Course Syllabus
General Microbiology Laboratory BIOL 3205
Fall 2017

Instructor: Naina Phadnis, Ph.D.
Email: naina.phadnis@utah.edu
Office: South Biology 311
Phone: 801-587-9380
Office meetings with the instructor can be arranged by appointment

Teaching Assistants
Katarina Mountz (section 1)
Amelia St Clair (section 2)

Lab location: SB 213 (12:55pm to 3:55pm)

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.

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, assignments as well as extra resources to enhance learning outcomes. Students may find it beneficial to refer to:


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

Prerequisites: BIOL 1210, BIOL 2020, CHEM 1210 or 1215.
Co or Pre-requisite of BIOL 3210

Students will be provided with a lab coat, safety eyeglasses, gloves and a lab notebook.

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 and/or the final exam 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 make you attend another section the same week.
Team-work: Students will work in teams of 2 to 3 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 please contact the instructor for assistance.

Reading the lab handout ahead of class: You are required to read the lab handout for that week before lab so that you have a general idea of the day's activities. 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. Reading the lab handout will be needed to answer graded pre-lab quiz questions.

COURSE WORK AND GRADING

GRADING: Weekly quizzes, assignments, final exam

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 exercise to be done that day. All quiz questions will be based on the lab handout for that week’s experiment. There will be approximately 8 pre-lab quizzes. You are allowed to drop 1 quiz grade. (Total points~70, +/-10)

Post-lab assignment: Each lab section will require every team to submit a 20-point post-lab assignment documenting the results and conclusions of the experiment done that week. Each team will have 2 weeks from the experiment to complete and submit the assignment on canvas. There will be approximately 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 (week 3 and week 9) and give feedback. A final notebook grading will occur in week 11. (Total points 20)

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 and power point to make their presentation. (Total points 40)

Final Exam: There will be one compulsory final exam for 150 points at the end of the semester before 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.

Bonus assignments: Bonus assignments will be explained in lab to earn you a few extra credit points.

Total points: 460
Pre-lab quizzes: 70, +/- one quiz (~15% of grade)
Post-lab assignments: 180 (team work), +/- one assignment (~39% of grade)
Notebook: 20 (~4% of grade)
Team presentations: 40 (~9% of grade)
Final lab exam: 150 (~33% of grade)

**Grading scheme:** All points are totaled and used to calculate a grade as shown below. This grading scheme has been activated on canvas so you should be able to follow your grade on canvas.

<table>
<thead>
<tr>
<th>Grade</th>
<th>Minimum Percentage</th>
<th>Maximum Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>100%</td>
<td>94%</td>
</tr>
<tr>
<td>A-</td>
<td>&lt; 94%</td>
<td>88%</td>
</tr>
<tr>
<td>B+</td>
<td>&lt; 88%</td>
<td>82%</td>
</tr>
<tr>
<td>B</td>
<td>&lt; 82%</td>
<td>76%</td>
</tr>
<tr>
<td>B-</td>
<td>&lt; 76%</td>
<td>70%</td>
</tr>
<tr>
<td>C+</td>
<td>&lt; 70%</td>
<td>64%</td>
</tr>
<tr>
<td>C</td>
<td>&lt; 64%</td>
<td>58%</td>
</tr>
<tr>
<td>C-</td>
<td>&lt; 58%</td>
<td>52%</td>
</tr>
<tr>
<td>D+</td>
<td>&lt; 52%</td>
<td>46%</td>
</tr>
<tr>
<td>D</td>
<td>&lt; 46%</td>
<td>40%</td>
</tr>
<tr>
<td>D-</td>
<td>&lt; 40%</td>
<td>34%</td>
</tr>
<tr>
<td>E</td>
<td>&lt; 34%</td>
<td>0%</td>
</tr>
</tbody>
</table>

(Students who miss 3 or more labs and/or the final exam will automatically receive an E grade)

**Tentative Laboratory schedule (maybe subject to change)**
Each laboratory section meets once a week for 3 hours.
**Sections: Tuesday, Wednesday (12:55-3:55) in SB 213**

| (Week 1) Aug 22-23 | **Introduction to Microbiology laboratory practice and procedure**  
Discovering the Ubiquity of microorganisms. Learning to work with microorganisms: lab safety, preparing media, aseptic technique, streak plate technique, spread plate technique, pure cultures. |
|-------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| (Week 2) Aug 29-30| **Microscopy**  
Follow up: on week 1 |
| (Week 3) Sep 5-6 | **Staining and observing microorganisms and their structures**  
Use staining and microscopy to view microbes, differentiate between them or to identify their cellular structures. |
| (Week 4) Sep 12-13 | **Analyzing and Measuring Microbial growth**  
Selective and differential media  
Requirement for oxygen and salt for growth  
Growth curves to calculate generation time |
| (Week 5) Sep 19-20 | **Quantitation of microorganisms: practice and applications**  
Quantifying bacteria in yogurt by plate count. Discuss applications in the food industry.  
Calculating bacteriophage titers. Discuss applications in virology.  
Estimating coliform load in a water sample |
<table>
<thead>
<tr>
<th>(Week 6) Sep 26-27</th>
<th>Follow up: Microbial growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Week 7) Oct 3-4</td>
<td><strong>Biotechnology</strong></td>
</tr>
<tr>
<td></td>
<td>Bacterial mutations and antibiotic resistance.</td>
</tr>
<tr>
<td></td>
<td>Plasmid isolation from bacteria</td>
</tr>
<tr>
<td></td>
<td>Bacterial transformation</td>
</tr>
<tr>
<td></td>
<td>Discuss applications and ethics.</td>
</tr>
<tr>
<td></td>
<td>Follow up: Quantitation</td>
</tr>
<tr>
<td>(Week 8) Oct 8-15</td>
<td><strong>Normal flora and Antimicrobials</strong></td>
</tr>
<tr>
<td></td>
<td>Antibiotic susceptibility testing</td>
</tr>
<tr>
<td></td>
<td>Disinfectants and Antiseptics</td>
</tr>
<tr>
<td></td>
<td>Isolating normal flora from skin and throat</td>
</tr>
<tr>
<td></td>
<td>Testing the 5-second rule</td>
</tr>
<tr>
<td>(Week 9) Oct 17-18</td>
<td><strong>Biochemical tests used to identify bacteria</strong></td>
</tr>
<tr>
<td></td>
<td>Using microscopic observations, growth characteristics and biochemical tests attempt to identify the organism in the unknown sample. Discuss applications in a pathology lab.</td>
</tr>
<tr>
<td>(Week 10) Oct 24-25</td>
<td><strong>Biochemical tests used to identify bacteria-2</strong></td>
</tr>
<tr>
<td></td>
<td>Complete tests and Case study discussion</td>
</tr>
<tr>
<td></td>
<td>Post lab completed in lab</td>
</tr>
<tr>
<td>(Week 11) Oct 31-Nov 1</td>
<td><strong>Application of Immunology: diagnostics and testing</strong></td>
</tr>
<tr>
<td></td>
<td>ELISA (simulated)</td>
</tr>
<tr>
<td></td>
<td>Blood group testing</td>
</tr>
<tr>
<td>(Week 12) Nov 7-8</td>
<td><strong>Epidemiology case study.</strong></td>
</tr>
<tr>
<td>(Week 13) Nov 14-15</td>
<td><strong>Exploring current Microbiology research:</strong> Team presentations!</td>
</tr>
<tr>
<td>(Week 14) Nov 21-22</td>
<td><strong>No lab this week</strong></td>
</tr>
<tr>
<td>(Week 15) Nov 28-29</td>
<td><strong>Review session</strong></td>
</tr>
<tr>
<td>(Week 16) Dec 5-6</td>
<td><strong>Final exam (practical +written)</strong></td>
</tr>
</tbody>
</table>

**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**

**Lab ETiquette 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.

**Late submission policy:** 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.

**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.

**The Americans with Disabilities Act:** 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.

**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.

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 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

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.

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 the class, reasonable prior notice needs to be given to the Center for Disability Services, 162 Olpin Union Building, Phone (Voice/TDD): (801) 581-5020, email: info@disability.utah.edu. CDS will work with you and the instructor to make arrangements for accommodations. All written information in this course can be made available in alternative format with prior notification to the Center for Disability Services. If you would like to request academic accommodations due to a disability, please contact Disabled Student Services. 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.
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

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, and engage – 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.
6. 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. Be able to design an experiment to culture microbes from a halophillic environment and be able to compare their growth to known halophiles and non-halophiles.
5. Understand binary fission. Know the various phases of growth in liquid media.
6. Be able to conduct a growth curve experiment and plot data using Excel.
7. Be able to calculate generation time using data generated.
8. Understand the clinical significance of generation time.
9. Know the concept of coliforms and indicator organisms.
10. Understand that water can be a powerful source of pathogens.
11. Understand the value of testing potability of water.
12. Be able to test water sample for coliforms and estimate the titer of coliforms in the sample.

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.

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. Normal flora and 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 anti-microbials 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 the concept of normal flora and how use of antibiotics can disrupt their existence.
9. Be able to appreciate that most people have similar normal flora profiles in a particular community. Understand that some people can be carriers of pathogenic microorganisms.
10. Understand that bacteria can transfer from one person to another and this transfer can depend upon various factors.
11. Be able to develop a hypothesis and design and conduct an experiment to test the 5-second rule of bacterial transfer. 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 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
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 three different diseases.
8. Understand the Biology and pathogenesis of the HIV virus, the bird flu virus and Borrelia burgdorferi that causes Lyme disease.

10. Epidemiology
1. Understand various terminologies used in epidemiological studies.
2. Understand disease transmission and factors that can affect it.
3. 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.

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 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 figure design.
5. Reporting laboratory findings honestly and performing experiments ethically and safely.
6. Be able to perform laboratory experiments under time pressure.
7. Be able to use MS Word, Excel and Power-point successfully.
8. Be able to look at laboratory experimental findings and infer conclusions from them.

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.