## Lec.1 Biotechnology

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**Biotechnology**

Biotechnology is the accumulation of more than 8000 years of human experience using living organisms and the process of fermentation to make products. Today biotechnology is applied to manufacturing processes used in health care, food, agriculture, industrial and environmental cleanup, among other applications. In **1919, Karl Ereky**, a Hungarian engineer, coined the term biotechnology for the first time to describe the interaction of biology and human technology.He envisioned a new era of technology based on using biology to turn raw materials into socially useful products.Nearly a century later, vision is being realized by thousands of companies and research institutions.Biotechnology composes of **Bio** that refers to the use of biological processes, and **technology** that refers to solve problems or make useful products.

A widely accepted definition of **Biotechnology** is "Application of scientific and engineering principles to processing of materials by biological agents to provide goods and service". Some other definitions replace rather ambiguous word ‘**biological agents’** with more specific words such as microorganisms, cells, plant and animal cells and enzymes. When a biotechnological process is implemented on a commercial scale there is every reason to believe that it will make in some **bioreactor or fermenter**.

**Biotechnology** is the use of living systems and organisms to develop or make useful products. Or its any technological application that uses biological systems, living organisms or derivatives thereof, to make or modify products or processes for specific use.

**Historical development of biotechnology**

**1- Stage1:Pre-Pasteur Era(before 1885)**

**●** Discovering of microorganisms

**●** Traditional microbial industry(bread, cheese, beer and wine)

**2- Stage2:Pasteur Era or fermentation Era(1885-1940)**

**●** Production gunpowder by soil microorganisms

**●** The fermentative ability of microorganisms

**●** Production of chemicals like acetone, butanol, ethanol and organic acids

**3- Stage3:Antibiotic Era(1940-1960)**

**●** Production of antibiotics

**●** Production ofenzymes and vitamins

**●** Production ofgibberellins ,amino acids, nucleotides and steroids

●Tissue cultures techniques

**4- Stage4:Post-antibiotic Era(1960-1975)**

●Production of single cell protein (SCP)

●Production of sterilantsanddisinfectants

●Enhancement of microorganisms productivity by genetic engineering techniques

**5-Stage5:Genetic engineering Era(1975-2000)**

● Production of therapeutic proteins(insulin, interferon,....etc)

●Production of new sources of energy(Biogasand biodiesel)

● Production of monoclonal antibodies

● Production of hybrid antibodies

● Production of biodetergents

●Immobilization of enzymes and cells

**6-Stage6:Transgenic organisms Era(2000-2025)**

●Production of vaccines by plants

●Production of therapeutic proteins by animals

●Production of genetically modified foods.

●Production ofartificial chromosomes

**Another division for biotechnology was included:**

1. **Ancient Biotechnology (stage I)**
2. **Classical Biotechnology (stages II , III and IV)**
3. **Modern Biotechnology (stages V and VI )**

Some important discoveries related to biotechnology have been shown in [Figure 1](http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3178936/figure/F1/).

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**Figure 1:History of the development of biotechnology. Some of the important biotechnology discoveries have been plotted in this graph, with a possibility for its unlimited growth in the future.**

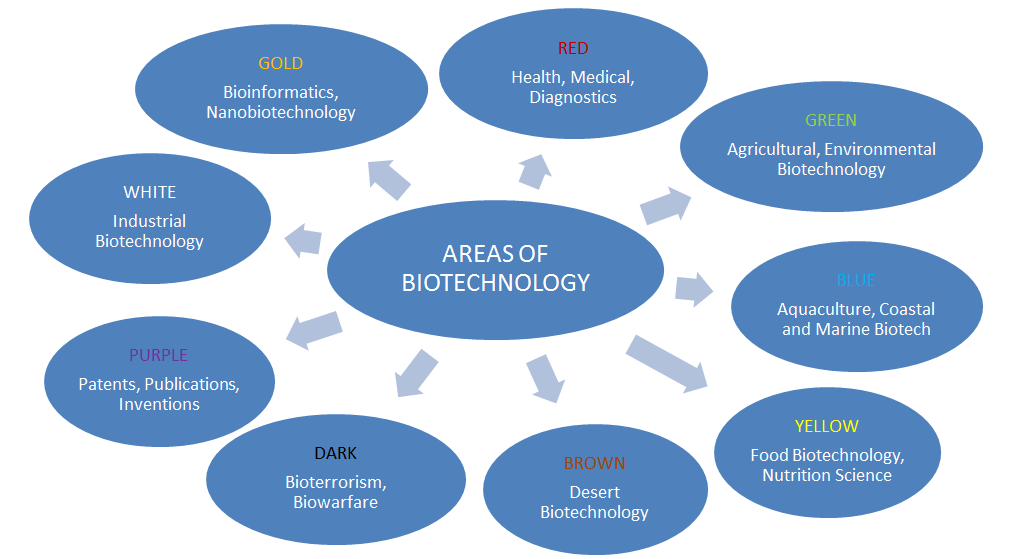
**Generations of biotechnology**

1- [**Blue biotechnology**](http://en.wikipedia.org/wiki/Blue_biotechnology)**:** is a term that has been used to describe the marine and aquatic applications of biotechnology.

**2-**[**Green biotechnology**](http://en.wikipedia.org/wiki/Green_biotechnology):is biotechnology applied to agricultural processes.

**3-**[**Red biotechnology**](http://en.wikipedia.org/wiki/Biopharmaceutical):is applied to medical processes.

**4- White or grey biotechnology:** is biotechnology applied to [industrial](http://en.wikipedia.org/wiki/Industry) processes or environment**.**

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**Figure 2: Generations of biotechnology**

**Biotechnology inputs**

**1-Monoclonal antibodies**

Using immune system cells that build antibodies which are characterized by very highly specialized and therefore can determine and discover the vital elements accurately even if very small quantities, and its applications**:**

**●**Identify and detect environmental pollutants.

**●**To detect harmful microorganisms in food.

**●** differentiate between normal cells and cancer cells.

**2- Tissue culture technology**

It is the cultivation of animal or plant cells in vitro(in the laboratory), and their applications:

**●**Cellular therapy.   
**●**the production of drugs from plant cells directly instead of the plant.   
**●**The use of animal cells in the detection efficiency of drugs instead of animals, reflecting the safety and accuracy.  
**●**Propagation and doubled of the plant tissues in the laboratory.

**3- Cloning**

Production numbers and models of genetically identical molecules, cells and animals and plants which are of three types: Molecular or DNA cloning, cells cloning and animal or reproductive cloning.

**4- Genetic modification**

It happensto modify thegenes ofthe same typeorthe transfer ofgenesfrom one species toanother andits applications**:**

**●**Production ofdrugs and vaccines.   
●Treatment of certaingenetic diseases.   
●To increase agricultural productionand reducecost.   
● Increasethe value ofthe nutritional contentinfood**.**

**5- Protein engineering**

This technique dependson the concept ofgenetic modificationin order toproducespecific proteinsornew proteinshaveuseful applicationssuch asenzymesorbiocatalysts.

**6- Hybrid technology**

It is intended to link biological sciences with other sciences to give useful applications such as:

**a- Biosensors**

This technologyconnectsbetween**biology andmicroelectronics**, and their applications:   
•measuring thecontentand quality offoodand safety.  
•measurement ofenvironmental contaminants.   
•helping doctorsto measurespecific componentsin the blooddirectly**.**

**b-Tissue engineering**

This technology connects between **cytology and materials science** to produce artificial tissues in the laboratories with its scaffolds. The successful examples of this technique the building of skin and cartilage.

**c-DNA chips**

This technologyconnectsbetweenthe **semiconductor industryandthe genes**making it possible toanalyzetens of thousands ofgenesina single-chiparea does not exceedper squarecentimeter, and their applications:   
●detection ofmutationsinspecific genes.   
●measurement ofgene activity.   
●Identification ofgenesimportantfor crop production.   
●Studying thestructuralsequenceof genetic material**.**

**d- Bioinformatics**

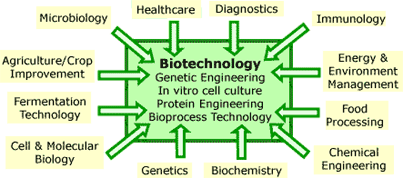
Thistechnology linkbetween**computer scienceand the genetic material,**especiallythe programsof statistical analysis, graphsimulation and databases and thatutilizedin the analysis ofthe vast amount ofinformation derived fromgenetic material, and their applications:   
•Geneticmappingand identification ofsitesandthe number of genesineachmap.   
•determination of the shapeandconstruction ofproteins.  
•Simulation theway ofproteins workandthread.

•The discovery ofthe causesand locations ofgeneticmaladiesanddesignappropriate treatment.

**Hybrid technology**

* Biology + Microelectronics=Biosensors
* Cytology + Materials = Tissue engineering
* Genes + Semi conductive = DNA chips
* Genetic material + Computer science = Bioinformatics

**Figure 3:Hybrid technology**

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**Figure 4: Inputs of biotechnology**