

PLP428R/528R Section 1
MICROBIAL GENETICS
COURSE SYLLABUS
Spring 2020
(Subject to modification where necessary)

PLP428R/528R (MIC 428R/528R, ECOL 428R/528R, MCB 428R/528R, SWES428R/528R, ACBS 428R/528R).

WHERE: ILC150

WHEN: MWF 4:00-4:50 PM

1. Instructor Information

Dr. David A. Baltrus
Marley 821C
uamic428@gmail.com
(520) 626-8215 (office)

TA: Seth Steichen
ssteiche@email.arizona.edu

2. Instructor Availability

Student Hours: I will have a regular student hour on Monday each week from 12:00 to 1:00PM in Marley 821C. I am often available by appointment (either for meetings in person or virtually through Zoom) and I am at the laboratory sections regularly, please feel free to contact me to set up appointments by email or ask questions during lab. This hour is available for you to ask any questions you may have about the material, but is also quite useful for reviewing and evaluating answers to any ongoing assignments that might be open at the time.

I am usually quite reachable through email, and I will try to respond within 24 hours (If I don't, email again, I won't be offended). However, unless there are extenuating circumstances, I will likely not respond to email between 7PM and 9AM and likely not on the weekends.

COURSE HOME PAGE

There is a D2L page for this course, and all relevant/necessary materials will be posted there (including slides from the lectures and supplementary material). I will send out reminders of assignments/office hours/review sessions/tests on D2L and will also send out links relevant to the course.

I have set up a Piazza group (sign up at piazza.com/arizona/spring2020/428528) This page serves as a useful way to organize into groups and ask questions about the material. This site lets you post questions anonymously, and enables other students to answer these questions. This group is combined for both online and in class sections, as almost all (save “in class questions”) will be shared across sections and will be due at similar times. Feel free to work with “in class” students on group projects or problem sets and to join in discussions. **This forum is the best place to post questions about problem sets, quizzes, or tests. Although there is no formal participation grade, I do monitor who chimes in with potential answers (right or wrong) and will take this activity consideration for those with borderline grades.** There's also a useful feature where you can ask others in the class if they'd like to form teams to work on projects. If you email me a question, it's very likely that I'll post and answer the question on Piazza (with any identifying information taken out) and give you a link to the answer so that others in the class can view.

3. Course Objectives

As microbiologists, biochemists, geneticists, doctors, medical technologists, biological engineers, or those in related biology-based careers, you will encounter situations where the concepts of microbial genetics apply. These may include dealing with an outbreak in a hospital or neighborhood, producing recombinant microbial products in large fermenters, dealing with bioterrorist agents, sequencing a novel gene that you have found in nature, or teaching the next generation of high school or college students about science.

As educated members of society we have a responsibility to ensure that technology is used appropriately and ethically. You must be able to read science news in the papers or hear about it on television or the radio and be able to think about the information in an intelligent and rational manner. Examples include stem cell research, recombinant vaccines used in human gene therapy treatments, using engineered microbes to degrade environmental pollutants, the release of engineered crop plants or animals, etc.

Microbial genetics is a wide ranging topic, and this course will cover information ranging from basic microbiology, molecular biology, and genetics to more specialized microbiological topics like quorum sensing, phage infection, and biofilm formation. My goal is to give you examples of and help you to understand the genetic bases underlying all of these topics but also help you to think critically and apply the same principles to new systems as well. Along the way, I will help you to understand how to read and critique primary research papers and will show you how these topics influence or will influence everyday life.

Although general classes in biology, molecular biology, and general genetics cover some of the aspects of microbial genetics, they lack the wide variety of concepts and methodologies that this course provides. I expect that going into this course that you will have a solid if basic background in chemistry, biochemistry, and genetics: this is an advanced course and you will be given significant amounts of information. There are no prerequisites, but having taken an

introductory genetics course or a basic microbiology course (MCB181, MIC205, etc...) will likely make your life easier. Strict memorization of the material will not get you an A, but memorization is necessary for you to think critically. You will succeed if you understand that the lectures build on each other as the semester goes on, and if you are able to draw links across all topics.

4. Course Outcomes 428 and 528

- Students will be able to articulate and describe pathways and processes related to bacterial DNA replication, gene expression, and protein translation
- Students will be able to illustrate basic genetic principles underlying complex microbiological phenotypes like quorum sensing and biofilm formation.
- Students will be able to explain technology used to sequence and analyze bacterial genomes and microbial communities
- Students will be able to classify the functions of multiple classes of antibiotics in the context of bacterial physiology and explain how this information relates to antibiotic resistance
- Students will be able to analyze bacterial gene sequences for regulatory regions and functions using widely available web-based tools
- Students will be able to read and evaluate primary scientific literature
- Students will be able to explain how basic tools and techniques can be used to construct new bacterial strains and genetic constructs and extend this knowledge to interpret bacterial phenotypes and physiology
- Students will be able apply principles of bacterial genetics to test new experimental hypotheses in bacterial genetics.

Additional Outcomes 528

- Students will learn to apply critical thinking skills and design screens to dissect the genetic basis underlying novel phenotypes in bacterial systems

5. Absence and Class Participation Activities

Attendance: you are all adults. While I would greatly appreciate if you to attend the lectures, there will be no credit directly given for attendance. However, it is fair game for me to include information on exams that I mention during lectures but which is not included in the recordings

posted online. There will also be points given for activities that occur during lectures, but these activities will not occur during every lecture.

There will be the opportunity to earn extra credit points throughout the course of the lectures through participation, however, I am not awarding points for participation outright. Class participation will be considered at my discretion for students with scores that fall within a few points of the grade cutoff. What is participation you may ask? When I ask a question in class, try your best to answer it. Do I know your name because you answered questions in class, contributed to discussions, or showed up at student hours? Did you help other students answer questions through Piazza? Did you come to any student hours? Etc...

6. Required Texts or Readings

Lectures:

The material will be presented primarily through lectures.

There is no assigned text for this course. Instead, I ask that you obtain a good microbial genetics text or good basic microbiology text to use as a reference. I **suggest** the following text:

Snyder, Larry and Wendy Champness. Molecular Genetics of Bacteria. 3rd. Washington, DC: ASM Press, 2007.

Please have access to a good microbial genetics or basic microbiology text to use as a reference as needed. The internet is also a great resource, so long as you realize that not all info you'll find is correct. If you find anything in doubt or find conflicting information, run it by me and I'll clarify. The discussion papers will be available from the course web site to download as PDF files. Throughout the course of the semester, I will also post a variety of other links/papers to the D2L website to be used as background information. A DNA sequence analysis manual will be available from D2L as a PDF file.

Slides used during the lectures will be available soon after the lecture, with "tentative" slides available the night before. However, simply reading over the slides will not be sufficient to pass this course. You need to attend lectures to get all the details. I will post versions of these lectures and to the D2L site, although these will not be exactly the same as the lectures.

Discussion papers:

During the semester we will hold a general discussion of three research papers. Reading and understanding primary research papers is something all scientists must be able to do. It is not easy, as many papers are very tersely worded and full of experimental details. Most papers are written in a similar format (Introduction, Materials & Methods, Results and Discussion). All try to

convey the scientific thought process. Please read them prior to attending the class discussions. It is often necessary to read a paper several times before all of the details can be understood. Study sheets will be available on D2L to help you in reading the papers. These discussions will build upon topics learned during the lectures and are fair game for test questions.

7. Required or Special Materials

None

8. Required Examinations or Papers

Over the course of the semester, there will be a total of 10 quizzes managed through D2L. There will be 2 exams during the semester and one final exam.

Students are also expected to complete a semester project using DNA sequence analysis to create a scientific poster:

One component of this course is the analysis of a sequence of DNA. This component is aimed at teaching you how to manipulate a sequence of DNA and how to glean information from it. Each team (2-3 members) of undergraduate students will be assigned an unknown DNA sequence for analysis (graduate students will work independently). We will be using all web-based programs for this analysis. The theory and steps of the analysis will be covered during the lectures and the computer lab periods. A DNA sequence analysis project manual will be available on the course web site. During this analysis you will learn how to:

Identify open reading frames.

Use NCBI BLAST to identify potential genes, gene products, and operons.

Identify potential promoters, terminators, ribosome binding sites.

Additionally, I will incorporate aspects of gene cloning, complementation, and phenotypic screening into the assignment and these topics will be thoroughly covered over the course of the semester.

This analysis will be the basis of a poster that you and your partner(s) will prepare and submitted as a PDF or equivalent file. This poster will include figures illustrating key aspects of your and include information on the biological function of your gene products. This poster, and your peer review of other posters, will determine your grade for this part of the course.

EXTRA ASSIGNMENTS FOR 528R STUDENTS

Students taking 528R will be given extra exam questions. Additionally, for reading assignments they will be expected to write 1 page summaries of discussion papers due at 4PM on the day of the discussion. These summaries will give an overview of the question being asked in the

paper, briefly describe the experiments, and include additional questions you have about the paper or future research directions. In addition, each graduate student will work alone on the DNA sequence analysis portion of the course and may be given larger regions to analyze.

9. Required Extracurricular Activities

None

10. Final Exam

The final exam can be taken in person and will be administered on Friday May 8th from 3:30-5:30PM. However, students can also take a version of the final exam administered through D2L and this will be available until 11:59PM on Wednesday May 13th.

11. Grading Scale

There are a total of 855 points available for 428R and 925 points available for 528R.

	428R	528R
In class questions	50	--
In class exams (2x)	100	150
D2L Quizzes (10x)	150	150
Short Answer Question Sets (3x)	75	75
DNA Sequence Analysis Project	300	300
Readings	30	75
Final Exam	150	175
TOTAL	855	925

There will be a series of in class (or through D2L) questions or activities for which I will award 50 points over the course of the semester.

Written exams may consist of fill in the blank and short answer/essay questions. The questions cover the material and also your understanding of the material. You may also be presented with data and asked to explain it. If you think that you deserve more credit on an exam question or assignment, please contact me within one week of receiving your scored exam to discuss your answer. All exam questions are derived from the material presented during the lectures, the discussions and the DNA sequence analysis.

You will be given 3 sets of short answer questions to answer outside of class and you can work in groups. These questions will be posted immediately after class and will be due the following class, no exceptions. These problem sets are worth 25 points each.

You will be given 10 total multiple choice quizzes on D2L, at the end of each week (not including in class test weeks). These quizzes are worth 15 points each.

Material for all exam/quiz/problem set questions will be cumulative over the course of the semester.

There will be a series of three discussion papers that we will talk about over the course of the semester. If you are enrolled in 428, you will be awarded 10 points each for annotating a PDF of this paper using a tool called Perusall. You will be provided the grading rubric for these 10 points at a later time. Annotations will be due by the start of the class session where each paper is discussed. Those enrolled in the 528 section will be required to submit a 1 page summary of the paper that contextualizes the research, describes the experiments, and answers guiding questions that will be provide with the paper.

Final grades will be based on total points earned. If you accumulate 450 points or more over the course of the semester, you will be given at least a D.

The rest of the grades will be determined by one of two distributions. At the start of the course, the distribution looks like this:

A>750, 750>B>650, 650>C>550,550>D>450>E

If a 70% participation rate is achieved for student evaluations, the distribution shifts to this:

A>725>B>625, 625>C>525,525>D>450>E

I will also offer 0.25 extra point for providing examples and descriptions of published papers (4-5 sentences) where genes or proteins within a microbe “behave” in a different way than described in class. The total number of points is unlimited, BUT, I will only award enough points to a student to increase their grade by one letter. For the most part, topics in class will discuss how genetic pathways work for only one or two different microbes. There are plenty of

exceptions to the examples I'll give. I will only award points once per reference. For each reference, fill in the form found at <https://goo.gl/forms/KqtVAe249otC0XJZ2>. Within this form, please fill in your name, a link to the paper (not another website, the actual primary paper), and a few sentences describing how the genetic pathway works as described in class and how this paper differs from that description.

On problem sets and write in answers on tests, you will receive 1/5 of the credit for the question if you leave the question blank.

NOTE: THE TIME TO EARN THE GRADE THAT YOU DESIRE IN THIS COURSE IS FROM THE FIRST DAY OF CLASS AND TO CONTINUE THROUGHOUT THE COURSE BY WORKING HARD. IT IS NOT APPROPRIATE TO TRY AND BARGAIN FOR THE GRADE AT THE END OF THE SEMESTER.

MISSED ASSIGNMENTS OR EXAMS

I will not accept late assignments. I will not reschedule missed exams, but will try to accommodate exam timing around extenuating circumstances. The time to notify me is before the exam if you are going to miss it due to something scheduled.

WITHDRAWALS

Students withdrawing from this course must notify the instructor prior to non-attendance in classes and execute drop or withdrawal procedures in accordance with the UA General Catalog.

INCOMPLETES

Any incomplete given must be verified with a written agreement with the student that specifies the work to be done and a timetable of completion.

12. Classroom behavior policy

Please silence cell phones at the beginning of class. Computers are OK if you are using them to take notes. If your computer or phone disrupts the class (ringing, texting, general annoying noises, etc...) I reserve the right to confiscate phones/computers for the class period or ask you to leave class (temporarily or permanently). Also, see the above section on grading (especially on class participation) and know that it works the other way too.

Additionally, since data suggests that computer use can be distracting to other students (<https://www.sciencedirect.com/science/article/pii/S0360131512002254>), I ask that if you have a computer please sit either on the right side (my left) of the room or in the back of the room.

13. Threatening behavior policy

The UA threatening behavior by students policy prohibits threats of physical harm to any member of the University community.

<http://policy.arizona.edu/education-and-student-affairs/threatening-behavior-students>

14. Academic Integrity Policy

The student code of academic integrity prohibits plagiarism and cheating

<https://deanofstudents.arizona.edu/policies-and-codes/code-academic-integrity>

15. Non-discrimination and Anti-harassment Policy

The University of Arizona is committed to creating and maintaining an environment free of discrimination. In support of this commitment, the University prohibits discrimination, including harassment and retaliation, based on a protected classification, including race, color, religion, sex, national origin, age, disability, veteran status, sexual orientation, gender identity, or genetic information. The University encourages anyone who believes he or she has been the subject of discrimination to report the matter immediately as described in the section below, "Reporting Discrimination, Harassment, or Retaliation." All members of the University community are responsible for participating in creating a campus environment free from all forms of prohibited discrimination and for cooperating with University officials who investigate allegations of policy violations.

<http://policy.arizona.edu/human-resources/nondiscrimination-and-anti-harassment-policy>

16. Accommodations for Students with Disabilities

At the University of Arizona we strive to make learning experiences as accessible as possible. If you anticipate or experience barriers based on disability or pregnancy, please contact the Disability Resource Center (520-621-3268, <https://drc.arizona.edu/>) to establish reasonable accommodations.

17. Schedule of Topics and Activities

Date (Modules Usually Released Around 4PM)	Day	Topic (Subject to Change)	Other	
1/15/20	Wed	Introduction		
1/17/20	Fri	Early Microbial Genetics Experiments		
1/20/20	Mon	NO CLASS		
1/22/20	Wed	Cell Structure		
1/24/20	Fri	Cell Structure	Quiz 1 opens 10am, closes following Tuesday at 9am	
1/27/20	Mon	DNA, chromosome structure		
1/29/20	Wed	DNA-protein Interactions		
1/31/20	Fri	Discussion 1	Quiz 2 opens 10am, closes following Tuesday at 9am	
2/3/20	Mon	DNA, chromosome structure		
2/5/20	Wed	DNA, chromosome structure		
2/7/20	Fri	Plasmids, replication, uses	Quiz 3 opens at 10am	
2/10/20	Mon	Plasmids, properties, and replication		
2/12/20	Wed	Plasmids, replication, uses		
2/14/20	Fri	Plasmids, replication,	Quiz 4 opens 10am,	

		uses	closes following Tuesday at 9am;	
2/17/20	Mon	DNA binding proteins and techniques	Problem Set 1 due TUESDAY 2/18 11:30PM	
2/19/20	Wed	RNA:types and functions		
2/21/20	Fri	Transcription	Quiz 5 opens 10am, closes following Tuesday at 9am	
2/24/20	Mon	Transcription		
2/26/20	Wed	Review		
2/28/20	Fri	Exam 1		
3/2/20	Mon	Translation, The Genetic Code		
3/4/20	Wed	Translation, The Genetic Code		
3/6/20	Fri	Genetic tools for studying transcription and translation		
3/9/20	Mon	SPRING BREAK		
3/11/20	Wed			
3/13/20	Fri		Genetic tools for studying transcription and translation	
3/16/20	Mon	Mutation and Phenotypes vs. Genotype		
3/18/20	Wed	Genetic tools for studying transcription and translation		
3/20/20	Fri	Restriction/Modification systems and CRISPR loci	Quiz 6 opens 10am, closes following Tuesday at 9am	
3/23/20	Mon	PCR, restriction enzymes, Gene cloning, Gibson assembly		
3/25/20	Wed	Gene cloning continued, alpha complementation		

3/27/20	Fri	Intro to gene regulation, lac operon	Quiz 7 opens 10am, closes following Tuesday at 9am	
3/30/20	Mon	trp operon, aporepressors and attenuation		
4/1/20	Wed	trp operon, aporepressors and attenuation		
4/3/20	Fri	Discussion 2	Quiz 8 opens 10am, closes following Tuesday at 9am	
4/6/20	Mon	Global regulation: sigma factors		
4/8/20	Wed	Global regulation: SOS response	Problem Set 2 Due 11:30PM	
4/10/20	Fri	Mutations and DNA repair	Quiz 9 opens 10am, closes following Tuesday at 9am	
4/13/20	Mon	DNA Recombination		
4/15/20	Wed	Review		
4/17/20	Fri	Exam 2		
4/20/20	Mon	Mutations and DNA repair		
4/22/20	Wed	Mutations and DNA repair	Class Project Due at 11:59PM	
4/24/20	Fri	DNA Recombination	Quiz 10 opens 10am, closes following Tuesday at 9am	
4/27/20	Mon	DNA Recombination		
4/29/20	Wed	Transposable elements		
5/1/20	Fri	Bacteriophage Lambda	Quiz 11 opens 10am, closes following Tuesday at 9am, Problem Set 3 due 4PM	

5/4/20	Mon	Bacteriophage Lambda		
5/6/20	Wed	Discussion 3		
5/8/20	Fri 3:30	Final Exam Opens		

18. Syllabus Changes

Information contained within the course schedule, other than the grade or absence policies may be subject to change with reasonable advance notice, as deemed appropriate.

19. Additional Information

Please answer the questions here (<https://goo.gl/forms/ludz9NS2YNmape4K3>) and I'll give you 2 extra credit points.

HOW TO SUCCEED IN THIS CLASS

My two main goals with this class are to 1) show you the absolutely incredible world of microbial genetics and genomics which I am fortunate enough to get to work with everyday 2) help you to think more critically about how to interpret and apply data and facts. This course will be different than most, if not all, other course you have taken in college. Many of the assignments are both open book and can be undertaken as group activities, however, there is NO COMMUNICATION allowed during exams. My goal is not to make you memorize specific details about specific cellular processes, I want you to be able to understand that information and apply it to other contexts. Although there will definitely be students that do well in the course simply by showing up and absorbing the info, a far majority of the students that do well in this course interact with and ask questions to other students and to me through the various forums. The graded activities are open book so please feel free to search the internet for helpful resources or even answers (some of the longer questions I'll ask will be derived from or based off of primary research papers, so if you find those papers you'll usually be well along the way to getting full credit). The quizzes will be open and available for you to see over a period of four days. While some the answers are clear and straightforward, you have four days to see and discuss the questions with your classmates and so some of the questions will be more complex and nuanced. Even though the quizzes are only 10 questions, you won't do well if you wait until the last minute to answer these.

I'm going to reiterate this because it's important, it is completely OK to ask me questions about the quiz, problem sets, poster projects. I'm not going to give you the answer right out, but I can help guide you in a direction. If you give me an answer and justify it, I can let you know if you're right or not even before you submit the quiz or problem sets. If you finish your poster early, please feel free to run it by me to see what I think. I can be a tough and specific grader, but part of this is because I try and give you every opportunity to run answers by me beforehand. I'm here to help you learn and understand the material, not to just sit in my office and maniacally laugh as I fail people.

Other than those larger issues, a couple of bite sized nuggets that seem to be correlated with doing well in the class:

Come to class, I know it's at a weird time, but it helps

Do all of the assignments

Watch the recorded lectures

Take advantage of the Extra Credit

LETTERS OF RECOMMENDATION

Many of you are likely interested in attending graduate or professional school after graduation, and these applications will likely require 2 or 3 letters of recommendation. I'm happy to write these letters under certain conditions, but suggest you read this:

<http://mychrobalromance.blogspot.com/2012/11/letters-of-recommendation.html>

QUESTIONS, COMMENTS AND SUGGESTIONS

I am happy to discuss any aspect of the lecture/laboratory at any time. Please come see me during office hours or email me if you have questions or conceptual difficulties. I am often present in the lab sessions, so feel free to ask me questions during that time.

STUDENT MENTAL HEALTH AND WELLBEING

Mental health is incredibly important for your wellbeing as a student. The University of Arizona provides numerous services to help with your health, and descriptions of these services can be found here: <https://diversity.uahs.arizona.edu/mental-health-wellness>

In an emergency, please contact the Banner Health crisis center at <https://www.bannerhealth.com/locations/tucson/banner-university-medicine-crisis-response-center-district>, call 911, or visit the closest Emergency Department.

Please also know that University faculty are mandatory reporters for sexual discrimination and abuse according to Arizona law

LAND ACKNOWLEDGEMENT

The University of Arizona sits on the original homelands of Indigenous Peoples who have stewarded this Land since time immemorial. We acknowledge and thank the Tohono O'odham and Pascua Yaqui peoples upon whose land we are guests here in Tucson.

CAMPUS PANTRY

The UA Campus Pantry is an ASUA service addressing food insecurity within the Wildcat community, and has multiple distribution events throughout the year available to anyone with a CatCard. Please visit <https://campuspantry.arizona.edu/> for more information.

****If you are in an emergency and need a food box now, please contact the Dean of Students Office at 520-621-7057 or email uofacampuspantry@gmail.com.**