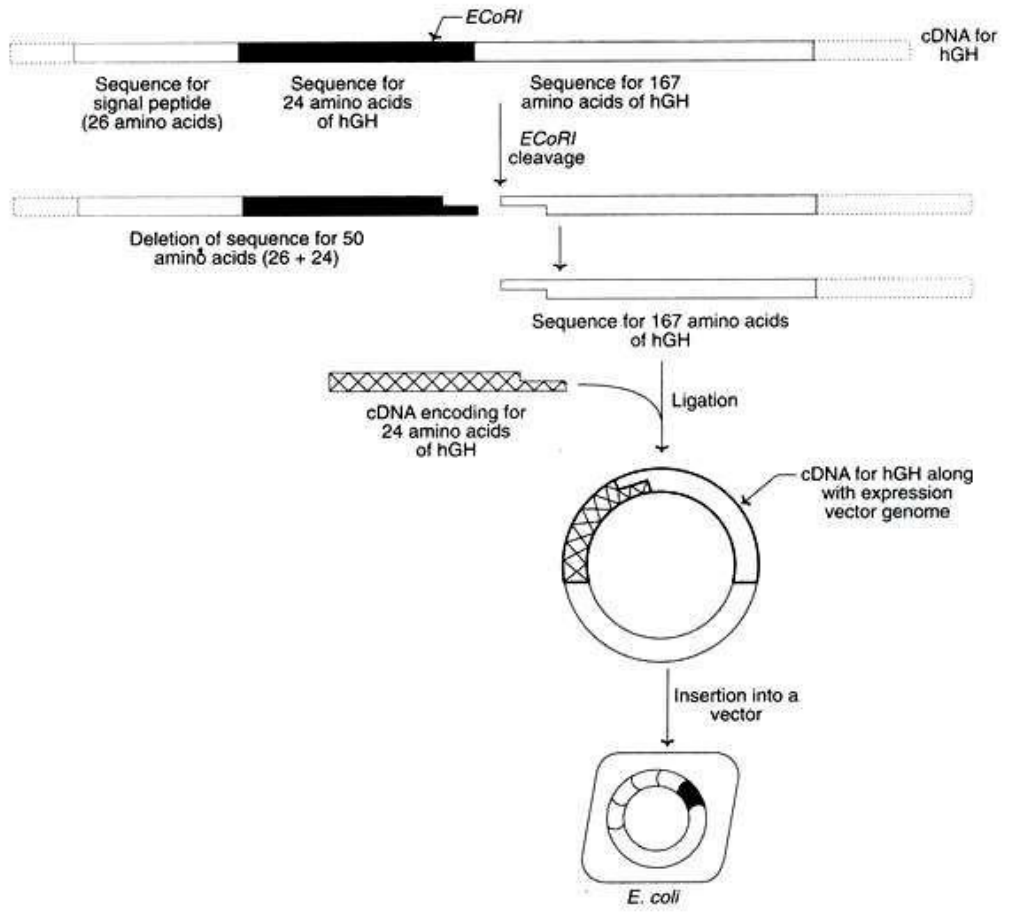



*Fig. 15.2 : The production of recombinant human growth hormone (cDNA–Complementary DNA, hGH–Human growth hormone)*

# Interferon:

- Interferon are group of proteins that interfere with viral multiplication or replication.
- By rDna,capable of making interferon.
- Alpha component of which have role in curing lymphoma and myelogenous leukemia.

# Antibiotics:

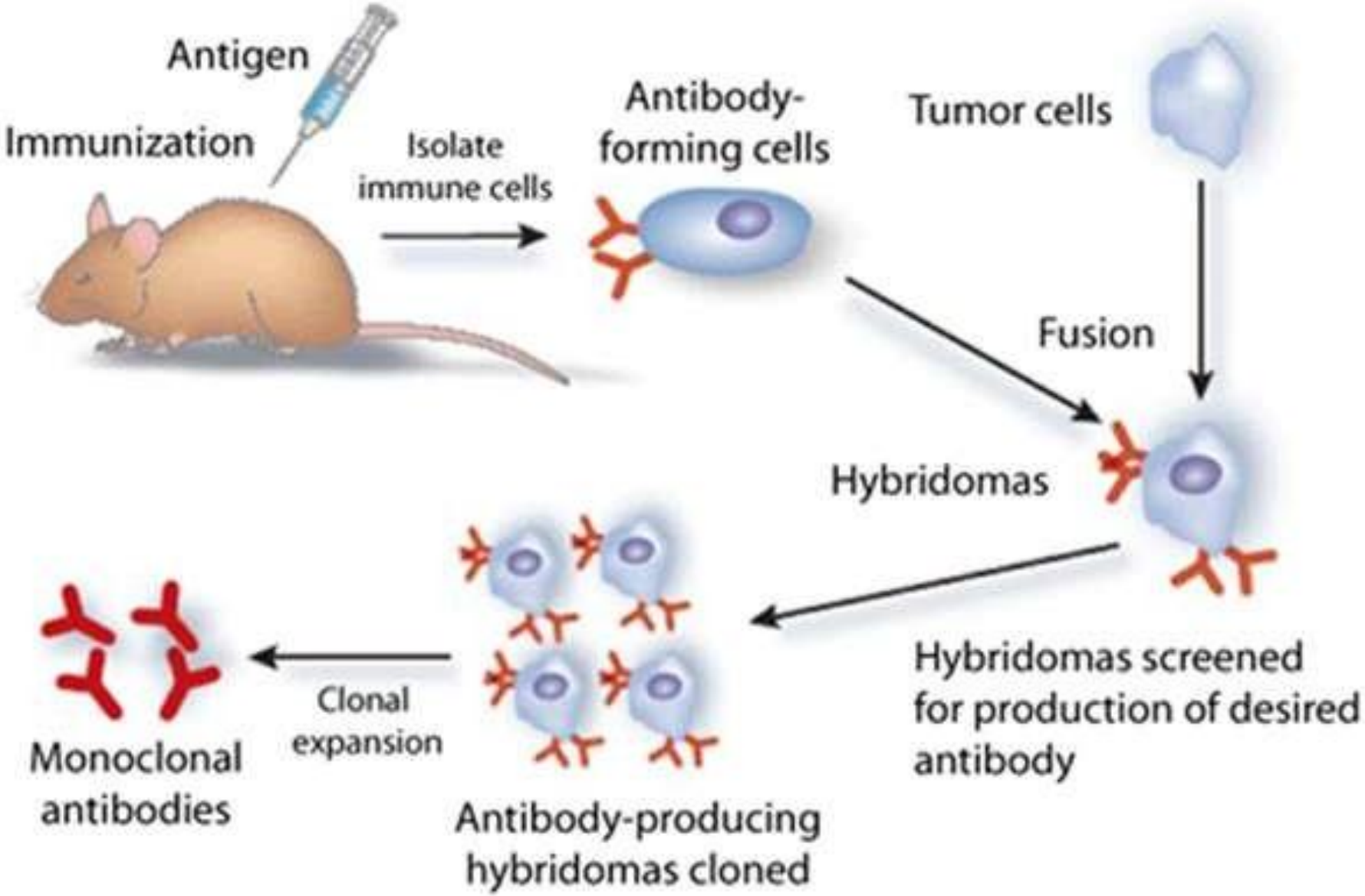
- Artificially prepared antibiotics also available.
- They denature harmful living pathogens.
- pencillin in 1928.

# Monoclonal antibodies:

- Antibodies are specific proteins produced by the immune system in response to presence of a specific antigen.
- Monoclonal antibodies are produced from single clone of antigen. That's why they are monospecific in nature.
- Production through **hybridoma technology**.

***Applications:***

- mAb are used for diagnosis of disease, Pregnancy and Treatment of cancer.


Antigen
Immunization
Isolate
immune cells
Antibody-
forming cells
Tumor cells
Fusion
Hybridomas
Hybridomas screened
for production of desired
antibody
Antibody-producing
hybridomas cloned
Clonal
expansion
Monoclonal
antibodies

# Molecular diagnosis of diseases:

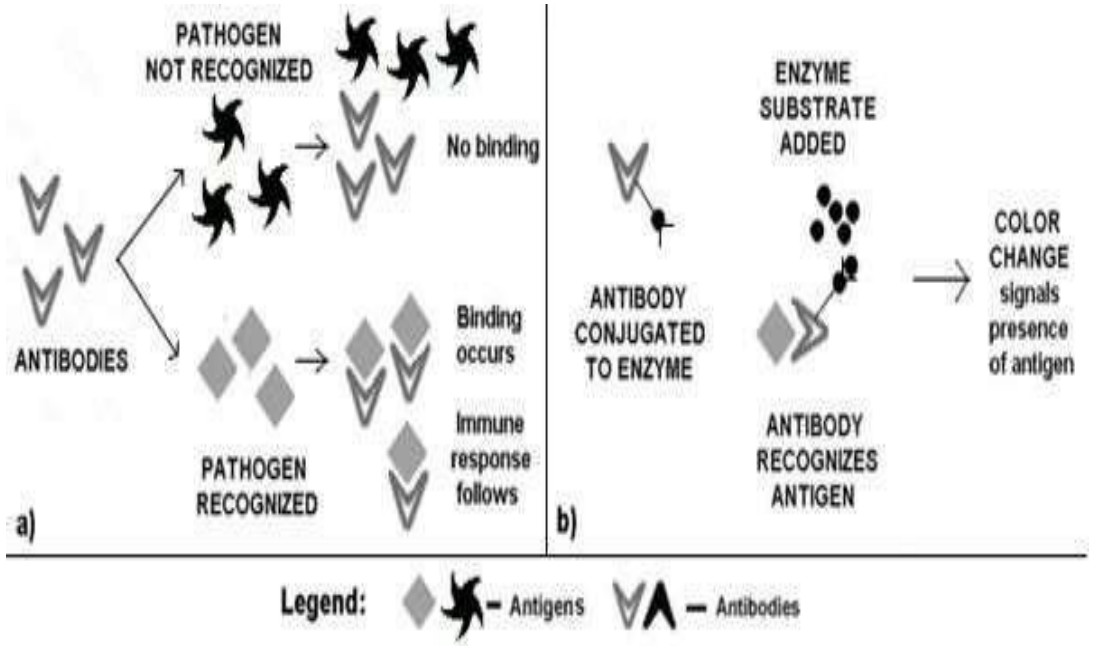
- Infectious diseases diagnosis mainly depends upon isolation and identification of pathogens, which may take several days.
- Development of **diagnostic kits** to identify pathogenic organisms by knowing the organism-specific DNA sequence has provided rapid, specific and correct diagnosis.
- Various diagnostic kits have been developed for AIDS, cancer, foot and mouth diseases, tuberculosis, etc.

- Based on ELISA and PCR principles.

For example:

in HIV patients, diagnosis conduct by:

- Antibody test uses a recombinant HIV protein to measure antibodies in the body that proliferate when there is a HIV infection.
- DNA test uses reverse transcription polymerase chain reaction (RT-PCR) to detect presence of HIV genetic material. This technique was developed using rDNA of molecules and analyzing the genome sequences.



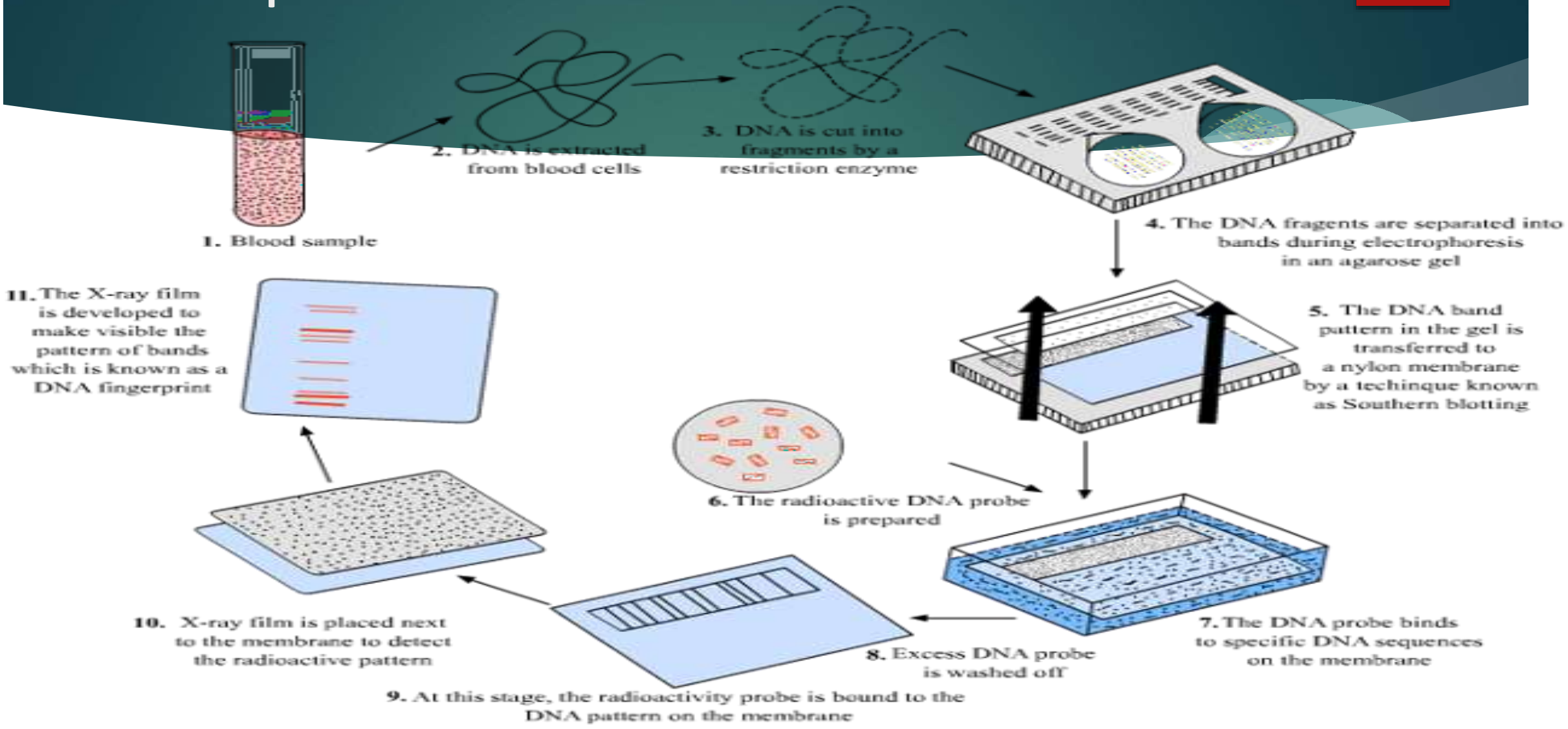
# DNA Fingerprinting:

- **Dr. Alec Jeffreys** developed DNA fingerprinting technique.
- Every person have its unique finger patterns that differs from other individual. There is possibility to alter these patterns but specific principle is unknown.
- Finger prints are detected on the basis of number of highly polymorphic genes.

**Applications:**

- Used in criminal identification.
- For child parentage establishment.
- Helpful for detection of racial group.

# Principle:




**Steps in DNA fingerprinting techinque**

# Gene Therapy:

- Injects functional genes into a cell to replace missing or defective genes in order to correct genetic disorders.
- A gene that is inserted directly into a cell usually does not function. Instead, a carrier called a **vector** is genetically engineered to deliver the gene.
- Gene therapy may be done in-vivo or e-vivo.

***Health Risks:***

toxicity, inflammation, and cancer.

# Applications of recombinant DNA technology in environment

# Importance

- We can use recombinant DNA technology in environment to cleanup the environment
- Measure the presence of hazardous compounds

- By Recombinant DNA technology plastic degradation can be enhanced by genetically modified organisms.
- Degrade oil spills or organic waste.
- Genetically modified strain of Pseudomonas putida able to degrade chemicals in oil spills.
- used in development of bioindicators
- bacteria have been genetically modified as 'bioluminescors' that give off light in response to several chemical pollutants.

# Applications of recombinant DNA technology in agriculture

# Importance

- used for the production of transgenic plants with:
- higher yield
- nutritional values.
- increased resistance to stress and pests.

# Plants with improved yield:-

- Genes are inserted into plants to increase their yield.
- Researchers at Japan's National Institute of Agrobiological Resources added maize photosynthesis genes to rice.
- Increased yields by 30 percent.

- **Insect resistance plants:-**
- Cry genes (popularly known as Bt genes) from a bacterium Bacillus thuringiensis are isolated.
- Then plant is modified using this gene.

  e.g cotton, rice, maize, potato, brinjal, cauliflower, cabbage etc.) with Bt genes have been developed.