

Biotechnology

Course Description:

Biotechnology is a semestral course. The course aims to make the students aware of the goals and processes of biotechnology (defined as using organisms for practical purposes) as well as the ethical/moral issues attendant to it.

The course consists of two main parts: (1) the first part discusses the biological and chemical basis of biotechnology; (2) the second part presents the applications of biotechnology in medicine, agriculture, environment and research.

BIOTECHNOLOGY: Course Outline and Learning Competencies

A. THE SCIENCE OF BIOTECHNOLOGY

I. Cell Structure and Function

1. Appreciate the highly organized structure of the cell.
 - 1.1. Identify the parts of the cell.
2. Recognize the relation between the structure of the cell and the functions it can do.
 - 2.1. Relate the processes that the cell performs with its structures.

II. Cell Division: Mitosis and Meiosis

1. Appreciate the importance of cell division to the survival of the cell, the organism and the species.
 - 1.1. Describe the cell cycle.
 - 1.2. Trace the changes that chromosomes undergo during mitosis.
 - 1.3. Trace the changes that chromosomes undergo during mitoses.
 - 1.4. Differentiate mitosis and meiosis in terms of:
 - (a) chromosome number of the daughter cells and
 - (b) importance to the species

III. Commonly Used Microbes in Biotechnology

1. Recognize the role of microbes in DNA research.
 - 1.1. Identify the parts of (a) a bacterium, (b) a yeast of (c) bacteriophage and their corresponding functions

IV. Molecular Genetics

1. Be familiar with the structural organization of (1) the chromosome and (b) the PNA.
 - 1.1. Identify the parts of a chromosome.
 - 1.2. Identify the components of DNA
2. Be familiar with the updated Central Dogma of Molecular Genetics

Trace the sequence of events involved in the expression of hereditary characteristics.

3. Understand protein synthesis.
 - 3.1. Identify the events of protein synthesis.

B. RECOMBINANT DNA TECHNOLOGY

1. Understand how bacterial genes can transfer from one cell to another.
 - 1.1. Using diagrams, illustrate how DNA technology transfers bacterial genes from cell to cell.
 - 1.2. Using diagram, illustrate how bacterial plasmids are used as vectors for the transfer of genes from one cell to another.
 - 1.3. Explain the role of *restriction enzymes* and *DNA ligase* in creating recombinant DNA.
 - 1.4. Explain the importance of gene cloning.

C. BIOTECHNOLOGY AND HEALTH

1. Recognize the limited supply of certain pharmaceutical products (*eg., hormones and vaccines*) and understand the need for mass-producing them.

Explain the importance of insulin in the treatment of diabetes.

 - 1.1. Describe the early method of producing insulin.
 - 1.2. Discuss how recombinant DNA technology has mass-produced insulin.
 - 1.3. Explain how a vaccine works.
 - 1.4. Discuss how genetic engineering was utilized in producing a vaccine to prevent hepatitis-virus infection.
 - 1.5. Give at least three other examples of pharmaceutical products made with the use of recombinant DNA technology.
2. Be aware of ethical issues related to genetic engineering in humans.
 - 2.1. Discuss one example of human gene therapy.
 - 2.2. Cite the major points for and against human gene therapy.

D. BIOTECHNOLOGY AND AGRICULTURE

1. Appreciate the role of biotechnology in increasing the yield and quality of farm plants and animals.
 - 1.1. Give at least two examples of agricultural crops and at least two examples of farm animals that have been genetically modified and the improved characteristics that have been imported on them.
 - 1.2. Cite the major points for and against genetically modified organisms ((GMOs).
2. Recognize potential gene products that may improve farm productivity.
 - 2.1. Discuss how gene products such as cellulase (a protein that can break down cellulose in animal feeds) and genetically modified bacteria with increased capability for nitrogen fixation can facilitate raising farm plants and animals.

E. BIOTECHNOLOGY AND ENVIRONMENT

1. Appreciate the help that genetic engineering can do to solve certain environmental problems.

Discuss the beneficial effects of genetically engineered bacteria for cleaning up oil spills.

 - 1.1. Explain how a gene for pest resistance that has been inserted into plants is indirectly beneficial to the environment.
2. Recognize the possible dangers that GMOs might inflict on the ecosystem.

- 1.2. Cite examples of possible harmful effects of planting GMOs on other organisms (e.g. insects and weeds) in the surrounding fields.

F. TRANSGENIC ORGANISMS IN RESEARCH

1. Understand why and how scientists make transgenic organisms (i.e., organisms that contain genes from another species).
 - 1.1. Discuss examples of transgenic animals/plants and the foreign genes they have received.
(Among the examples, include the mouse that carries human genes which make it susceptible to HIV. Discuss how this transgenic animal can accelerate the search for a cure for AIDS.)
2. Be aware of the ethical/moral questions raised concerning genetic engineering research.
 - 2.1. Collect published articles expressing opposing views/opinions from various sectors of society. Study the arguments for and against research in biotechnology.