

COURSE OUTLINE

Biotechnology Skills

Course Description

BI 252. Biotechnology Skills. 2 hours credit. Prerequisite: CH 105 or higher, or BI 110 or BI 120 or BI 130 or BI 250, all with a C or better, or instructor approval. This course will enable the student to use technical skills to perform safe and effective biotechnology procedures. The student will be able to use equipment and perform procedures used in modern biotechnology laboratories. This class requires high-speed internet access to accomplish online learning. This course is intended for biology majors and/or other students interested in technical career paths in biotechnology.

Course Relevance

This course will enable the student to safely and effectively apply advanced biotechnology skills and equipment used in either a commercial or academic biotechnology laboratory to a depth not covered in other BCC Biology offerings. The student will practice and become competent at working with biologic organisms, protein, and DNA. These capabilities are required to obtain employment in biotechnology related businesses/laboratories. These skills are relevant to bioengineering, improvements in crops, food animals, medicine, and energy production.

Required Materials

Daugherty, E. (2007). *Biotechnology: laboratory manual*. St. Paul, MN: Paradigm Publishing

Laboratory notebook with carbon-copy pages

Computer access to the internet:

This is a blended learning class requiring high-speed internet access to accomplish course online activities. Exercises, and quizzes and auxiliary materials will be accessible BCC's learning management system.

Calculator capable of means and standard deviations

Learning Outcomes

The intention is for the student to be able to:

1. Work effectively and safely with biologic materials (organisms, proteins, and DNA) and operate common biotechnology laboratory tools, equipment (including centrifuges), and follow biotechnology procedures. Prepare, manipulate, concentrate, and quantitate proteins and nucleic acids. Execute calculations necessary to determine concentration, recovery, density, and prepare appropriate concentrations and volumes of biotechnology reagents.

2. Work with bacterial and yeast cells in culture by preparing media and buffers, sterilizing by filtration/autoclave, and perfecting sterile culture techniques, laminar flow hood use, serial transfer of cultures and quantitate cells. Perform fermentation and distillation methods for ethanol fuel/spirits production.
3. Perform DNA fragmentation with endonucleases and isolate desired fragments by electrophoretic means, and clone DNA fragments. Perform DNA transformation of cells. Perform the Polymerase Chain Reaction (PCR) to expand selected DNA fragments.

Learning PACT Skills that will be developed and documented in this course

Through involvement in this course, the student will develop ability in the following PACT skill area(s):

Analytical Thinking Skills

1. Problem solving
 - By preparing laboratory solutions based on their molar components, the student will be able to calculate quantities of reagents needed to perform specific experiments. The student will be able to read graphs and interpret the meaning of those results. The student will be able to analyze and interpret the results of their own experiments.

Major Summative Assessment Task(s)

These learning outcome(s) and the Learning PACT skill(s) will be demonstrated by:

1. Producing a laboratory notebook, biologic reagents, and biologic products in those processes. The student will demonstrate effective use of biotechnology tools, prepared reagents, and problem-solving calculations. The student will collectively apply these learning experiences by producing alcohol from a fermentable grain and by producing a plasmid DNA preparation by growing the plasmid-containing bacteria and recovering and manipulating the plasmid DNA containing an expressible gene product.

Course Content

- I. Skills or Competencies-Actions that are essential for achieve the course outcomes:
 - A. Execute personal safety in the laboratory with regard to biologics, chemicals, heat, flame, and equipment
 - B. Preparing of biological solutions, buffers, and media
 - C. Pipet accurately using micro and macro pipets, and determine the mass of solid reagents
 - D. Autoclave and filter sterilize biologic materials
 - E. Culture bacteria/yeasts
 - F. Electrophoresis of proteins and DNA
 - G. Explain the principles of alcohol fermentation
 - H. Set up and run a distillation apparatus to recover alcohol from a fermented product
 - I. Recover, quantitate, electrophoretically separate, and endonuclease cleave a DNA plasmid containing a functional gene.

Learning Units

- I. Laboratory safety
 - A. Personal safety-protective garb
 - B. Safe handling of biologicals, chemicals, heat and flame
 - C. Safe equipment operation: centrifuges, power supplies, hoods, microscopes

- II. Fundamental lab skills: principles and practice
 - A. Accurate pipetting micro and milliliter
 - B. Balance operation, solutions preparation
 - C. Buffers, intro to media
 - D. Data collection maintaining accurate data and procedural notes

- III. Handling and culture of bacterial and yeast cultures
 - A. Solid and liquid media preparations and culture
 - B. Sterile techniques, autoclave principles and function

- IV. Proteins-handling
 - A. Buffers
 - B. Sterilization
 - C. Concentration (pressure dialysis & centrifugal filtration)
 - D. Effective storage

- V. Proteins- manipulations
 - A. Electrophoretic
 - B. Charge and size separation
 - C. Western blotting

- VI. Fermentation
 - A. Biochemical Principles
 - B. Applications to bio-fuel and spirits/brewer products
 - C. Yeast fermentation for production of ethyl alcohol

- VII. Distillation principles and practice
 - A. Set-up a small still
 - B. Recover alcohol from yeast fermentation

- VIII. Deoxyribonucleic Acids (DNA)
 - A. Introduction to DNA
 - B. Handling, buffers, quantitation
 - C. Transformation and transfection
 - D. DNA endonuclease digestion
 - E. DNA electrophoresis
 - F. DNA fragment isolation
 - G. Ligation of fragment into plasmid
 - H. Plasmid construction
 - I. Transformation of bacterial clones with plasmid DNA

J. Polymerase Chain Reaction- expansion of DNA samples

Learning Activities

This class will largely involve using the tools and equipment of science using laboratory exercises and projects. These laboratory activities will be supplemented with online exercises to practice calculations, data analysis, and problem solving prior to applying those skills in the face-to-face laboratory activities. Laboratory experiences will include pipetting, measurements, record keeping, DNA and protein electrophoresis, microbial culture, DNA manipulations including: endonuclease digestions, plasmid purification.

Grade Determination

The student will be graded on learning activities and assessment tasks. Grade determinants will include daily lab work demonstrating skill competencies to the instructor, quizzes, at least two lab practical exams, and laboratory work sheets, a grade for their laboratory notebooks, and grades for the products produced in summative tasks.