Syllabus

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Biology 212 | General Microbiology

MWF 1:30-2:30pm
415 Jones Building
Fall 2019

Pre-requisites:
One course in a biological science or consent of the instructor

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Course Overview

Although you may not see them, microbes are integral to all areas of life. Bacteria, fungi, and viruses perform critical roles in ecosystem function and plant health as well as human health. Of course, microbes are perhaps best known for their ability to cause disease. To prevent disease, we must understand how pathogenic microbes invade and manipulate host biology as well as how beneficial microbes promote health and prevent pathogen colonization.

Throughout this course, students will use current literature to examine recent challenges and advances in microbiology with a specific focus on host-microbe biology. We will focus primarily on bacteria to gain an understanding of basic mechanisms of pathogenesis and function, with brief forays into fungi and viruses to broaden student understanding of microbial pathogenesis. Although plant pathogens cause rampant crop loss and severely impact ecosystem function, this course will focus on human host interactions to provide a satisfying deep dive into the underlying microbial molecular tools and virulence strategies.

Students are expected to enter this course having taken at least one Introductory Biology course but are not expected to have a detailed knowledge of microbiology. With that in mind, we will start building knowledge early using papers from the current literature to learn basic bacterial structure, genetics, metabolism, and lifestyle, microbiology techniques, and experimental approaches. As students acquire a working knowledge, our weekly paper discussions will shift to focus more closely on pathogenesis and host interactions, fundamental questions in the field, experimental results, and future directions for study. By the end of the course, students will have the opportunity to demonstrate their knowledge by identifying a question in the field and designing an experiment to solve one of microbiology's great mysteries!

Course Objectives

Through full participation in this course, students will be able to:

1. Describe different microbes including bacteria, fungi, and viruses and compare and contrast them based on differences in structure, function, pathogenicity, and virulence strategy
2. Summarize main questions from current literature and critically evaluate scientific results
3. Formulate scientific questions and design experiments to test hypotheses in microbiology
4. Evaluate ethical implications of emerging techniques in microbiology and develop strategies for communicating these implications to the general public

Readings

All of the readings for this class will be recently published journal articles from the microbiology literature. These articles will be available on Sakai with additional links to relevant background reading in the form of scientific reviews and opinion pieces.

There is one optional text for this course:
Microbiology, an introduction by Tortora, Funke, and Case. Any edition 9-12. 2013. Pearson. ISBN# 978-0-321-73360-3.

This textbook may be helpful to reinforce basic principles of microbe structure and function and supplement the knowledgebase we will build using the current literature. A firm foundation in these underlying principles is critical for novel discovery.

Assignments and Evaluations

All work will be assessed on a 10-point scale. For example, 90-100 results in an A, 80-90 a B, and so on. Please note that no late work will be accepted except under extenuating circumstances and with documentation in accordance with Duke policies.

Final grades will be calculated using the following percentages:

Weekly Assignments	10%
Participation	10%
Written Assignments	15%
Final Design Project	15%
Midterm 1	15%
Midterm 2	15%
Final Exam	20%

Weekly Assignments

Each week, students will complete a brief assignment based on the readings assigned for that week. These assignments are due by 11:59PM the day before the indicated class meeting (see proposed schedule) and will be graded for completion. To begin the semester, assignments will ask students to outline the experimental techniques used in the reading. As we continue to build a working knowledge of microbiology, students will be asked to identify the main findings in scientific figures as well as describe the techniques used to achieve the results. By the end of the course, students will develop future directions, pose ethical considerations, and propose potential experiments. Students should be prepared to discuss the readings and assignments at the start of the class period.

Participation

During class meetings, students will participate in individual and group activities, using information from the readings and working with their peers to grapple with new concepts and challenge current scientific findings. Examples of in-class activities include analyzing scientific figures, discussing ethical concerns, and designing experiments. The purpose of these activities is to learn how to read scientific papers and analyze data and results with the help of peers and the instructor. Practicing these skills in class will prepare students for out-of-class assignments, exams, and design projects. Students are expected to come to class prepared and ready to participate actively in all activities.

Written Assignments

Throughout the course, students will submit for feedback short written assignments designed to help students fully explore potential project topics and gradually build the final project. We will dedicate time in class before each due date for questions and peer review. Each assignment will constitute 3.75% of the final grade in the course. Students should refer to the final design project rubric for guidance on what to include in each written assignment as well as formatting requirements. The written assignments will be as follows:

1. Proposed Topic and Annotated Bibliography

   The proposed topic should be an interesting, unanswered question in microbiology and may apply to host-pathogen biology, commensal microbiota, environmental microbes, among others. Importantly, the topic may be in an area not covered throughout the course. Bibliographies should consist of no fewer than twenty peer-reviewed articles with the relevance of each noted in a brief sentence or two.

2. Introduction and Background

   Using the references compiled in the first written assignment, students will compose a brief introduction to provide context and rationale for their scientific question and proposed experiments. This section should not exceed half a page and must include at least two tentative scientific aims that address the overarching question. The proposed aims may exceed the half page limit.

3. Research Proposal
   In this assignment, students will fully develop their proposed aims by including specific techniques and experiments to address each hypothesis. Collectively, the aims and experiments must serve to shed light on the overarching question and central hypothesis. This section will be submitted along with a revised introduction and background. Together, these should not exceed 1.5 pages.

4. Abstract and Broader Impacts
   Students will use these sections to give a brief overview of the research proposal as well as place the scientific questions in a larger context. Additionally, these sections should explicitly state the significance of the proposed work. Students will submit this assignment along with revised versions of the preceding written assignments. Collectively, the document should not exceed 2 pages.

Final Design Project

The final project will be submitted for evaluation in the form of a National Science Foundation Graduate Research Fellowship. Written assignments are designed to generate the final design project over the course of the semester, allowing students to receive ample peer and instructor feedback on each component before the final submission. Final projects will be graded according to the rubric posted on Sakai and found at the end of this syllabus.

Midterm and Final Exams

There will be two midterm exams and one cumulative final. Practice questions and exam questions from previous years are available on the course website. In general, exam questions will challenge students to interpret real scientific results and propose follow-up experiments to advance scientific understanding. For both midterms, students may submit a regrade request if they feel a mistake has been made in the grading; however, submission for a regrade may result in a lower grade than the original if the instructor finds additional mistakes or flaws in logic that were unaccounted for in the initial evaluation.

Attendance and Late Work Policies

Attendance is expected in all class meetings. More than 3 unexcused absences will result in one letter grade reduction from the final grade for the course. Please note that no late work will be accepted except under extenuating circumstances and with documentation in accordance with Duke policies. The following circumstances constitute excused absences and exceptions to the late work policy:

1. Significant illness
2. Personal instances of distress or emergency
3. Religious observance
4. Varsity athletic participation
5. Required court or legal appearances

For required forms and more detailed policies, please consult this Duke policy.

Disability Statement

Student learning increases within diverse classroom environments. This class welcomes students from all backgrounds, identities, and abilities. Students who need accommodations to create a more productive learning environment are encouraged to contact the Student Disabilities Access Office at 919-668-1267 or disablities@aas.duke.edu before the start of the semester or early in the semester.

Title IX, Harassment, and Diversity

Duke University and this classroom are committed to encouraging and sustaining a learning and living community that is free from harassment, violence, and prohibited discrimination. In that regard and consistent with federal law (e.g., Title IX of the Education Amendments of 1972 and the Violence Against Women Act), Duke has developed this comprehensive Student Sexual Misconduct Policy, applicable to all students (undergraduate, graduate, and professional, or any student enrolled in any Duke program).

The Student Sexual Misconduct Policy prohibits all forms of sex/gender-based harassment, sexual/gender violence, sexual exploitation, relationship violence (domestic violence and dating violence), and stalking. Collectively, these terms are referred to in this policy as "Sexual Misconduct." They are defined below under "Prohibited Conduct." Non-sex/gender-based harassment is also a violation of university policy, as described under the university's Harassment Policy.

Duke and this classroom aspire to create a community built on collaboration, innovation, creativity, and belonging. Our collective success depends on the robust exchange of ideas—an exchange that is best when the rich diversity of our perspectives, backgrounds, and experiences flourishes. To achieve this exchange, it is essential that all members of the community feel secure and welcome, that the contributions of all individuals are respected, and that all voices are heard. All members of our community have a responsibility to uphold these values. More information on resources at Duke can be found on the Office of Diversity and Inclusion website.

Academic Integrity

Duke University is a community dedicated to scholarship, leadership, and service and to the principles of honesty, fairness, respect, and accountability. Citizens of this community commit to reflect upon and uphold these principles in all academic and non-academic endeavors, and to protect and promote a culture of integrity. To uphold the Duke Community Standard:

> I will not lie, cheat, or steal in my academic endeavors;
> I will conduct myself honorably in all my endeavors; and
> I will act if the Standard is compromised.

Proposed Schedule

Assignments are due by 11:59PM on Sakai the day before the class meeting unless otherwise noted. Full descriptions of each assignment are available on Sakai. No late work will be accepted without proper documentation or extenuating circumstances. Students are expected to complete the assigned readings prior to the class meeting.

Week	Class	Readings	Assignments
Microbe Structure and Function			
1	8-21-19		Introduce Yourself on Sakai
	8-23-19	Review: The Bacterial Cell Envelope Silhavy 2010 Interactive Cell: https://www.cellsalive.com/cells/bactcell_js.htm	Bring signed copy of the syllabus to class
2	8-26-19	Intro and Methods: Schmitt 2007	
	8-28-19	Results: Schmitt 2007	Weekly Assignment 1: Outline experimental techniques from the reading
	8-30-19	Discussion: Schmitt 2007	
Bacterial Genetics and Life Cycle			
3	9-2-19	Labor Day	
	9-4-19	Review: Bacterial Genetics Maloy 2001 Intro and Methods: Borgeaud 2015	Weekly Assignment 2: Outline experimental techniques from the reading and propose one follow-up question
	9-6-19	Results and Discussion: Borgeaud 2015	FDP: Bring draft of written assignment 1 to class for peer review
4	9-9-19	Intro and Methods: Chou 2015	Written assignment 1: Proposed FDP Topic and Annotated Bibliography
	9-11-19	Results: Chou 2015	Weekly Assignment 3: Outline experimental techniques from the reading and propose one follow-up question
	9-13-19	Discussion: Chou 2015	
5	9-16-19	Intro and Methods: Rodriguez 2005	
	9-18-19	Results and Discussion: Rodriguez 2005	
	9-20-19	Midterm 1	
Bacterial Stress Response and Virulence Mechanisms			
6	9-23-19	Review: Bacterial Stress and Virulence Mechanisms	

		Fang 2016 and Diard 2017	
	9-25-19	Intro: Chao 2016	Weekly Assignment 4: Propose experiments to address the claims from the reading
	9-27-19	Results and Methods: Chao 2016	FDP: Bring draft of written assignment 2 to class for peer review
7	9-30-19	Discussion: Chao 2016	Written assignment 2: FDP Intro and Background
	10-2-19	Intro: Garcia-Contreras 2014	Weekly Assignment 5: Propose experiments to address the claims from the reading
	10-4-19	Results and Methods: Garcia-Contreras 2014	
8	10-7-19	Discussion: Garcia-Contreras 2014	
	10-9-19	Intro: De la Cruz 2013	Weekly Assignment 6: Propose experiments to address the claims from the reading
	10-11-19	Fall Break	
9	10-14-19	Results and Methods: De la Cruz 2013	
	10-16-19	Discussion: De la Cruz 2013	FDP: Bring draft of written assignment 3 to class for peer review
	10-18-19	Intro: Mougous 2006	Written Assignment 3: FDP Research Proposal **DUE 11:59PM on 10-18-19**
10	10-21-19	Results and Methods: Mougous 2006	
	10-23-19	Discussion: Mougous 2006	
	10-25-19	Midterm 2	
Host-Pathogen Interactions			
11	10-28-19	Review: Bacterial-Host Interactions Casadevall 2000 and Casadevall 2009	
	10-30-19	Intro: Tan 2015	Weekly Assignment 7: Propose experiments to address the claims from the reading and suggest one follow-up experiment
	11-1-19	Results and Methods: Tan 2015	
12	11-4-19	Discussion: Tan 2015	
	11-6-19	Intro: Price 2018	Weekly Assignment 8: Propose experiments to address the claims from the reading and suggest one follow-up experiment
	11-8-19	Results and Methods: Price 2018	FDP: Bring draft of written assignment 4 to class for peer review

13	11-11-19	Discussion: Price 2018	Written Assignment 4: FDP Abstract and Broader Impacts
	11-13-19	Intro: Rauch 2017	Weekly Assignment 9: Propose experiments to address the claims from the reading and suggest one follow-up experiment
	11-15-19	Results and Methods: Rauch 2017	
14	11-18-19	Discussion: Rauch 2017	
	11-20-19	Intro: Rivera-Chavez 2016	Weekly Assignment 10: Propose experiments to address the claims from the reading and suggest one follow-up experiment
	11-22-19	Results and Methods: Rivera-Chavez 2016	FDP: Bring draft of the final design project to class for peer review
15	11-25-19	Discussion: Rivera-Chavez 2016	Final Design Project Due
	11-27-19	Thanksgiving Break	
	11-29-19	Thanksgiving Break	
16	12-2-19		
	12-4-19		
	12-6-19	LDOC	
17	12-9-19	Final Exams	
	12-11-19	Reading Day/Final Exams	
	12-13-19	Final Exams	
18	12-16-19	Final Exams	
	12-18-19	Final Exams	

Final Design Project Rubric

CATEGORY	Very Good	Good	Fair	Needs Improvement
Abstract	Abstract is concise, informative, and clearly indicates the relevant details of the proposed study.	Abstract is relevant and of required size, offering details about the proposed study	Abstract lacks relevance or fails to offer appropriate details about the proposed study or is too lengthy.	Abstract is missing or inappropriate given the problem, research questions, and method.
Introduction and Background	Articulates clear, reasonable, and succinct research questions, and questions are fresh, interesting and significant.	Research questions are stated clearly and are connected to the research topic.	Elements are poorly formed, ambiguous, or not logically connected to the description of the problem, purpose or research methods.	Research question(s), definitions, assumptions and limitations were omitted or inappropriate given the context, purpose or methods of the study.
Research Proposal	The purpose, questions, and design are mutually supportive and coherent. Appropriate and important limitations and assumptions have been clearly stated.	The research design has been identified and described in sufficiently detailed terms. Some limitations and assumptions have been identified.	The research design is confusing or incomplete given the research questions. Important limitations and assumptions have not been identified.	The research design is erroneous given the hypothesis or has not been identified and or described using standard terminology. Limitations and assumptions are omitted.
Broader Impacts	Includes interdisciplinary implications; benefits to society; engages diverse groups; partnerships; measurable outcomes.	Includes current outreach & teaching efforts; pubs & presentations; future plans well reasoned.	Lacks specifics; too loosely connected to scope of work; promises too much.	Failed to address; includes assertions or assumptions; no past/current efforts.
Organization	The narrative has the appropriate length and the ideas are presented in a clear structural and logic manner identifying reasonable well the reasons and means to achieve the goal of the proposal	Proposal format has been followed mostly. The narrative presents the ideas in an almost structural and logical manner.	The content and length of the proposal are inadequate (i.e. there is some logic in the narrative part, but the ideas lack clear focus and structural argumentation).	The length of the narrative exceeds the suggested limit as indicated in the solicitation. The ideas are presented in a random manner with no focus.