

Introduction to Biotechnology

Definition of Biotechnology

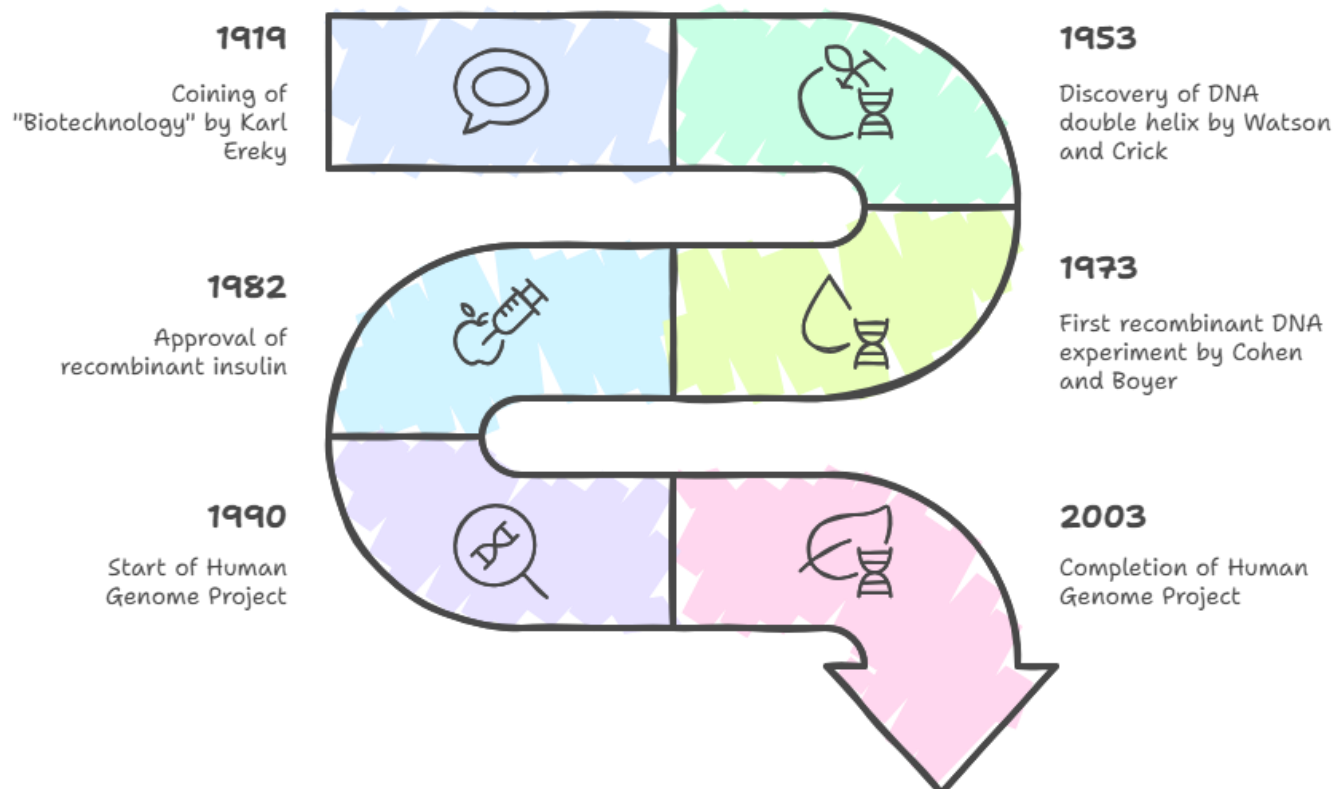
- **Biotechnology** is a multidisciplinary science that applies biological systems, living organisms, or their derivatives to develop products or processes for specific uses.
- In **clinical pathology**, biotechnology is essential for:
 - Disease diagnosis
 - Monitoring health conditions
 - Developing targeted therapies

WHO Definition:

- Biotechnology is any technological application that uses biological systems, living organisms, or derivatives thereof to make or modify products or processes for specific use.

Historical Background:

- **Traditional biotechnology:** Includes ancient practices like fermentation to make bread, alcohol, and cheese.
- **Modern biotechnology:** Emerged after the discovery of the **structure of DNA** (1953) and the development of **recombinant DNA technology** (1970s).



Branches of Biotechnology:

Branch	Application Area
Red Biotechnology	Medicine and healthcare (e.g., vaccines, antibiotics, gene therapy)
Green Biotechnology	Agriculture (e.g., genetically modified crops, biofertilizers)
White Biotechnology	Industrial processes (e.g., enzymes, biofuels, bioplastics)
Blue Biotechnology	Marine and aquatic applications (e.g., marine drugs, aquaculture)
Yellow Biotechnology	Food and nutrition (e.g., fermentation, probiotics)
Grey Biotechnology	Environmental (e.g., bioremediation, waste treatment)

Biotechnological Tools and Their Applications in Disease Diagnosis:

Key Areas and Tools:

- **Genetic Engineering:** Alteration of DNA sequences
- **Recombinant DNA Technology:** Inserting foreign genes into organisms
- **Tissue Culture:** Growing cells or tissues in controlled conditions
- **CRISPR-Cas9:** A gene-editing tool
- **Bioinformatics:** Application of computer technology to understand biological data

Applications of Biotechnology:

1. HIV/AIDS

- **Tools Used:** ELISA, Western Blot, RT-PCR
- **Purpose:** Detection and quantification of the HIV virus

2. Cancer

- **Tools Used:** PCR, NGS (Next Generation Sequencing), FISH, Flow Cytometry
- **Purpose:** Detection of genetic mutations, oncogenes, and abnormal (cancerous) cells

3. Genetic Disorders

- **Tools Used:** PCR, Microarray, Karyotyping
- **Purpose:** Diagnosis of inherited genetic diseases

4. Infectious Diseases

- **Tools Used:** PCR, CRISPR-based diagnostics, ELISA
- **Purpose:** Rapid and accurate identification of bacterial, viral, or parasitic pathogens

5. Hemoglobinopathies

- **Tools Used:** Hemoglobin Electrophoresis, DNA Testing
- **Purpose:** Diagnosis of conditions like thalassemia and sickle cell anemia

Importance:

- Improves human health and nutrition
- Increases agricultural productivity
- Supports sustainable industrial processes
- Offers eco-friendly solutions to environmental problems



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