Course Syllabus
General Microbiology Laboratory BIOL 3205
Fall 2019

Instructor: Naina Phadnis, Ph.D.
Email: naina.phadnis@utah.edu
Office: Building 44, Room 222
Phone: 801-587-9380

Lab location: Crocker Science Center: Lecture Room 144 connected to 146 Lab

Timing: 12:55pm to 3:55pm on each section day
Section 001: Tuesday
Section 002: Wednesday

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.

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 a 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.

Prerequisites: BIOL 1210, BIOL 2020, CHEM 1210 or 1215.
Co or Pre-requisite of BIOL 3210 (PATH 3100 or BIOL 3370 is also OK)

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, assignments as well as extra resources to enhance learning outcomes. Students may find it beneficial to refer to:
• Microbiology: A human perspective, 8th or 7th Edition, McGraw Hill
• Laboratory Exercises in Microbiology, John P. Harley. 9th Edition, McGraw Hill

Canvas navigation and basic computer skills are expected. All communication with students will happen through canvas or via email.

Attendance: Timely attendance is required. Unexcused absences and chronic tardiness will result in an automatic deduction from your final course grade. Students who miss three or more labs automatically fail the course. If you are going to miss a lab please notify the instructor ahead of time and I will do my best to help you attend another section the same week.

Team-work: Students will work in teams of 2 to 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.
**Pre-lab homework**: 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 planning on your part. Pre-lab homework will help answer graded pre-lab quiz questions.

**COURSE WORK AND GRADING**

**Pre-lab quiz**: Almost each week, except week 1, students will need to take a 10-point pre-lab quiz. This quiz will ask basic questions based on the lab concepts for that day. All quiz questions will be based on the lab handout 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 9 pre-lab quizzes. You are allowed to drop 1 quiz grade. (Total points~80, +/-10)

**Post-lab assignment**: Each lab section will require every individual or team to submit a 20-point post-lab assignment based on the experiment done that week. Each student/team will have 2 weeks from the day of the experiment to complete and submit the post-lab assignment on canvas (except post labs 8, 9 and 10) which will be completed during lab. There will be ~10 post-lab assignments. You are allowed to drop 1 post-lab grade. (Total points ~180, +/-20).

**Lab notebooks**: Each student will be provided with a lab notebook. Students are required to take detailed notes for all lab modules. Students will need to record the following: hypotheses or purpose/aim, explanations and procedures in brief, results, data, inferences and conclusions. TAs will regularly check student notebooks and give feedback (see the schedule). Notebook rubric is provided on canvas. (Total points 30)

**Student Presentations**: Each team will pick one recent Microbiology research article and present its findings to the class. Students will use relevant A/V aids to make their presentation. Rubric for grading presentations will be provided on canvas. (Total points 40)

**Final Exam**: There will be one compulsory final exam at the end of the semester during last week of classes. The lab practical exam will include written and hands-on components. A review session will be held in lab the week before. Missing the final exam means I cannot evaluate your final readiness after taking this course and therefore will have to give you a failing grade. (Total points 150)

**Bonus assignments**: In class and online bonus assignments will be explained in lab to earn you a few extra credit points.

**Total points: ~480**
- Pre-lab quizzes: 80, +/- one quiz (~15% of grade)
- Post-lab assignments: 180 (team work), +/- one assignment (~38% of grade)
- Notebook: 30 (~6% of grade)
- Team presentations: 40 (~9% of grade)
- Final lab exam: 150 (~32% of grade)

**Grading scheme**: All points are totaled and used to calculate the course grade as shown to the right.

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<thead>
<tr>
<th>Grade</th>
<th>Range</th>
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<tbody>
<tr>
<td>A</td>
<td>100% to 94%</td>
<td>A-</td>
<td>&lt; 94% to 88%</td>
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<tr>
<td>B+</td>
<td>&lt; 88% to 82%</td>
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<td>&lt; 82% to 76%</td>
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<td>B</td>
<td>&lt; 76% to 70%</td>
<td>B-</td>
<td>&lt; 76% to 70%</td>
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<td>C+</td>
<td>&lt; 70% to 64%</td>
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<td>C</td>
<td>&lt; 58% to 50%</td>
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<td>&lt; 58% to 50%</td>
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<tr>
<td>E</td>
<td>&lt; 50% to %</td>
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(Students who miss 3 or more labs and/or the final exam receive an E grade)
### Tentative Laboratory schedule (maybe subject to change)

Each laboratory section meets once a week for 3 hours.

**Sections: 001 Tuesday and 002 Wednesday (12:55-3:55) in CSC 144/146**

<table>
<thead>
<tr>
<th>Lab 1</th>
<th>Aug 20-21</th>
<th><strong>Introduction to Microbiology laboratory practice and procedure</strong></th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>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.</td>
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<td><strong>Assignments Due</strong></td>
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<thead>
<tr>
<th>Lab 2</th>
<th>Aug 27-28</th>
<th><strong>Microscopy</strong></th>
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<tr>
<td></td>
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<td>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</td>
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<td><strong>Assignments Due</strong></td>
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<td>• Pre lab quiz</td>
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<tr>
<th>Lab 3</th>
<th>Sep 3-4</th>
<th><strong>Staining and observing microorganisms and their structures</strong></th>
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<tr>
<td></td>
<td></td>
<td>Using staining and microscopy to view microbes, differentiate between them or to identify their cellular structures.</td>
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<td><strong>Assignments Due</strong></td>
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<td>• Pre lab quiz</td>
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<td></td>
<td></td>
<td>• Post lab 1 due</td>
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<table>
<thead>
<tr>
<th>Lab 4</th>
<th>Sep 10-11</th>
<th><strong>Analyzing and Measuring Microbial growth</strong></th>
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<tr>
<td></td>
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<td>Selective and differential media</td>
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<td>Requirement for oxygen for growth</td>
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<td>Growth curves to calculate generation time</td>
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<td>Review and plan for Biofilm Project.</td>
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<td><strong>Assignments Due</strong></td>
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<td>• Pre lab quiz</td>
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<td>• Post lab 2 due</td>
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<td>• Notebook check - ungraded feedback</td>
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<thead>
<tr>
<th>Lab 5</th>
<th>Sep 17-18</th>
<th><strong>Quantitation of microorganisms: practice and applications</strong></th>
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<tr>
<td></td>
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<td>Quantifying bacteria in yogurt/probiotics. Discuss applications in the food industry. Calculating bacteriophage titers. Discuss applications in virology. Estimating coliform load in a water sample</td>
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<td><strong>Assignments Due</strong></td>
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<td>• Pre lab quiz</td>
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<td>• Post lab 3 due</td>
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<tr>
<th>Lab 6</th>
<th>Sep 24-25</th>
<th><strong>Biotechnology</strong></th>
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<tr>
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<td>Bacterial mutations and antibiotic resistance.</td>
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<td>Plasmid isolation from bacteria</td>
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<td>Bacterial transformation</td>
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<td>Discuss applications and ethics.</td>
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<td><strong>Assignments Due</strong></td>
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<td>• Pre lab quiz</td>
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<td>• Post lab 4 due</td>
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<thead>
<tr>
<th>Lab 7</th>
<th>Oct 1-2</th>
<th><strong>Normal flora and Antimicrobials</strong></th>
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<tr>
<td></td>
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<td>Antibiotic susceptibility testing (Kirby Bauer)</td>
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<td>Disinfectants and Antiseptics (Minimum contact time assay)</td>
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<td><strong>Assignments Due</strong></td>
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<td></td>
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<td>• Pre lab quiz</td>
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<td>• Post lab 5 due</td>
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<table>
<thead>
<tr>
<th>No Lab</th>
<th>Oct 6-13</th>
<th><strong>Fall Break</strong></th>
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<tr>
<td></td>
<td></td>
<td><strong>Assignments Due</strong></td>
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<td>• No assignments due</td>
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<thead>
<tr>
<th>Lab 8- part 1</th>
<th>Oct 15-16</th>
<th><strong>Biochemical tests used to identify bacteria</strong></th>
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<tr>
<td></td>
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<td>Using microscopic observations, growth characteristics, biochemical tests and rDNA sequencing to identify unknown bacterium.</td>
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<td><strong>Assignments Due</strong></td>
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<td>• Pre lab quiz</td>
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<td>• Post lab 6 due</td>
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<td>• Notebook check -graded</td>
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*Design and Prep Biofilm Analysis*
| Lab 8- part 2 | Biochemical tests used to identify bacteria-2  
Complete tests and Case study analysis (post-lab in class) | • Post lab 7 due  
• Post lab 8 completed in lab  
• Option to retake pre-lab quiz |
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<tbody>
<tr>
<td>Oct 22-23</td>
<td>Start Biofilm Analysis</td>
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| Lab 9 | Immunology and Epidemiology  
ELISA, Blood typing, Epidemiology analysis of an outbreak. | • Pre lab quiz  
• Post lab 9 completed in lab |
| Oct 29-30 | Stain Biofilms | |
| Lab 10 | Complete Biofilm analysis  
Measure biofilm formation and analyze the impact of antimicrobials on biofilm formation. | • Pre lab quiz  
• Post lab 10 completed in lab |
| Nov 5-6 | | |
| Lab 11 | Exploring current Microbiology research: Team presentations! | • No quiz  
• Team presentations  
• No post lab |
| Nov 12-13 | | |
| Lab 12 | Review and Practice | • Notebook check - graded |
| Nov 19-20 | | |
| No lab | Thanksgiving Break (No lab this week)  
Online Study Discussions offered | • No assignments due |
| Nov 26-27 | | |
| Dec 3-4 | Final exam (practical + written) | • Exam |

**Laboratory Safety Guidelines**

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 collaborative 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.
**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.

**Universal Learning Policy:** I am committed to making our classroom, laboratory, canvas discussions board, 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.

**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 make arrangements for 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.

**Course Drop Policy:** The drop and withdrawal policy is the same as the University of Utah policy. Contact the registrar or view the academic calendar for more information.

**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.*

**Equipment Failure:** It is your responsibility to maintain your electronic equipment in order to participate in the course assignments. *Equipment failures will NOT be an acceptable excuse for absent assignments.*

**Canvas literacy expectations:** Students are expected to be computer literate and Canvas navigation skills are also expected.
**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.

**Rescoring exams or quizzes:** If you believe that your score is incorrect, you may submit your post-lab/exam for rescoring, subject to the following conditions: Exams/quizzes written in pencil or erasable pen are NOT eligible for re-scoring. All re-scores must be requested in writing by 7 days after grades or exams are made available. Do NOT write ANYTHING on your exam after return! Exams will not be re-scored if they have been altered in any way (a random subset of exams will be photocopied before they are returned to students).

**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 has to be requested to be considered.

**Wellness:** Personal concerns such as stress, anxiety, relationship difficulties, depression, cross-cultural differences, etc., can interfere with a student’s ability to succeed and thrive at the University of Utah. For support and confidential consultation, contact the Center for Student Wellness, 426 SSB, 801-581-7776. [http://www.wellness.utah.edu](http://www.wellness.utah.edu)

**Academic misconduct:** All suspected cases of academic misconduct including 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](http://www.admin.utah.edu/ppmanual/8/8-10.html).

**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](http://regulations.utah.edu/academics/6-400.php)

**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.

**Learning outcomes**

**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 genetics, gene expression to explain how information is stored, transmitted and utilized in microbes and microbial communities.
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.

4) Systems: Students will be able to explain how biological units interact to give rise to emergent properties at multiple levels of biological organization. These interactions range from the cycling of matter and energy at the subcellular to organismal and interdependency of organisms.

5) 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.

6) Ability to use quantitative reasoning: Students will be able to use mathematical and computational methods to apply quantitative approaches to understanding Biology.

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 subdisciplinary knowledge from within and outside of biology in order to interpret biological phenomena, communicate with clear written and oral arguments, and work collaboratively to solve problems.

8) Ability to explain the relationship between science and society – Students will be able to evaluate the interactions between biology and society, including the societal impacts of biological research as well as public perception and decision-making about science, and clearly communicate biological concepts and their implications to broad audiences.

Detailed Expected Learning Outcomes from each Lab Exercise

1. Introduction to Microbiology laboratory practice and procedure
   1. Discovering the Ubiquity of microorganisms. Learning to work with microorganisms: aseptic technique, streak plate technique, spread plate technique, pure cultures.
   2. Know that microbes are everywhere. Understand the practice and importance of aseptic technique and employment of proper laboratory safety procedures.
   3. Familiarize yourself with different methods and media used to culture bacteria. Be able to isolate bacteria from a population using different techniques.
   4. Understand how pure cultures are obtained and what is their importance.

2. Microscopy
   1. Know how magnification, resolution and contrast are important for microscopy.
   2. Know how to use a light microscope and identify its parts and uses.
   3. Understand the meaning of refractive index and why oil is used in higher magnification lenses.
   4. Appreciate the use of bright field, dark field and phase contrast microscopy.
   5. Be able to prepare wet mounts of bacterial cultures using appropriate aseptic technique.
   6. Be able to focus and observe microorganisms up to the 100X lens successfully.
   7. Appreciate the size differences between eukaryotes and prokaryotes.
   8. Describe the various shapes of bacteria and use proper terminologies to describe shape.
   9. Observe true bacterial motility using the hanging drop method.
   10. Be able to differentiate true motility from brownian motion and flow.
   11. Appreciate the importance of flagella and chemotaxis in movement of bacteria.
   12. Understand how chemotaxis involves cell surface receptors and response by flagellar rotation.

3. Staining and observing microorganisms
   1. Know why staining is important and the pros and cons of staining.
   2. Describe how Gram staining works and its importance.
3. Be able to successfully prepare a smear and perform Simple staining and Gram staining and interpret the results.
4. Be able to appreciate the importance of staining to view bacterial cell structures.
5. Know various parts of a prokaryotic cell.
5. Be able to perform capsule staining and interpret results.

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

5. Quantitation of microorganisms - bacteria from yogurt and phage

1. Understand 10-fold serial dilutions to dilute microorganisms.
2. Use of spread plate technique to quantify microorganisms in a sample.
3. Be able to calculate microbial titers from plate counts.
4. Understand the importance of normal flora and the use of probiotics.
5. Know that bacteria are used to make various foods and understand fermentation reactions.
6. Know that Lactobacilli are used to make yogurt and the use of selective media to isolate them.
7. Understand that industries are required to meet certain standards to maintain bacterial titers in food products.
8. Be able to test commercially available bacterially fermented foods to determine the titer of live active cultures.
10. Be able to use pour plate method to infect bacteria with phage.
11. Know the concept of a plaque. Be able to identify and quantitate plaques.
12. Use plaque counts to calculate phage titers.
13. Be able to solve quantitative problems to calculate microbial titers.
14. Know the concept of coliforms and indicator organisms.
15. Understand that water can be a powerful source of pathogens.
16. Understand the value of testing potability of water.
17. Be able to test water sample for coliforms and estimate the titer of coliforms in the sample.

6. Biotechnology
1. Understand the concept of horizontal gene transfer.
2. Know what are plasmids and how they aid horizontal gene transfer.
3. Understand plasmid selection and use of media to isolate plasmid-bearing bacteria.
4. Be able to isolate plasmid DNA from bacteria using plasmid isolation kits.
5. Know the function of each individual solution used to isolate plasmid.
6. Understand the concept of transformation and competence.
7. Be able to prepare chemically competent cells and understand the biology behind artificially making cells competent.
8. Be able to transform plasmids into competent bacterial cells. Understand the importance and application of this step.
9. Be able to calculate transformation efficiencies and understand the importance of this calculation.
10. Appreciate the power of transformation.

7. Antimicrobials

1. Understand the concept of antibiotics and their use and modes of action.
2. Know the risk of rising antibiotic resistance in bacteria and the value for testing drug resistance.
3. Be able to perform Kirby Bauer assay to test drug susceptibility of Gram negative and Gram positive bacteria.
4. Understand the concept of narrow spectrum and broad-spectrum antibiotics.
5. Use disk diffusion assays to test susceptibility of microorganisms to various disinfectants and antimicrobials in our environment.
6. Be able to appreciate that cell structure or genetic make up plays a role in susceptibility to antimicrobials.
7. Understand the difference between a disinfectant, antiseptic and antibiotic.
8. Understand how to design a minimum contact time assay with appropriate controls.
9. Be able to draw conclusions from data from the experiment and develop a new hypothesis.

8. Biochemical tests used to identify bacteria

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

9. Immunity and epidemiology

1. Understand the concept of humoral immunity and antibodies.
2. Appreciate the use of antibodies to detect antigens, pathogens or seroconversion.
3. Understand the biology behind ELISAs and which type of ELISA test to use.
4. Know the ABO and Rh blood typing system.
5. Be able to use antibodies to perform blood typing and be able to use it to determine blood type.
6. Understand genotyping and the use of STRs in identifying perpetrators in forensic analysis.
7. Be able to perform a simulated ELISA test and be able to infer the results of the ELISA in context of different diseases.
8. Understand the Biology and pathogenesis of HIV.
9. Understand various terminologies used in epidemiological studies.
10. Understand disease transmission and factors that can affect it.
11. 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 field-work 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.

10. Biofilm analysis

1. Understand the meaning and composition of a microbial biofilm.
2. Know where biofilms can be formed and their implications in health.
3. Design an experiment to test biofilm formation
5. Develop and design appropriate controls and analyze data.

11. Team presentations

1. Be able to browse through Microbiology research articles and identify topics that interest you.
2. Be able to read and understand current scientific literature.
3. Be able to explain research findings and their significance to an audience orally.
4. Be able to use audio visual aids efficiently to communicate results and motivate an audience.
5. Work efficiently with team members.

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

1. Read lab handout and lab modules before class and come prepared to each lab session.
2. Take careful notes and document hypothesis, results and conclusions carefully to be able to complete post-lab assignments.
3. Be able to recall/perform experiments done in lab, understand their significance and be able to infer reasonable conclusions from the results.
4. Develop good scientific writing skills with attention to writing style, flow of information, formatting, grammar and data presentation.
5. Reporting laboratory findings honestly and performing experiments ethically and safely.
6. Be able to perform laboratory experiments under time constraint.
7. Be able to use MS Word, Excel and Power-Point successfully.
8. Be able to design controlled experiments, analyze data and infer conclusions.

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.