

**Master Course Syllabus
Kennedy King College
One of the City Colleges of Chicago
Biotechnology
Semester/Academic Year (20__ - 20__)**

Course Prefix and Number: Biotech 212

Course Title: Basic laboratory skills and safety

Length of Course: 16 weeks

PCS Code: 1.2

IAI Code:

Semester Credit Hours: 3.0

Contact Hours: 5 (4000 minutes)

Lecture Hours: 1 (800 minutes)

Lab Hours: 4 (3200 minutes)

Method of Delivery (mark all that apply): Face to Face Online Hybrid

Course Catalog Description: This course covers basic concepts and techniques necessary to work effectively in a biotechnology lab. The importance of quality regulations and standards and the role of the technician in producing quality results are emphasized. Laboratory math is introduced and applied. Students learn basic techniques including measuring, weighing, mixing solutions, following, and writing procedures, keeping records, making observations, and using instrument manuals and catalogues. Principles of metrology (measurement) are introduced and students practice using, calibrating, and verifying the performance of instruments. Students survey potential laboratory hazards and safety procedures. The course covers regulation of chemicals: flammable, reactive, corrosive, and toxic substances. Writing assignments, as appropriate to the discipline, are part of the course.

Prerequisites: Pursuit of an Associates of Applied Science Degree in Biotechnology (0215).

Course Objectives:

This course covers:

1. How to create a safe workplace for themselves, other people, and the environment
2. How students should document their work according to established documentation practices.
3. How to prepare for laboratory work effectively and consistently
4. How to recognize and reduce variability in laboratory work, understanding of why this is important.
5. How to recognize problems, trouble-shoot their cause, correct problems and prevent similar problems in the future.
6. How to perform calculations, prepare graphs and use these to interpret their results

Student Learning Outcomes:

Upon successful completion of the course, students will be able to:

1. Design experimental procedures to answer technical questions as they emerge in biotechnology laboratories.
2. Apply problem solving and critical thinking techniques to situations in the biotechnology laboratory.
3. Distinguish factors that affect laboratory procedures and results.
4. Utilize basic mathematics and statistics skills to assist in analyzing and scrutinizing laboratory data.
5. Utilize correct laboratory terminology to assist in communicating with biotechnology team members.
6. Be certain that accurate and comprehensive laboratory records are maintained.
7. Monitor and assess procedures and techniques to assure precision of laboratory results.
8. Utilize appropriate laboratory procedures to assure safety.
 - a. Be able to recognize biohazard symbols.
 - b. Be able to follow established safety regulations.
 - c. Use protective gloves when appropriate.
 - d. Properly dispose of contaminated material and equipment.
 - e. Use isolation and sterile techniques when appropriate.
9. Perform analytical tests and procedures that reflect current practices in biotechnology laboratories.

Suggested Topical Outline					
Class Units (# of units is dependent on course – adjust accordingly)	Topic (Required)	Content (Optional - provide details)	Lab Information	Desired Outcome(s)	Suggested Assessment Method(s)
Unit 1	Quality, Regulations and Standards: Lecture: The Biotechnology Workplace (“Workplace”) •Lecture: Introduction to Quality (“Quality Part” I and “Quality Part II”)	Reading: Problems:	1. Classroom activity Kelsey Case Study 2. Read the handout “How to Access the Code of Federal Regulations.” 2. Classroom activity Reading GMP Regulations	<ul style="list-style-type: none"> •Aware of diverse careers in biotech •Aware of historical basis for GXP •Aware that biotechnology produces products •Aware that quality systems help ensure product quality •Able to identify key elements of a quality system 	Laboratory notebook check. Problem sets.
Unit 2	Quality, Regulations and Standards: • Lecture: Documentation	Reading: Problems:	1. Classroom Activity 7 Being an Auditor 2. Laboratory Exercise 3 Keeping a Laboratory Notebook 3. Classroom Activity 8: Writing and Following an SOP	<ul style="list-style-type: none"> •Able to interpret and apply established principles of documentation in all circumstances relating to laboratory work • Able to record chemical information and procedural information in a laboratory notebook according to established principles of documentation • Able to follow an SOP without deviation • Able to write an SOP that is clear enough for another student to follow successfully 	Laboratory notebook check. Problem sets.
Unit 3	Quality, Regulations and Standards: Lecture/discussion: ” Brief Intro Descriptive Statistics”	Reading: Problems	1. Classroom Activity: Quality Control in the M&M Factory 2. Practice basic statistical calculations from homework problems.	<ul style="list-style-type: none"> • Aware that statistics is a discipline that allows us to make decisions in the presence of variability in the world • Able to understand and explain basic statistical terms including “population,” “sample,” and “variable” • Able to distinguish measures of central tendency and measures of dispersion • Able to calculate a mean and apply it to analyzing the center of a data set • Able to calculate standard deviation and apply it to analyzing 	Laboratory notebook check. Problem sets.

				the dispersion of a data set • Able to graph a frequency histogram for a data set and interpret what the histogram says about the data	
Unit 4	Introduction to Workplace Safety	Homework: Complete personal hygiene safety	Classroom Activity 1: Performing a risk assessment (Seidman et. al.) Laboratory Exercise 1: Tracking the spread of chemical contamination (Seidman et. al.) In-class activity: Writing introduction to laboratory reports	<ul style="list-style-type: none"> • Develop a safety mindset • Perform a simple risk assessment • Model good laboratory report format and content • Discuss, in depth, the format and content of laboratory report introduction sections • Complete a personal safety hygiene contract <p>Summarize the purview of both OSHA and the CDC</p>	Laboratory notebook check. Exam 1
Unit 5	Introduction to Workplace Safety: Lecture "Introduction to Workplace Safety" Video: "Can't Take NoMore" 1980 OSHA video	Home work: Complete CDC/ OSHA activity	Classroom activity 2: Exploring safety-related government websites (CDC and OSHA)	<ul style="list-style-type: none"> • Develop a safety mindset • Perform a simple risk assessment • Model good laboratory report format and content • Discuss, in depth, the format and content of laboratory report introduction sections • Complete a personal safety hygiene contract <p>Summarize the purview of both OSHA and the CDC</p>	Laboratory notebook check.
Unit 6	Working with Hazardous Chemicals:	Homework: Lab report writing: Write up an introduction	Classroom activity 3: Responding to Emergencies (Seidman et.	<ul style="list-style-type: none"> • Identify the safety equipment available in the laboratory • Complete Laboratory Exercise: Tracking the 	Laboratory notebook check.

		and post to discussion board Video: Labconco Fume Hood Airflow and Operation	al.) Laboratory Exercise 3: Keeping a Laboratory Notebook (Seidman et. al.), discuss rubric Classroom Activity 4: Understanding the chemicals with which you work (Seidman et. al.)	spread of chemical contamination <ul style="list-style-type: none"> • Model good laboratory report introduction format and content • Discuss, in depth, the format and content of laboratory notebook entries • Practice using Safety Data Sheets to safely plan laboratory exercises • Introduce the concept of chemical incompatibility with regard to equipment and supplies Explore proper fume hood usage	
Unit 7	Working with Hazardous Chemicals: Lecture: "Working with Hazardous Chemicals"		Laboratory: Examining the ways chemical contamination is spread Cont. DEMO: Laboratory Exercise 29 (Part A): Check your test tubes to see if they are resistant to ethyl acetate		Laboratory notebook check.
Unit 8	Handling and Storage of Hazardous Chemicals:	Homework: Work on lab report methods	In-class activity: Writing laboratory	<ul style="list-style-type: none"> • Model good laboratory report discussion format and content 	Laboratory notebook check. Midterm

	<p>Lecture: "Handling and Storage of Hazardous Chemicals"</p> <p>Video: "The Chem Lab: Safety in Every Step"</p>	<p>section, results section and Complete draft of discussion section Post to discussion board</p>	<p>ryreport discussi on sections</p> <p>Classroom Activity 6: Analyzing safety issues in a laboratory procedure (Seidman et. al.)</p>	<ul style="list-style-type: none"> • Discuss the proper handling and storage of hazardous chemicals • Examine the NFPA Hazard Diamond System of labeling • Emphasize the process of risk reduction when planning laboratory work • Practice researching hazards and reducing risk in a laboratory procedure • Write drafts of materials and methods sections and results sections of laboratory reports <p>Write a draft of a discussion section and reflect on other students' work</p>	<p>lab Exam Exam 2</p>
Unit 9	<p>Emergency Response:</p> <p>Lecture: "Emergency Response Plans"</p> <p>Video: "Fire extinguisher training video"</p>		<p>Flinn Mystery Substance Identification: The Identification of Unlabeled Laboratory Chemicals</p>	<ul style="list-style-type: none"> • Discuss proper response to emergency situations • Discuss the proper use of fire extinguishers • Use safety information resources to learn about the hazards of chemicals • Use laboratory tests to help identify chemicals <p>Use safety information to determine proper disposal methods for hazardous chemicals</p>	<p>Laboratory notebook check.</p>
Unit 10	<p>DATA ANALYSIS METROLOGY:</p> <ul style="list-style-type: none"> •* Lecture/discussion: Metrology basics (e.g., standards, traceability, calibration, error, accuracy, 	<p>Reading:</p> <p>Problems:</p>	<p>1. Classroom Activity 9: Constructing a Simple Balance</p> <p>2. Laboratory Exercise 4: Recording Measurements with the Correct Number of Significant Figures</p> <p>3. Laboratory</p>	<ul style="list-style-type: none"> • Able to understand and explain basic metrology terms including "standard" "calibration," "traceability", "error", "accuracy", and "precision" • Able to explain what a "trustworthy" measurement is • Able to explain why "trustworthy" measurements are essential in any product quality system • Able to use percent error to evaluate accuracy • Able to use standard deviation to 	<p>Laboratory notebook check. Problem sets.</p>

	precision) ("Metrology") •* Lecture/discussion: "Weighing"		Exercise 5: Good Weighing Practices discussion afterwards	evaluate precision •Able to operate and verify the performance of various laboratory balances •Able to obtain accurate and precise weight measurements •Able to analyze the accuracy and precision of weight measurements using percent error and standard deviation •Able to evaluate the linearity of a balance with understanding •Aware of factors that influence weight measurements	
Unit 11	DATA ANALYSIS METROLOGY: •*Lecture/discussion: Measuring Volume ("Volume")	Reading: Problems:	1. Laboratory Exercise 6: Performance Verification of Balances 2. Laboratory Exercise 7: Measuring Volumes; Performance Verification of a Micropipette Discussion afterwards	•Able to operate and verify the performance of various micropipettes using gravimetric method •Able to obtain accurate and precise volume measurements •Able to analyze the accuracy and precision of volume measurements using percent error and standard deviation •Aware of factors that influence volume measurements	Laboratory notebook check. Problem sets.
Unit 12	DATA ANALYSIS METROLOGY: •*Lecture/discussion Measuring pH ("pH")	Reading: Problems:	1. Laboratory Exercise 8: Performance Verification Micropipette 2. Laboratory Exercise 9: Measuring pH with Precision and Accuracy Discussion afterwards	•Able to explain different types of pH electrodes and their applications •Able to calculate the percent efficiency of an electrode with understanding of the meaning of this calculation •Able to explain linearity in the context of pH measurements •Able to operate and verify the performance of various pH meters including calibration and linearity checks •Aware of factors that influence pH measurements •Able to identify difficult samples for pH measurements •Able to trouble-shoot basic pH measurement problems	Laboratory notebook check. Problem sets. Exam 3
Unit 13	SOLUTIONS AND REAGENTS: *Lecture/discussion Solutions calculations when there is one solute	Reading: Problems:	1. Classroom Activities 11 and 12: Getting Ready to Prepare Solutions with One Solute 2. Laboratory Exercise 14: Preparing	•Able to define "solvent" and "solute" •Able to explain the use of precents, weight/volume, molarity, and parts methods of expressing concentration •Able to perform calculations of the amounts of solute required when concentration is expressed in different ways	Laboratory notebook check. Problem sets.

	("Solutions 1")		Solutions with One Solute 3. Laboratory Exercise 15: Preparing Solutions to the Correct Concentration Discussion afterwards	<ul style="list-style-type: none"> •Able to use a catalog to find chemicals •Able to prepare solutions with one solute accurately and consistently 	
Unit 14	SOLUTIONS AND REAGENTS: *Lecture/discussion Solutions calculations when there is more than one solute ("Solutions 2")	Reading: Problems:	1. Laboratory Exercise 16: Working with Buffers 2. Laboratory Exercise 17: Preparing Breaking Buffer Discussion afterwards	<ul style="list-style-type: none"> •Able to explain the purpose of a buffer •Able to analyze the relationship between temperature and pH in a buffer using a linear graph •Able to perform calculations of the amounts of solutes required when a solution has more than one solute •Able to prepare buffers accurately and consistently •Able to apply the $C_1V_1=C_2V_2$ equation when relevant •Able to prepare dilutions correctly 	Laboratory notebook check. Problem sets.
Unit 15	SOLUTIONS AND REAGENTS: *Lecture/discussion Why do biological solutions have particular solutes? ("Solutions 3")	Reading: Problems:	1. Laboratory Exercise 18: Preparing TE Buffer 2. Laboratory Exercise 19: More Practice Making a Buffer Discussion afterwards	<ul style="list-style-type: none"> •Able to explain the functions of biological solutions •Able to provide reasons why biological solutions sometimes contain buffering agents, salts, detergents, and enzymes •Able to explain why biologists often work with cold solutions 	Laboratory notebook check. Problem sets.
Unit 16					Final comprehensive lab Exam Lab notebook submission Final Exam

Students Course Is Expected to Serve: Students may take this course to meet concentration requirements for an Associates of Applied Science Degree in Biotechnology.

Suggested Texts, Materials, and Resources:

Text: Seidman, L. A. (2022). Laboratory Manual for Biotechnology and Laboratory Science: The basics (LMB&LS). CRC Press; 2nd edition.

Seidman, L. A., Moore, C. J., & Mowery, J. (2022). Basic laboratory methods for biotechnology: Textbook and laboratory reference (BLMB). CRC Press; 3rd edition.

Materials:
 Resources: Various Internet websites
 Supplies: a lab coat, goggles and gloves are helpful

Suggested Methods of Instruction: We will utilize lecture, discussion, group activities and laboratories.

Suggested Methods of Assessment and Evaluation:
 (Formative and Summative): We will utilize quizzes, exams, lab reports, homework and problem sets to assess students in this course.

Suggested Grading Scale:

Assignments:	Grade Distribution: 90 % to 100 % = A 80 % to 89% = B 70 % to 79 % = C 60 % to 69 % = D Below 60% = F
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Suggested Exit Assessment/Competencies (as applicable):

Processing Validation (To be completed by College)

Add – Effective Term/Year: _____ Reactivate – Effective Term/Year: _____
 Inactivate – End Term/Year: _____ Withdraw – End Term/Year: _____

Approved College(s):

DA: ___ HW: ___ KK: X MX: ___ OH: ___ TR: ___ WR: ___

Syllabus Preparer/Advocate: _____ Clifford Wilson, III _____

Title of Advocate: _____ Assistant Professor _____

College of Advocate: _____ Kennedy King College _____

ICCB Submission Date: (/ /)

ICCB Approval Date: (/ /)

IAI Submission Date: (/ /)

IAI Approval Date: (if applicable) (/ /)

IAI Panel: _____

IAI Code: _____

