

# COURSE SYLLABUS

<b>LAST REVIEW</b>	Spring 2021
<b>COURSE TITLE</b>	Introduction to Biotechnology
<b>COURSE NUMBER</b>	BIOL-0105
<b>DIVISION</b>	Math, Science, Business & Technology
<b>DEPARTMENT</b>	Biology
<b>CIP CODE</b>	24.0101
<b>CREDIT HOURS</b>	2
<b>CONTACT HOURS/WEEK</b>	Class: 2
<b>PREREQUISITES</b>	None
<b>COURSE PLACEMENT</b>	None

## COURSE DESCRIPTION

Introduction to Biotechnology is designed to give students an understanding of the foundational scientific principles and applications of the biotechnology. Students will focus on pharmaceutical, agricultural, medical, genomic and forensic applications of biotechnological methods and will deepen their understanding of biotechnology-related career fields in the process. Students will also explore the history of biotechnology, the regulatory methods used by industry, and the ethical issues raised by this application of science.

## PROGRAM LEARNING OUTCOMES

1. Overview of Biomanufacturing: Demonstrate an understanding of the subjects at the interface of Biology and Business central to Biomanufacturing field.
2. Lab Skills: Demonstrate proficiency in basic bio-manufacturing/biotechnology laboratory skills including: making measurements, preparing cultures and solutions, checking pH, using a microscope, DNA extraction, western blotting, agarose gel electrophoresis, bacterial transformations, PCR, growing cells in the Bioreactor, centrifugation and chromatography.
3. Understanding the Manufacturing Industry: Demonstrate competency in (1) Math and Measurement, (2) Spatial Reasoning and Manufacturing Technology, and (3) Business Acumen and Quality.

## TEXTBOOKS

<http://kckccbookstore.com/>

## METHODS OF INSTRUCTION

A variety of instructional methods may be used depending on content area. These include but are not limited to: lecture, multimedia, cooperative/collaborative learning,

labs and demonstrations, projects and presentations, speeches, debates, panels, conferencing, performances, and learning experiences outside the classroom. Methodology will be selected to best meet student needs.

## **COURSE OUTLINE**

- I. Biotechnology, Past and Present
  - A. Historical Developments
  - B. Major Scientific Discoveries
- II. Gene Expression
  - A. DNA Structure and Replication.
  - B. RNA transcription.
  - C. Translation and Protein Folding
  - D. Lac Operon
- III. Recombinant DNA Technology
  - A. Restriction Endonucleases
  - B. Transformation.
  - C. Purifying Proteins
  - D. Polymerase Chain Reaction
  - E. DNA sequencing
  - F. Cloning
- IV. The Use of Microbes in Biotechnology
  - A. Microorganism Products
  - B. Product Production Process
  - C. Bioremediation.
- V. Plant Applications in Biotechnology
  - A. Plant Culture
  - B. Tissue culture
  - C. Genetic Engineering
- VI. Animal Applications in Biotechnology
  - A. Gene Transfer
  - B. Transgenic Animals
  - C. Animal Propagation
- VII. Genomics
  - A. Human Genome Project
  - B. Applications of DNA Sequencing
  - C. Human Genome Project Applications
- VIII. Pharmaceutical Applications in Biotechnology
  - A. Chemistry Techniques
  - B. Sample Purity Analysis
  - C. Gene Therapy
- IX. Forensic Applications in Biotechnology
  - A. Legal and Technical Requirements
  - B. Methods
  - C. DNA Databases
- X. Regulation of the Biotechnology Industry

- A. Regulatory Agencies
- B. Making Policy
- C. Patents
- XI. Bioethics
  - A. Public Concerns
  - B. Benefits and Risks
  - C. Rights and Responsibilities
- XII. Careers in Biotechnology
  - A. Careers
  - B. Portfolio
  - C. Resume
  - D. Positions

### **COURSE LEARNING OUTCOMES AND COMPETENCIES**

Upon successful completion of this course, the student will:

- A. The learner will be able to discuss the foundations of modern biotechnology.
  - 1. The student will be able to describe major historic developments in biotechnology fields.
  - 2. The student will be able to identify the major scientific discoveries that lead to recombinant DNA technology and explain how those discoveries are used in industry today.
- B. The learner will be able to explain the biochemical principles that form the basis for biotechnology.
  - 3. The student will be able to describe the structure of DNA and the process of replication.
  - 4. The student will be able to explain the process of RNA transcription.
  - 5. The student will be able to explain the process of translation and the subsequent folding of the protein product.
  - 6. The student will be able to explain the regulation of gene expression using the lac operon as an example.
- C. The learner will be able to describe the common methods and applications of biotechnology with regards to microorganisms, plants and animals.
  - 7. The student will be able to describe the process of excising DNA using restriction endonucleases.
  - 8. The student will be able to explain the process of cell transformation.
  - 9. The student will be able to describe methods used for purifying proteins following transformation.
  - 10. The student will be able to explain the role of Polymerase Chain Reaction (PCR) in recombinant technology.
  - 11. The student will be able to describe common DNA sequencing methods.
  - 12. The student will be able to describe the natural occurrence of cloning and the human applications of the process.
  - 13. The student will be able to list products made in microorganisms.
  - 14. The student will be able to outline the steps in product production, recovery, and purification from microorganisms.

15. The student will be able to explain the role of microorganisms in bioremediation.
16. The student will be able to describe the structure and function of plants as it relates to plant culture and breeding.
17. The student will be able to explain the process of plant tissue culture.
18. The student will be able to provide examples of genetic engineering in plants and food products derived from plants.
19. The student will be able to describe gene transfer methods in animals.
20. The student will be able to define the role of transgenic animals.
21. The student will be able to discuss various methods of animal propagation.
- D. The learner will be able to describe the common methods and applications of biotechnology with regards to medicine, forensics and the human genome project.
22. The student will be able to explain how scientists use DNA sequencing to elucidate the human genome.
23. The student will be able to cite examples of how and where DNA sequencing is used during biotechnology.
24. The student will be able to give examples of advances made possible because of the Human Genome Project.
25. The student will be able to compare combinatorial chemistry techniques to genetic engineering techniques.
26. The student will be able to discuss the techniques used in analysis samples for purity including melting point determinations, mass spectrophotometry, and HPLC.
27. The student will be able to illustrate how gene therapy may be used in the treatment of genetic disorders.
- E. The learner will be able to locate and interpret the regulations that govern the products of biotechnology.
28. The student will be able to discuss the legal and technical requirements of forensic science pertaining to: evidence gathering and conservation, interpretation of evidence and reliability of technology employed.
29. The student will be able to describe the methods used in DNA profiling.
30. The student will be able to outline DNA databases and their use in profiling.
31. The student will be able to describe the need for and function of regulatory agencies such as those in government, industry, and society.
32. The student will be able to analyze policy-making procedures for products and techniques of biotechnology.
33. The student will be able to explain the process for gaining a patent for a new technology.
- F. The learner will be able to acknowledge both sides of the ethical implications of biotechnology.
34. The student will be able to cite specific examples of public concerns with the use of biotechnology.
35. The student will be able to illustrate examples of how biotechnology has led to benefits and risks to society.
36. The student will be able to identify the rights, interests, and responsibilities of people involved in bioethical issues.

G. The learner will be able to describe a biotechnology company and biotechnology-related careers.

37. The student will be able to elaborate the opportunities for careers in biotechnology in health, medicine, genetics, agriculture, etc.

38. The student will be able to develop a portfolio that demonstrates proficiency in specific tasks including writing samples and performance-based skills.

39. The student will be able to create an appropriate resume for use in applying for laboratory positions at a biotechnology company.

40. The student will be able to demonstrate knowledge of the vast variety of Departments and positions, scientific and nonscientific, at a typical biotechnology company.

### **ASSESSMENT OF COURSE LEARNING OUTCOMES AND COMPETENCIES**

Student progress is evaluated through both formative and summative assessment methods. Specific details may be found in the instructor's course information document.

### **COLLEGE POLICIES AND PROCEDURES**

*Student Handbook*

<https://www.kckcc.edu/files/docs/student-resources/student-handbook-and-code-of-conduct.pdf>

*College Catalog*

<https://www.kckcc.edu/academics/catalog/index.html>

*College Policies and Statements*

<https://www.kckcc.edu/about/policies-statements/index.html>

*Accessibility and Accommodations*

<https://www.kckcc.edu/academics/resources/student-accessibility-support-services/index.html>.