



Course Syllabus

General Microbiology Laboratory BIOL 3205

Fall 2023

Instructor: Naina Phadnis, Ph.D. (*She, her, hers*)
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Office: Biology 227

Lab location: Biology 170

Timing: 12:55pm to 3:55pm on each section day

Section 001: Tuesday

Section 002: Wednesday

Section 003: Thursday

Course description: This once-a week, one-credit laboratory course will equip students with a broad hands-on knowledge of common practices in a Microbiology laboratory. The course curriculum is designed based upon recommendations by the American Society of Microbiology and aims to provide laboratory and analytical skills to students on various essential topics and laboratory exercises in the field.

Prerequisites: BIOL 1210, BIOL 2020, CHEM 1210 or 1215. Co or Pre-requisite of BIOL 3210 (PATH 3100 or BIOL 3370 or any other microbiology lecture course is also OK). Please contact the instructor if you do not meet these pre-requisites but would still like to take the course to see if you qualify.

Lab Modality: Biology 3205 is being presented in an *in-person* format and attendance to your designated lab section is expected. All laboratory sessions will be conducted during your designated lab time and all assessments and assignments will need to be submitted online on canvas. Given the nature of this course, attendance is required, and adjustments cannot be granted to allow non-attendance. However, if you need to seek an ADA accommodation to request an exception to this attendance policy due to a disability, please contact the Center for Disability and Access (CDA). CDA will work with us to determine what, if any, ADA accommodations are reasonable and appropriate.

Attendance: Timely attendance is required. You are required to keep your lab section day and time free for all your lab work regardless of class modality. Unexcused absences and chronic tardiness will result in an automatic deduction from your final course grade. Please note that you can only attend the lab section you are registered for. Given the in-person nature of this course, attendance is required, and I cannot guarantee that adjustments will be granted to allow non-attendance. If you miss lab due to covid-19, severe illness or severe unexpected circumstances please notify the instructor as soon as possible and I will do my best to make necessary arrangements to help you make up missed graded assignments, but making-up missed lab exercises cannot be arranged due to space and time restrictions. Documentation of restrictions or illnesses will need to be provided to get accommodations. Missing more than three lab sessions without make-up arrangements will result in an automatic failing grade.

Important: Lab begins the first week of classes. **Attendance to first day of lab is absolutely essential to get all students trained with safety practices.** Students who miss first lab cannot continue with the course. Students will be provided with masks, lab coat, safety glasses, gloves and a lab notebook. Wear closed toe shoes (entire foot covered) and tie long hair back. Hats to be taken off. Cubbies will be provided to store your belongings.

Texts: No primary text is required. Students will be provided with a lab-handout for each lab section prior to the relevant laboratory exercise. A canvas module for each week of lab will be made available with lab handout, relevant videos, case studies, assignments as well as extra resources to enhance learning outcomes.

Teamwork: Students will work individually and in teams of 3-4 to achieve course objectives. It is the students' responsibility to cooperate fully with team members to complete course requirements. Any team conflicts should be resolved by respectful communication between all team members. If team conflicts cannot be resolved by communication between students in a team, please contact the instructor for assistance.

COURSE WORK AND GRADING

Pre-lab: You are required to go to the lab module on canvas and read the lab description, lab handout and watch relevant videos BEFORE coming to lab so that you have a good understanding of the lab's overall theme and practices. Your lab instructor will give a short summary of the exercise at the beginning of class, but this is not meant to substitute for advanced preparation on your part. Almost each week, except week 1, students will need to take a 10-point pre-lab quiz online on canvas before lab. This quiz will ask basic questions based on the pre-lab reading and viewing for that week's lab. All quiz questions will be based on the lab handout or online videos for that week's lab experiment. Lab modules on canvas will highlight topics and provide videos and resources for the quiz. There will be approximately 10 pre-lab quizzes. **You are allowed to drop 2 quiz grades.** (Total points~80, +/-10)

Post-lab assignment: Each lab section will require every individual to submit a 20-point online post-lab assignment based on the experiment done that week. Each student will have 2 weeks from the day of the experiment to complete and submit the post-lab assignment on canvas. Some post-lab assignments will be completed as part of the lab (see schedule for details). There will be ~10 post-lab assignments. **You are allowed to drop 2 post-lab grades.** (Total points ~160, +/-20).

Lab notebooks: Each student will need to keep a lab notebook for the in-person lab section. Students are required to take detailed notes for all lab modules according to the guidelines provided. Students will upload pictures of their physical lab notebook to canvas every few weeks: once for feedback and once for grading. Notebook rubric is provided on canvas. (Total points 30)

Biofilm Project Report: Each team will submit a written report of their biofilm project on Canvas. A template and rubric will be provided for this assignment. (Total points 30)

Final Exam: There will be one **final online written exam** at the end of the semester during last week of classes. An exam prep session will be conducted, and a practice exam will also be provided. (Total points100)

Grade calculation (Displayed on Canvas):

Pre-lab quizzes: 80 (20% of grade)
Post-lab assignments: 160 (40% of grade)
Notebook: 30 (~7.5% of grade)
Research Report: 30 (~7.5% of grade)
Final lab exam: 100 (~25% of grade)
Total points: **~400**

Grading scheme: All points are totaled and used to calculate the course grade as shown to the right.
(Students who miss >3 labs and/or the final exam receive an E grade)

A	100%	to 94%
A-	< 94%	to 88%
B+	< 88%	to 82%
B	< 82%	to 76%
B-	< 76%	to 70%
C+	< 70%	to 64%
C	< 64%	to 58%
D	< 58%	to 50%
E	< 50%	to %

Tentative Laboratory schedule

Lab 1 Aug 22-24	Introduction to Microbiology laboratory practice and procedure Discovering the Ubiquity of microorganisms. Learning to work with microorganisms: lab safety procedures, preparing media, aseptic technique, streak plate technique, spread plate technique, pure cultures. Getting comfortable with microbiology terminologies. Student teams set up.
Lab 2 Aug 29-31	Microscopy Using a microscope to view live microorganisms from various branches of the microbial world. Students get comfortable using various settings and the 100X oil immersion lens. Students get familiar with techniques used to observe bacterial motility. Unknown sample investigation begins. Follow up: On week 1 results
Lab 3 Sep 5-7	Staining and observing microorganisms and their structures Using staining and microscopy to view microbes, differentiate between them or to identify their cellular structures.
Lab 4 Sep 12-14	Quantitation of microorganisms: practice and applications Quantifying bacteria in yogurt/probiotics. Discuss applications in the food industry. Calculating bacteriophage titers. Discuss applications in virology. <i>Ungraded notebook check for weeks 1-3</i>
Lab 5 Sep 19-21	Biotechnology Bacterial mutations and antibiotic resistance. Plasmid isolation from bacteria Bacterial transformation Discuss applications and ethics. Follow up: Quantitation
Lab 6 Sep 26-28	Analyzing and Measuring Microbial growth Assaying requirement of oxygen for growth Growth curves to calculate generation time <i>Develop testable hypothesis and plan for biofilm project.</i>
Lab 7 Oct 3-5	Biofilm Project Begins <i>Start biofilm experiment</i>
No Lab Oct 10-12	Fall Break
Lab 8 Oct 17-19	Using Bacterial Growth Patterns for Diagnosis and Treatment <i>Biofilm Project: Stain Biofilms</i> Using selective and differential media and biochemical tests for identification of bacteria. Antibiotic susceptibility testing for treatment identification.
Lab 9 Oct 24-26	Identifying bacteria using biochemical tests and rDNA sequencing. Module wrap up with Case Study <i>Complete Biofilm analysis</i> <i>Graded notebook check for weeks 4-8</i>
Lab 10 Oct 31-Nov 2	Applications of immunology: ELISA and blood typing
Lab 11 Nov 7-9	Infectious Disease Epidemiology: Case Study analysis

Lab 12 Nov 14-16	Analyzing and Presenting Microbiology Research Data Biofilm Analysis Report Due
No lab Nov 21-23	Thanksgiving Break (No lab this week)
Lab 13 Nov 28-30	Review and Practice Exam
Lab 14 Dec 5-7	Final exam

Lab Safety Policies

The BIOL 3205 lab works with BSL-1 (pose least risk to the population) microorganisms. No blood/pathogenic microbes/antigens are handled in this laboratory. All microbes are handled using lab safety procedures listed below. All microbial contaminated waste is discarded in biohazard waste and disposed after autoclaving by the biology lab coordinator. All students are trained in aseptic technique and proper waste disposal before starting laboratory work. All microbial strains are stored in refrigerators, incubators or freezers in rooms with key-tag entry to authorized personnel only. No students are ever left alone in the laboratory without a teaching aide or authorized person.

The following regulations must be followed for the safety of you and your classmates, and for successful laboratory work.

- Handle all microorganisms as though they are pathogens. Also, handle biochemical reagents with care, as with any chemical. Follow the techniques of handling cultures and microscopes that are demonstrated on the first day of lab (see handout for lab 1).
- Wear laboratory coats and protective eyeglasses (both provided to you) to prevent the contamination of clothing and to protect against stains. Please wear long pants and closed toe shoes to the lab to protect from any spills. Wear gloves while performing all experiments. Keep long hair tied back. These policies will be strictly implemented. Students are NOT allowed to take lab coats home. There are hangers provided in the lab for storage. In case of a spill on your lab coat please notify the instructor. Lab coats are disinfected and laundered at an authorized facility only.
- No eating or storing food, no drinking, no chew gum, no putting on lip balm, no putting on or removing contact lenses or putting anything in your mouth/eyes (i.e., no mouth pipetting or chewing on pencils) in the laboratory. Place all backpacks and personal items in the front of the class, away from the benches.
- Learn where the laboratory safety equipment is stored (fire extinguisher, eye wash, first aid kit, shower, etc.), and how to use it. Learn where to find information on laboratory safety procedures. Signs provided by the CDC are posted in the lab to remind students of proper safety procedures to follow.
- Wash your hands carefully with soap and water at the start and end of the laboratory period.
- Wash off desktops with disinfectant both at the beginning and the end of the laboratory period. Appropriate decontaminants: 1:10 bleach or 70% ethanol. Sitting time in bleach 20 minutes.
- Keep the desktops clear of all material not in use, e.g. clothing and books, in order to prevent their contamination. Work on the desktop, not over books or paper towels.
- When contaminated material is spilled, inform the laboratory assistant immediately. Proper procedure will require instructor and student to secure area, deny entry to non-authorized people. Instructor should assume everything spilled is infectious, wear personal protective equipment, cover spill with

paper towels, prepare fresh disinfectant and pour slowly around spill, use tongs to pick up objects, leave for >20 min, place in biohazard, wash hands, bag waste for pickup.

- Glass pipettes as a potential puncture hazard. Non-infectious sharps in broken glass containers. Infectious sharps in biohazard sharps container. Do not overfill containers.
- Be careful with the Bunsen burner. Make sure that paper, alcohol, the gas hose, and your microscope are kept clear of the flame.
- Place all contaminated materials into the appropriate containers; they will be autoclaved before disposal. Students will be trained in proper waste disposal on first day of class. Never, take any of the lab materials outside of the lab.
- In case of a non-life-threatening injury to students please notify lab supervisor. Contact Office of risk and insurance management at 801-581-5590 and EHS at 801-581-6590. Make sure to complete form E-1 first report of injury. To obtain medical attention for minor injuries to students contact student health center at the Madsen Health center, 555 South Foothill Blvd, SLC UT 84112 at 801-581-6431.
- For life threatening injury or illness call emergency medical services by calling 911.
- It is recommended that students who are immune compromised do not take this laboratory course.

Course Policies

Attendance, Participation and Late Submissions Policy

Attendance and participation are highly important in this lab class. If you must be absent because of an emergency or illness, please make every effort to speak with me about it beforehand, if possible, or as soon as possible. I will excuse such absences with a doctor's note or other form of official documentation. Please notify me of absences due to religious observance or University sporting events as soon as you can. Keep in mind that more than two unexcused absences will begin to affect your final grade and three or more unexcused absences will result in a failing grade. Without prior permission, assignments submitted late will receive a 10% deduction per day late. For example, if your 20-point assignment submission is one day late then automatically 2 points will be deducted prior to grading. If you are going to be late due to unforeseen circumstances, please take permission from your TA or instructor and the late deductions will not be applied. *Students* are expected to log in and check canvas **every day** for posted announcements and assignments. Students are also strongly advised to set up notifications for canvas, so they do not miss any important notifications.

Laboratory Etiquette and Safety Policy: Students are required to maintain a respectful and safe learning atmosphere. All students will be provided with the rules detailing the behavioral, ethical and safety policies in the laboratory in this syllabus. Severe violations of safety policies will result in an automatic deduction or failing grade based upon the instructor's judgment.

How to Join Class on Zoom and Class Etiquette: For TA review sessions and In case of change of modality, accommodation or for a meeting with instructors, the course may require you to participate via zoom. When you join class on Zoom, please conduct yourself in the same manner as if we were in a classroom or a lab. Join the Zoom meeting 5 minutes early to make sure you can connect because class will start promptly on time. As you join, please make sure that you have your **webcam on** and are **muted** the entire time unless you are asking a question. If you have any reason that you are unable to have your webcam on, please let the TA know. To ask a question during class use the raise of hand function in Zoom and wait to speak until the instructor calls on you. Also feel free to ask questions over Zoom chat, which will be monitored by the TAs during class. In Zoom chat, please only post messages that are relevant to the class. The instructor has the right to ask you to leave the zoom classroom for inappropriate behavior. If you have any reason that you are unable to have your webcam on, please let the TA/instructor know.

Universal Learning Policy: I am committed to making our online classroom, laboratory, canvas discussions, our practices, and our interactions as inclusive as possible. Mutual respect and the ability to listen to others are crucial to my course. Respectful participation in all aspects of the course will make our time together productive and engaging.

Rescoring Quizzes, Assignments or Exams: If you believe that your score is incorrect, you may submit a request for your quiz or exam to be regraded to the TA provided you submit a written explanation of why you think you deserve a regrade and the request is made within 7 days after the assignment score is released.

Use of Electronic Devices and Equipment Failure: It is your responsibility to maintain your computer, video camera, laptop, clicker or cell phone equipment in order to participate in the course. *Equipment failures will NOT be an acceptable excuse for absences or missing assignments.* Please do not use your electronic devices during class for non-course related activities because it disrupts your attention and the class. The instructor holds the right to ask you to leave the classroom for such behavior.

Canvas and Zoom literacy expectations: Students are expected to be computer literate and Canvas and zoom navigation skills are expected.

Disabilities Accommodations and Compliance with ADA Regulations: The University of Utah seeks to provide equal access to its programs, services, and activities for people with disabilities. If you will need accommodations in this class, reasonable prior notice needs to be given to the Center for Disability Services, 162 Olpin Union Building, (801) 581-5020. CDS will work with you and the instructor to arrange accommodations. All written information in this course can be made available in an alternative format with prior notification to the Center for Disability Services. If you think you need an accommodation for a disability, please let the instructor know at your earliest convenience. If you have a letter from Disabled Student Services indicating you have a disability that requires academic accommodations, please present the letter to me so we can discuss the accommodations you might need for class. Some lab exercises may be modified to facilitate your participation. As soon as you make me aware of your needs, I can work with you and the Center for Disability Services to help determine appropriate accommodations. I will treat any information about your disability with the utmost discretion. Your success in this class is important to me. We can work together to adapting procedures and assignments to meet both your needs and the needs of this lab course.

Addressing Sexual Misconduct. Title IX makes it clear that violence and harassment based on sex and gender (which includes sexual orientation and gender identity/expression) is a civil rights offense subject to the same kinds of accountability and the same kinds of support applied to offenses against other protected categories such as race, national origin, color, religion, age, status as a person with a disability, veteran's status or genetic information. If you or someone you know has been harassed or assaulted, you are encouraged to report it to the Title IX Coordinator in the Office of Equal Opportunity and Affirmative Action, 135 Park Building, 801-581-8365, or the Office of the Dean of Students, 270 Union Building, 801-581-7066. For support and confidential consultation, contact the Center for Student Wellness, 426 SSB, 801-581-7776. To report to the police, contact the Department of Public Safety, 801-585-2677(COPS).

Online Classroom Equivalency: E-mails and canvas are all considered equivalent to classrooms and student behavior within those environments shall conform to the student code. Specifically:

- A. *Posting photos or comments off topic in a classroom are still off-topic on canvas.*
- B. *Off color language and photos are NEVER appropriate.*
- C. *Using angry or abusive language is called flaming and is not acceptable and will be dealt with according to the student code.*
- D. *Do not use ALL CAPS, except for titles since it is an equivalent of shouting online, as is overuse of punctuation marks such as exclamations!!!!!! And question marks?????*

E. Course e-mails, e-journals and other online course communications are part of the classroom and as such are University property and subject to the Student Code. Privacy regarding these communications between correspondents must not be assumed and should be mutually agreed upon in advance, in writing.

Plagiarism: Plagiarism is defined as the “practice of taking someone else’s work, words or ideas and passing them off as your own” (google dictionary). The post-lab assignments in this course can test your abilities to construct your own thoughts. As a student, please give yourself plenty of time to complete an assignment, seek help or time extensions for your work and try to work through writing challenges. If you have questions about how or whether you should give credit to a source in your assignment, you are always welcome to check with me or the TA. If you are having difficulty with an assignment, please contact me.

Course Drop Policy: The drop and withdrawal policy is the same as the University of Utah policy. **August 25** is the last day to drop with no tuition and no notation on the transcript. **September 15** is the last day students can withdraw, but tuition will be assessed. Contact the registrar or see the academic calendar for more information.

Incompletes: University policy allows assignment of a grade of incomplete (I) if 20% or less of the course work remains unfinished. I will consider assigning an “incomplete (I)” only under EXCEPTIONAL circumstances unrelated to academic performance, and only if a student is passing the course with a C or better when the “Incomplete” is requested. Then incomplete grade must be requested to be considered.

Wellness: I understand that these are unusual and stressful times. Personal concerns such as family illness, financial worries, stress, anxiety, relationship difficulties, depression, cross-cultural differences, etc., can interfere with a student’s ability to succeed and thrive. Your physical and mental wellness is very important to me. Please seek the necessary help and support for such issues. For support and confidential consultation, contact the Center for Student Wellness, 426 SSB, 801-581-7776. <http://www.wellness.utah.edu>

Academic Misconduct: Although I acknowledge that due to the Covid-19 pandemic you may face temptations and stresses, but cheating is never the solution. I will do my best to reduce such stresses and temptations, but they also cannot be completely avoided. Your instructors and TAs are available to help you through this time and you should reach out for course support. I want you to understand that cheating is not a victimless crime, and it results in severe inequities for other students at our university. All suspected cases of academic misconduct including consulting others during an online exam, looking up answers on disallowed resources, using someone else’s clickers, cheating, and plagiarizing will be dealt with according to rules in the student code, University policy 6-400(V). By accepting admission to the University, you have agreed to abide by the University rules provided to you in the student handbook. Take note of B 2 a, b, and c. Cheating and plagiarism are serious offenses and can result in getting a zero on the assignment, failing a class, a note in your record or being expelled. Here is the link <http://www.admin.utah.edu/ppmanual/8/8-10.html>. *ALL cases of academic misconduct will be dealt with seriously and reported to the college. You will also be signing a code of conduct form on the first day of class and for each exam. “Be the change you want to see in this world”.*

Pedagogy Accommodations Policy: I do not grant content accommodation requests as the course content fulfills legitimate pedagogical goals.

Discrimination and Harassment policies: I have zero tolerance for any discriminatory or harassing behavior. If you or someone you know has been harassed or assaulted, you are encouraged to report it to the Title IX Coordinator in the Office of Equal Opportunity and Affirmative Action, 135 Park Building, 801-581-8365, or Office of the Dean of Students, 270 Union Building, 801-581-7066. To report to the police, contact the Department of Public Safety, 801-585-2677(COPS). Please see Student Bill of Rights, section E <http://regulations.utah.edu/academics/6-400.php>

Campus Safety Policy: The University of Utah values the safety of all campus community members. To report suspicious activity or to request a courtesy escort, call campus police at 801-585-COPS (801-585-2677). You will receive important emergency alerts and safety messages regarding campus safety via text message. For

more information regarding safety and to view available training resources, including helpful videos, visit safeu.utah.edu

Diversity / Inclusivity Statement: It is my intent that students from all diverse backgrounds and perspectives be well served by this course, that students' learning needs be addressed both in and out of class, and that the diversity that students bring to this class be viewed as a resource, strength and benefit. It is my intent to present materials and activities that are respectful of diversity: gender, sexuality, disability, age, socioeconomic status, ethnicity, race, and culture. Your suggestions are encouraged and appreciated. Please let me know ways to improve the effectiveness of the course for you personally or for other students or student groups. In addition, if any of our class meetings conflict with your religious events, please let me know so that we can make arrangements for you.

Names/Pronouns: Class rosters are provided to the instructor with the student's legal name as well as "Preferred first name" (if previously entered by you in the Student Profile section of your CIS account, which managed can be managed at any time). While CIS refers to this as merely a preference, I will honor you by referring to you with the name and pronoun that feels best for you in class or on assignments. Please advise me of any name or pronoun changes so I can help create a learning environment in which you, your name, and your pronoun are respected. If my TAs or I are mispronouncing your name or not using the correct pronoun, please let us know. It is very important to me that all my students feel included and comfortable in this course.

Veterans Center: If you are a student veteran, the U of Utah has a Veterans Support Center located in Room 161 in the Olpin Union Building. Hours: M-F 8-5pm. Please visit their website for more information about what support they offer, a list of ongoing events and links to outside resources: <http://veteranscenter.utah.edu/>. Please also let me know if you need any additional support in this class for any reason.

English Language Learners: If you are an English language learner, please be aware of several resources on campus that will support you with your language and writing development. These resources include: the Writing Center (<http://writingcenter.utah.edu/>); the Writing Program (<http://writing-program.utah.edu/>); the English Language Institute (<http://continue.utah.edu/eli/>). Please let me know if there is any additional support you would like to discuss for this class.

Detailed Expected Learning Outcomes from each Lab Exercise

Introduction to Microbiology laboratory practice and procedure

- Learn to work safely with microorganisms. Know that microbes are everywhere. Understand the practice and importance of aseptic technique and employment of proper laboratory safety procedures.
- Familiarize yourself with different methods and media used to culture bacteria. Be able to isolate bacteria from a population using different techniques.
- Understand how pure cultures are obtained and what is their importance.

Microscopy

- Know how magnification, resolution and contrast are important for microscopy.
- Know how to use a light microscope and identify its parts and uses.
- Understand the meaning of refractive index and why oil is used in higher magnification lenses.
- Appreciate the use of bright field, dark field, and phase contrast microscopy.
- Be able to prepare wet mounts of bacterial cultures using appropriate aseptic technique.
- Be able to focus and observe microorganisms up to the 100X lens successfully.
- Appreciate the size differences between eukaryotes and prokaryotes.
- Describe the various shapes of bacteria and use proper terminologies to describe shape.
- Observe true bacterial motility using the hanging drop method.
- Be able to differentiate true motility from Brownian motion and flow.
- Appreciate the importance of flagella and chemotaxis in movement of bacteria.

Staining and observing microorganisms

- Know why staining is important and the pros and cons of staining.
- Describe how Gram staining works and its clinical significance.
- Be able to successfully prepare a smear and perform Simple staining and Gram staining and interpret the results.
- Be able to appreciate the importance of staining to view bacterial cell structures.
- Know various parts of a prokaryotic cell.
- Be able to perform capsule staining and interpret results.
- Apply knowledge of staining results to solve case studies.

Microbial Growth

- Understand the use of complex, minimal, selective, and differential media and know the clinical significance and use in bacterial isolation and identification.
- Know how various factors affect microbial growth and how this knowledge can be used to limit or enhance microbial growth.
- Be able to identify bacterial oxygen requirements based on growth in agar deep. Know the use of proper scientific terminologies to explain growth requirements.
- Understand binary fission. Know the various phases of growth in liquid batch media.
- Be able to conduct a growth curve experiment and plot data using Excel.
- Be able to calculate generation time using data generated.
- Understand the clinical significance of generation time.
- Be able to define biofilms and where they are found.
- Be able to study and analyze the factors that impact biofilm formation.
- Appreciate the impact of biofilms on the environment and in health care.

Quantitation of microorganisms

- Understand 10-fold serial dilutions to dilute microorganisms.
- Use of spread plate technique to quantify microorganisms in a sample.
- Be able to calculate microbial titers from plate counts.
- Understand the importance of normal flora and the use of probiotics.
- Know that bacteria are used to make various foods and understand fermentation reactions.
- Know that Lactobacilli are used to make yogurt and the use of selective media to isolate them.
- Understand that industries are required to meet certain standards to maintain bacterial titers in food products.
- Be able to test commercially available bacterially fermented foods to determine the titer of live active cultures.
- Know what phages are. Understand the mechanism of pathogenesis of bacteria by phage.
- Be able to use pour plate method to infect bacteria with phage.
- Know the concept of a plaque. Be able to identify and quantitate plaques.
- Use plaque counts to calculate phage titers.
- Be able to solve quantitative problems to calculate microbial titers.

Biotechnology

- Understand the concept of horizontal gene transfer.
- Know what plasmids are and how they aid horizontal gene transfer.
- Understand plasmid selection and use of media to isolate plasmid-bearing bacteria.
- Be able to isolate plasmid DNA from bacteria using plasmid isolation kits.
- Know the function of each individual solution used to isolate plasmid.
- Understand the concept of transformation and competence.
- Be able to prepare chemically competent cells and understand the biology behind artificially making cells competent.
- Be able to transform plasmids into competent bacterial cells. Understand the importance and application of this step.

- Be able to calculate transformation efficiencies and understand the importance of this calculation.
- Appreciate the power of transformation.

Antimicrobials

- Understand the concept of antibiotics and their use and modes of action.
- Know the risk of rising antibiotic resistance in bacteria and the value for testing drug resistance.
- Be able to perform Kirby Bauer assay to test drug susceptibility of Gram-negative and Gram-positive bacteria.
- Understand the concept of narrow spectrum and broad-spectrum antibiotics.
- Use disk diffusion assays to test susceptibility of microorganisms to various disinfectants and antimicrobials in our environment.
- Be able to appreciate that cell structure or genetics plays a role in susceptibility to antimicrobials.
- Be able to draw conclusions from data from Kirby Bauer experiments.

Biochemical tests used to identify bacteria

- Understand the importance of bacterial identification and classification.
- Know that morphological phenotypes, growth characteristics and biochemical properties can be used to narrow down to organism identities.
- Know how to perform and infer various biochemical tests and understand the chemistry and Biology behind each test.
- Understand that many bacteria share many features making identification of individual species difficult.
- Understand the power of using rDNA sequence to identify bacterial genera/species.
- Discuss a clinical case study and be able to identify the appropriate lab test to use.
- Be able to read results of diagnostic tests to identify the causative agent and prescribe the next course of action based on those results.

Immunity and epidemiology

- Understand the concept of humoral immunity and antibodies.
- Appreciate the use of antibodies to detect antigens, pathogens, or seroconversion.
- Understand the biology behind ELISAs and which type of ELISA test to use.
- Know the ABO and Rh blood typing system.
- Be able to use antibodies to perform blood typing and be able to use it to determine blood type.
- Understand genotyping and the use of STRs in identifying perpetrators in forensic analysis.
- Be able to perform a simulated ELISA test and be able to infer the results of the ELISA in context of different diseases.
- Understand the Biology and pathogenesis of HIV.
- Understand various terminologies used in epidemiological studies.
- Understand disease transmission and factors that can affect it.
- Discuss an epidemiological case study with classmates. After completing this case study, the participants should be able to: define the terms outbreak, epidemic, reservoir, vehicle, vector, and carrier. List the steps to investigate of an outbreak. Know concept of case definitions and line listings. Understand the value of epidemiological fieldwork and investigations and asking the correct questions. Developing testable hypotheses. Draw, interpret, and describe the value of an epidemic curve. Calculate and compare food-specific attack rates to identify possible vehicles. Understand the importance of investigating an outbreak that has apparently ended.

Research Report and Analyzing research data.

- Be able to read, understand and analyze microbiology research data.
- Be able to write a collaborative research article like a scientific publication.
- Work efficiently with team members.

Pre-lab quizzes, post-lab assignments and Final exam

- Read lab handout and follow experiment protocols.
- Take careful notes and document hypothesis, results, and conclusions.
- Be able to recall/perform experiments done in lab, understand their significance and be able to infer reasonable conclusions from the results.
- Develop good scientific writing skills with attention to writing style, flow of information, formatting, grammar, and data presentation.
- Report laboratory findings honestly and performing experiments ethically and safely.
- Be able to perform laboratory experiments under time constraint.
- Be able to use MS Word, Excel, and Power-Point successfully.
- Be able to design controlled experiments, analyze data and infer conclusions.

Expected Learning Outcomes for Core Concepts and Competencies in Biology:

1) Transmission, flow and interpretation of biological information: Students will be able to apply a knowledge of gene expression to explain how information is stored, transmitted and utilized in microbes. This learning outcome will be met in the lab exercise on horizontal gene transfer and gene expression.

3) Structure and function: Students will be able to apply knowledge of molecular, cellular, and organismal structures to explain the diverse set of functions that underlie the remarkable diversity of individual microorganisms as well as communities of microorganisms. This learning outcome will be met in the lab exercises on microbial diversity, staining of microbial structures and identification of unknown microorganisms.

4) Ability to apply the process of science: Students will be able to apply the process of science to identify knowledge gaps, formulate hypotheses, and test them against experimental and observational data to advance an understanding of the natural world. This learning outcome will be met in every lab exercise and post lab assignments.

6) Ability to use quantitative reasoning: Students will be able to use mathematical and computational methods to apply quantitative approaches to understanding Biology. This learning outcome will be met in many lab exercises but specifically in the lab exercise involving quantitation of microorganism.

7) Ability to participate in the interdisciplinary nature of science through clear communication and collaboration with other disciplines – Students will be able to apply concepts and sub-disciplinary knowledge from within and outside of biology to interpret biological phenomena, communicate with clear written and oral arguments, and work collaboratively to solve problems. This learning outcome will be met in all post lab assignments and research presentations.

8) Ability to explain the relationship between science and society– Students will be able to evaluate the interactions between biology and society and clearly communicate biological concepts and their implications to broad audiences. This learning outcome will be met in multiple post lab assignments and research presentations.

Note: This syllabus is meant to serve as an outline and guide for our course. Please note that I may modify it with reasonable notice to you. I may also modify the Course Schedule to accommodate the needs of our class. Any changes will be announced in class and posted on Canvas under Announcements.