POINT LOMA NAZARENE UNIVERSITY	**Department of Biology** **BIO3015(L)-1: Microbiology Lecture and Lab (3+1 units)**
Fall 2022	

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Office hours every Monday from 2-5 pm. Or, e-mail me with your availability to set up an alternative appointment time.	
Lecture every M/W/F 11-11:55 am in Bond Academic Center room 104	
Lab every R 1:30-4:30 pm in Sator Hall room 105	
Final exam on Wednesday December 14, 10:30-1:00 pm	

COURSE DESCRIPTION

An in-depth exploration of the world of microscopic organisms, including their diversity, physiology, biochemistry and ecology. Emphasis is on prokaryotes, but also some discussion of microscopic eukaryotes and viruses. Lecture and lab. Offered every year.

Prerequisite(s): BIO2010 and BIO3045.

ASSESSMENT AND GRADING

A total of 760 points are possible in the class: 585 points in lecture and another 175 points in lab. Points from lecture and lab will be combined into a single score and one grade will be assigned to both at the end of the semester.

Exams (400 points) – There will be four exams, including the final, in this course, each worth 100 points. Each exam will consist of various question types (multiple choice, fill-in-the-blank, short answer) to assess your retention of basic facts and concepts as well as your ability to apply them to new situations. The final exam will consist of 50% new material (the immune response) and 50% cumulative content from the rest of the semester. If you have a legitimate conflict with an exam date/time, you must let the instructor know prior to the week of the exam to make arrangements for a makeup exam. Exam dates are firm - please make your plans accordingly. Missed exams cannot be made up without prior instructor approval and only for a legitimate reason. If you have more than two final exams scheduled on the same day as our final you may be eligible to re-schedule, but you must inform the instructor no later than December 1.

In-class activities (150 points) – Ten of these activities will be worth 15 points each.

Daily quizzes (35 points) – 35 daily, one-question/one-point quizzes on the assigned reading/videos for that day.

Laboratory experience (175 points) – The BIO3015 lab consists of a bona fide research experience. Students will learn fundamental microbiology lab techniques in this context. See the description at the end of this syllabus for details.

Point breakdown

Exams (4)	400 points (52.6%)
In-class activities (10)	150 points (19.7%)
Daily quizzes (35)	35 points (4.6%)
Laboratory experience	175 points (23.0%)
TOTAL	760 possible points

Grade Scale Based on Percentages

A	B	C	D	F
A 93-100	B+ 88-89	C+ 78-79	D+ 68-69	F 59 or lower
A- 90-92	B 82-87	C 72-77	D 62-67	
	B- 80-81	C- 70-71	D- 60-61	

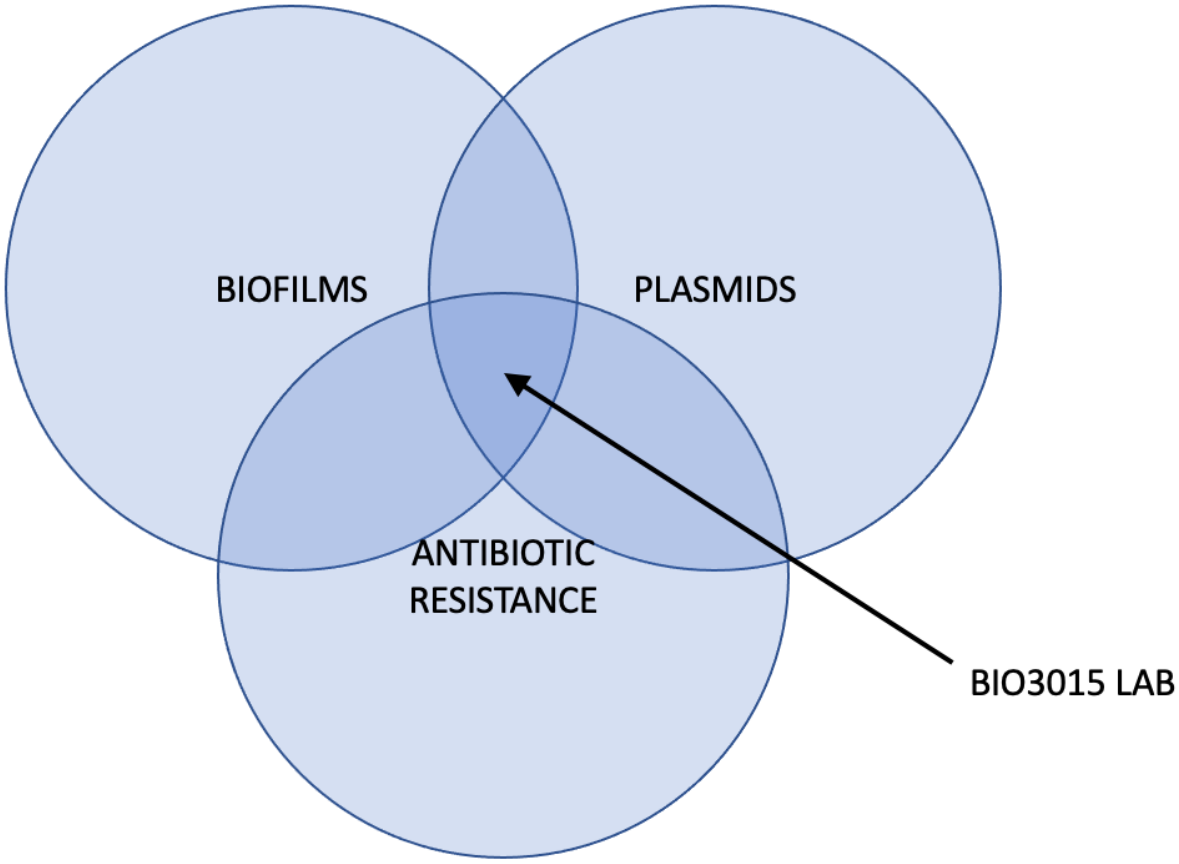
*NOTE: Grades from lecture and lab will be combined to generate a single final grade for the course, which will be recorded for both lecture and lab on transcripts.

*NOTE: Final percentages will be rounded to the nearest whole number and the letter grade assigned will be **non-negotiable**.

LECTURE TOPICS AND SCHEDULE

Module/Dates	Topics	Reading Guides and Videos
Weeks 1 and 2 T 8/30 – F 9/9	Microbial architecture • Viruses • Fungi, protozoa, helminths • Bacteria and archaea	RG-Ch5 Viruses and their multiplication RG-Ch2 Microbial cell structure and function BIO3015 Episodes 001-008 BIO2020 Episodes 006-017
Weeks 3 and 4 M 9/12 – F 9/23	Bacterial growth • Batch growth • Continuous culture • Environmental factors • Biofilms	RG-Ch4 Microbial growth and its control RG-Ch20 Microbial ecosystems BIO3015 Episodes 009-010 BIO2020 Episodes 023-026, 016 Center for Biofilm Engineering
F 9/23	**Exam 1**	
Weeks 5 and 6 M 9/26 – F 10/7	Energy metabolism • Aerobic respiration • Anaerobic respiration • Fermentation	RG-Ch3 Microbial metabolism BIO2020 Episodes 018-022
Weeks 7 and 8 M 10/10 – M 10/24	Horizontal gene transfer • Transformation • Transduction • Conjugation and plasmids • Insertion sequences and transposons • Integrons	RG-Ch11 Genetics of *Bacteria* and *Archaea* BIO2020 Episode 034
M 10/24	**Exam 2**	**Up to 20% cumulative**
Weeks 9 and 10 M 10/26 – F 11/4	Antibiotics and resistance • The Sanford Guide • Mechanisms of action • Mechanisms of resistance	RG-Ch28 Clinical microbiology and immunology BIO2020 Episodes 035-040
Weeks 12 and 13 M 11/7 – M 11/21	Infection and virulence factors • Structures • Proteins	RG-Ch25 Microbial infection and pathogenesis BIO2020 Episodes 053-057
M 11/21	**Exam 3**	**Up to 20% cumulative**
Weeks 15 and 16 M 11/29 – F 12/9	The immune response • Innate immunity • Adaptive immunity	RG-Ch26 Innate immunity RG-Ch27 Adaptive immunity BIO2020 Episodes 058-068
W 12/14	**Final exam (10:30-1 pm)**	**50% new, 50% cumulative**

LAB DESCRIPTION



Description

The BIO3015 lab is not based on a lab manual with standard lab activities. Instead, it is research-based, and as such cannot be easily described in a lab manual. The focus will be the intersection among three of the most important topics in microbiology: biofilms, plasmids, and antibiotic resistance. You will learn many useful lab techniques in the context of culturing biofilms, mating bacteria with plasmids, and determining antibiotic resistance properties.

Lab techniques introduced (not necessarily mastered) in BIO3015L

- Use micropipettes and standard glass pipettes to handle liquids
- Use the autoclave to sterilize media and durable supplies and kill unwanted cultures
- Prepare nutrient media, both broth and solid agar-based media
- Prepare stock solutions
- Perform basic concentration calculations using stock solutions
- Culture bacteria in broth and on solid media
- Carry out streak plate and spread plate techniques
- Carry out dilution series for quantification of bacteria
- Cultivate biofilms on glass slides and in 96-well microtiter plates

- Stain and visualize bacteria with light microscopy
- Quantify bacterial growth and biofilm density using a microtiter plate reader
- Apply basic statistics in Microsoft Excel to replicate experiments
- Mate bacteria to induce conjugation of plasmids in liquid and on solid surfaces
- Perform antimicrobial susceptibility testing
- Design, execute, and interpret an experiment aimed at inhibiting biofilms or conjugation
- Read the primary literature
- Maintain an electronic laboratory notebook
- Contribute to a team
- Create a scientific poster in Microsoft Power Point
- Present a scientific poster to a live and mixed audience at a campus-wide poster session

Strains:
- *E. coli* J53 (azide)
- *E. coli* HY842 (rifampicin, streptomycin, zeocin)
- *E. coli* MG1655 csrA (kanamycin, nalidixic acid)

Plasmids:
- pMG252 (streptomycin, tetracycline)
- pTREC9 (ampicillin, tetracycline)

Lab schedule:
9/1
Reading and quiz: Rather et al. 2021 up to and including "escape of biofilm cells from immune system"
Discussion: Intro to BIO3015 Lab, intro to biofilms, set up Lab Archives accounts
Hypothesis: *E. coli* attaches to surfaces and forms a 3D biofilm.
Experiment: Inoculate J53, HY842, MG1655 csrA, and soil slide biofilms (no plasmids, no abx)
Predicted outcome: Biofilms will be visible on glass slides.

9/8
Reading and quiz: Ghigo 2001
Follow up: Microscopy of slide biofilms from last week
Discussion: Intro to plasmids
Hypothesis: The presence of a conjugative plasmid enhances biofilm formation in E. coli.
Experiment: Inoculate J53 (+/- pMG252) and HY842 (+/- pTREC9) slide biofilms
Predicted outcome: Biofilms will be visibly heavier in strains with plasmids than those without.

9/15
Reading and quiz: Srinivasan et al. 2021 up to and including "signaling in biofilm formation"
Follow up: Microscopy of J53 and HY842 slide biofilms
Hypothesis: The presence of a conjugative plasmid enhances biofilm formation in E. coli.
Experiment: Inoculate J53 (+/- pMG252) and HY842 (+/- pTREC9) in microtiter plate biofilms with replicates
Predicted outcome: Biofilms will be measurably heavier in strains with plasmids than those without.

9/22
Reading and quiz: No reading or quiz this week.
Follow up: Read biofilms in microtiter plates
Discussion: Intro to conjugation
Prep for next week: Prep selective plates for liquid and filter matings (2X)

9/29
Reading and quiz: Koraimann et al. 2018 up to and including "the backbone genome of F as a model for $MOB_{F12}A$ plasmids"
Hypothesis: Bacteria in close proximity can exchange plasmids.
Experiment: Carry out liquid matings between HY842/pTREC9 (donor) and J53 (recipient)
Predicted outcome: Map out expected results for each plate in the mating

10/6
Reading and quiz: Koraimann et al. 2018 from "variability and mosaicism in $MOB_{F12}A$ plasmids" up to and including "positioning of plasmid molecules before cell division"
Follow up: Interpret liquid matings from last week.
Hypothesis: Bacteria in close proximity can exchange plasmids.
Experiment: Carry out filter matings between same strains.
Predicted outcome: Map out expected results for each plate in the mating.
Prep for next week: Prep plates for antibiograms.

10/13
Reading and quiz: Koraimann et al. 2018 from "toxin-antitoxin modules" up to and including "the leading region and establishment in new hosts"
Follow up: Interpret filter matings from last week.
Discussion: Study and discuss the pTREC9 map.
Hypothesis: Bacteria that receive a plasmid via conjugation can inherit resistance to multiple antibiotics all at once.
Experiment: Carry out antibiograms on transconjugants.
Predicted outcome: Transconjugants will display more resistances than just the original one selected for.

10/20 NO LAB (ADVISING AND FALL BREAK)

10/27
Reading and quiz: Hausner and Wuertz 1999
Follow up: Interpret antibiograms from last week.
Hypothesis: Bacteria conjugate more frequently when the recipient is in a biofilm state than when it is planktonic.
Experiment part I: Inoculate microtiter plates with recipient bacteria for biofilm formation
Prep for next week: Prep selective media (recipients, transconjugants) for matings (12X, 6 biofilms and 6 planktonic replicates)

11/3
Reading and quiz: No reading or quiz this week.
Experiment part II: Carry out biofilm mating and liquid mating (using unattached bacteria from biofilms), mate 1 hr and then spread onto selective plates (recipients, TGs only)
Prep for next week: Test one or more natural extracts for anti-biofilm or anti-conjugation activities. Hypothesis?

11/10
Reading and quiz: Koraimann et al. 2018 from "IS elements, transposons, and integrons" up to and including "cargo III"
Discussion: Study pTREC9 map focusing on mobile elements.
Follow up: Interpret biofilm and liquid matings from last week.
Hypothesis: ??
Experiment: Set up and initiate final experiment to inhibit (1) biofilm formation, (2) biofilm persistence, or (3) conjugation using a natural extract from bacteria, fungi, or plants.

11/17
Reading and quiz: No reading or quiz this week.
Follow up: Interpret final experimental results from last week.
Lab exam (open resources)

11/24 NO LAB (THANKSGIVING BREAK)

12/1 Work on posters and Lab Archives

12/8 Poster presentations (open to the public)

Lab Grades

8 Lab quizzes based on assigned journal article reading	40
Lab Archives	40
Lab exam	40
Poster	40
Teamwork	15
TOTAL	175

PLNU Mission
To Teach ~ To Shape ~ To Send

Point Loma Nazarene University exists to provide higher education in a vital Christian community where minds are engaged and challenged, character is modeled and formed, and service is an expression of faith. Being of Wesleyan heritage, we strive to be a learning community where grace is foundational, truth is pursued, and holiness is a way of life.

COURSE LEARNING OUTCOMES

The primary objective of this course is to familiarize the Biology student with the world of microorganisms with an emphasis on the domain *Bacteria*. We will begin with fundamental concepts of microbiology (architecture, growth, and metabolism) followed by focused discussions of medical microbiology and immunology.

Specific course learning outcomes (CLOs): By the end of this course, students will be able to

1. describe the physical architecture and physiology of *Bacteria*;
2. explain the ways in which *Bacteria* cause disease and resist antibiotics;
3. paraphrase the mechanisms involved in the innate and adaptive immune system;
3. analyze the methods and results reported in the primary research literature in microbiology;
4. evaluate the validity of an author's main arguments in a primary research article in microbiology.

REQUIRED RESOURCES

(1) Brock *Biology of Microorganisms*, 16th ed. E-Text (not including Mastering) is required.
(2) *Sanford Guide to Antimicrobial Therapy* app (not the booklet). See separate instructions (by email) for a 40% student discount on the app.

STATE AUTHORIZATION

State authorization is a formal determination by a state that Point Loma Nazarene University is approved to conduct activities regulated by that state. In certain states outside California, Point Loma Nazarene University is not authorized to enroll online (distance education) students. If a student moves to another state after admission to the program and/or enrollment in an online course, continuation within the program and/or course will depend on whether Point Loma Nazarene University is authorized to offer distance education courses in that state. It is the student's responsibility to notify the institution of any change in his or her physical location. Refer to the map on State Authorization to view which states allow online (distance education) outside of California.

PLNU COPYRIGHT POLICY

Point Loma Nazarene University, as a non-profit educational institution, is entitled by law to use materials protected by the US Copyright Act for classroom education. Any use of those materials outside the class may violate the law.

PLNU ACADEMIC HONESTY POLICY

Students should demonstrate academic honesty by doing original work and by giving appropriate credit to the ideas of others. Academic dishonesty is the act of presenting information, ideas,

and/or concepts as one's own when in reality they are the results of another person's creativity and effort. A faculty member who believes a situation involving academic dishonesty has been detected may assign a failing grade for that assignment or examination, or, depending on the seriousness of the offense, for the course. Faculty should follow and students may appeal using the procedure in the university Catalog. See Academic Policies for definitions of kinds of academic dishonesty and for further policy information.

PLNU ACADEMIC ACCOMMODATIONS POLICY

PLNU is committed to providing equal opportunity for participation in all its programs, services, and activities. Students with disabilities may request course-related accommodations by contacting the Educational Access Center (EAC), located in the Bond Academic Center (EAC@pointloma.edu or 619-849-2486). Once a student's eligibility for an accommodation has been determined, the EAC will issue an academic accommodation plan ("AP") to all faculty who teach courses in which the student is enrolled each semester.

PLNU highly recommends that students speak with their professors during the first two weeks of each semester/term about the implementation of their AP in that particular course and/or if they do not wish to utilize some or all of the elements of their AP in that course.

Students who need accommodations for a disability should contact the EAC as early as possible (i.e., ideally before the beginning of the semester) to assure appropriate accommodations can be provided. It is the student's responsibility to make the first contact with the EAC.

PLNU ATTENDANCE AND PARTICIPATION POLICY

Regular and punctual attendance at all class sessions is considered essential to optimum academic achievement. If the student is absent for more than 10 percent of class sessions, the faculty member will issue a written warning of de-enrollment. If the absences exceed 20 percent, the student may be de-enrolled without notice until the university drop date or, after that date, receive the appropriate grade for their work and participation.

SPIRITUAL CARE

Please be aware PLNU strives to be a place where you grow as whole persons. To this end, we provide resources for our students to encounter God and grow in their Christian faith. If students have questions, a desire to meet with the chaplain or have prayer requests you can contact the Office of Spiritual Development.