BIOT 110: BIOTECHNOLOGY I: BASIC LAB SKILLS AND DOCUMENTATION

Citrus College Course Outline of Record

Heading	Value
Effective Term:	Fall 2024
Credits:	5
Total Contact Hours:	198
Lecture Hours :	36
Lab Hours:	162
Hours Arranged:	0
Outside of Class Hours:	72
Total Student Learning Hours:	270
Strongly Recommended:	BIOT 107 or BIOT 108 or BIOL 105 or BIOL 124; Intermediate algebra or higher; ENGL 101.
Transferable to CSU:	Yes
Transferable to UC:	Yes - Approved
Grading Method:	Standard Letter

Catalog Course Description

This course introduces students to scientific instrumentation and techniques employed in the biotechnology industry. The course includes a significant laboratory component focused on laboratory safety, operation of standard equipment, industry documentation practices, laboratory math, preparation of chemical solutions, aseptic technique, and DNA isolation and manipulation. Students will gain an appreciation for the diversity of biotechnology companies in our region and local workforce trends. Good communication, teamwork, and work-readiness skills are emphasized. 36 lecture hours, 162 lab hours.

Course Objectives

- Identify key industry sectors in biotechnology.
- Convert between units of measure in the metric system with an appropriate number of significant figures.
- Collect and record environmental data from circular chart recorders.
- Perform and verify measurements of length, weight, and volume with accuracy and precision using rulers, digital balances, and volumetric glassware.
- Transfer specific volumes with precision and accuracy using standard laboratory instruments, such as micropipettes and electronic pipette controllers.
- Create and maintain equipment identification tags and usage logs utilizing GDP.
- Identify, calibrate (if necessary), and safely operate standard laboratory equipment, including spectrophotometer, pH/conductivity meter, centrifuge, vortexer, vacuum pump, stirring hot plate, stationary and shaking incubators, heat block, compound light microscope, power supplies, autoclave, and water bath.
- Write and employ standard operating procedures (SOP) for laboratory equipment.
- Explain the importance of and demonstrate proficiency in aseptic technique.
- Identify the purpose of a biological safety cabinet and demonstrate proper technique for working within and disinfecting the cabinet.
- Calculate the molecular weight of a compound and its concentration in a solution using percentages, molarity, molality, and/or normality.
- Provide examples of local companies and their use of biotechnology to address societal challenges.
- Prepare and sterilize solutions (buffers, percent, molarity, dilutions, culture media) with the correct concentration and pH.
- Generate standard curves using serial dilutions, and apply this standard curve to quantify the concentration of an unknown sample.
- Aseptically inoculate small-scale bacterial cultures and generate a growth curve using spectrophotometry.
- Perform DNA extraction and manipulation, including restriction digestion, PCR amplification using a programmable thermocycler, and/or agarose gel electrophoresis.
- Explain the importance of positive and negative controls for experiments.
- Compose a typed resume and cover letter highlighting education, skills, and past employment to apply for biotechnology job opportunities.
- Work collaboratively with a team to perform and troubleshoot laboratory activities.
- List key aspects of Good Laboratory Practice (GLP).
- Utilize material safety data sheets (SDS) to properly label, handle, and store materials using correct personal protective equipment (PPE).
- Demonstrate proper technique for hand sanitization with soap and water, as well as alcohol-based hand sanitizers.
- Identify and operate all safety and first aid equipment, including eye wash stations, fire extinguishers, emergency showers, and emergency shut-off valves.
- Demonstrate the correct cleaning procedure for laboratory glassware.
- Explain the importance of and demonstrate proper usage of Good Documentation Practice (GDP) when recording information on logs and data sheets.
- Maintain a laboratory notebook with raw data and appropriate written analysis of experiments.

Major Course Content

Introduction to biotechnology

1. Local biotechnology companies
2. Workforce trends in the region

Introduction to the scientific method Laboratory/workplace documentation

1. Good Documentation Practice (GDP)
2. Industry standard notebook format and intellectual property rights
3. Confidentiality or non-disclosure agreements (NDA)

Laboratory safety

1. Good Laboratory Practice (GLP)
2. Regulatory oversight
   a. Occupational Health and Safety Administration (OSHA)
   b. Centers for Disease Control and Prevention (CDC)

    c. Food and Drug Administration (FDA)
    d. Environmental Protection Agency (EPA)
3. Material Safety Data Sheets (SDS)
4. Chemical rating systems and hazard labels
5. Chemical compatibility issues
6. Sources of contamination

Laboratory math

1. Metric system and unit conversion
2. Scientific notation
3. Significant figures
4. Chemical formulas and formula weight
5. Concentration expressions: molarity, molality, percent, normality, parts
6. Calculations for molar and percent solutions
7. Calculations for buffer preparation
8. Stock versus working solutions
9. Dilutions
10. Data analysis and graphing

Metrology - use, calibration, and maintenance of standard instruments

1. Balances - top loading and analytical
2. Micropipettes; volumetric glassware
3. pH/conductivity meters
4. Thermometers; temperature recording devices
5. Spectrophotometer

Lab equipment - purpose, safe use, and maintenance of common equipment

1. Centrifuge
2. Biological safety cabinet
3. Chemical fume hood
4. Stationary and shaking incubators; water baths
5. Electrophoresis apparatus and power supplies
6. Autoclave
7. Sitr plates

Biotechnology tools/techniques

1. Basic chemistry of buffers and pH
2. Isolation and storage of biological molecules
3. DNA technology and analysis
4. Microbial culture
5. Separation and quantification of biological molecules

Workforce preparation

1. Resume construction
2. Cover letters/introductory emails
3. Interviewing skills

Lab Content

Laboratory safety

1. Personal protective equipment (PPE)
2. Emergency safety equipment
3. Chemical/biohazardous labeling, storage, and waste disposal
4. Performing risk assessments

Laboratory Documentation

1. Standard Operating Procedure (SOP)
2. Equipment tags and usage logs
3. Laboratory notebooks
4. Time cards

Principles of Metrology

1. Metric system units and conversions
2. Graphic analysis using Excel
3. Accuracy and precision
4. Calibration and verification
5. Measurement of temperature
6. Measurement of weight
7. Measurement of volume
8. Measurement of pH and conductivity
9. Spectrophotometry

Solution Preparation

1. Preparation of buffers, stock solutions, and dilutions
2. Preparation of culture media
3. Preparation of serial dilutions

Introduction to Assays

1. Generation of standard curves
2. Positive and negative controls
3. Quantitation of DNA
4. Analysis of protein (quantity and/or function)

Molecular Separation Methods

1. Centrifugation
2. Filtration
3. Gel electrophoresis
4. Chromatography

Aseptic Technique

1. Procedures for cleaning laboratory equipment and glassware
2. Hand sanitization
3. Use of biological safety cabinet
4. Autoclave sterilization

Culture and Manipulation of Bacteria

1. Aseptic inoculation
2. Bacterial staining
3. Use of compound light microscope
4. Bacterial growth curves and enumeration
5. Proper storage of bacterial cultures
6. DNA isolation (genomic and plasmid)
7. Restriction digestion and/or PCR
8. Bacterial transformation

Employment Skills

1. Resume workshop
2. Resume/cover letter revision
3. Interviewing workshop

Suggested Reading Other Than Required Textbook

Students will read and complete supplemental handouts provided in the laboratory.
Students will read technical articles, news items, and/or online resources relating to the biotechnology industry and specific course content.

Examples of Required Writing Assignments

Students will write a resume and cover letter targeted to entry-level positions in the bioscience industry.
Students will write a standard operating procedure that describes the steps for safely utilizing a piece of laboratory equipment.

Examples of Outside Assignments

Students will complete homework assignments with questions, such as: (1) How many grams of agarose are required to make 100 mL of a 1% w/v solution? (2) How much solute is required to prepare a 1 L solution of 2.5 M NaCl?
Students will answer discussion questions, such as: (1) Describe the general process for calibrating a pH meter. (2) Using your data gathered in the laboratory, does it matter whether enzymes are kept on ice or at room temperature during a 1 hour experiment?

Instruction Type(s)

Lab, Lecture, Online Education Lab, Online Education Lecture