

BIEB 194 Microbial Ecology, Fall 2022

This is a discussion-based course and requires in-person attendance. If you do not anticipate being able to attend all classes in person, you should drop this course.

Masks: Per UCSD mandate, you will need to wear a face mask at all times in lecture. This includes time spent in the classroom immediately before and after class. This means there will be no food or drink in class. UCSD recommends the use of N-95 and KN-95 masks.

Microbial Ecology. 2 units. BIEB 194 is an introduction to microbial ecology. Microbes, including bacteria, archaeae, and viruses, are the most numerous organisms on the planet and potentially the most maligned. The vast majority do not cause disease. Instead they make the oxygen we breath, help grow the food we eat, and then help us digest it. This course will explore the beneficial microbial communities which form the foundation of Earth's biological and chemical processes. Reading primary literature including foundational research and contemporary discoveries in environmental and host-associated systems, students will learn theory, methods, and applications of microbial ecology and evolution to contemporary world issues including human health, conservation of biodiversity, and climate change.

Professor: Sara Jackrel

Contact Information: Office hours are available upon request. The best way to reach me is through my email, sjackrel@ucsd.edu, however this should only be used for urgent matters and to request an appointment for office hours. For all other inquiries, please discuss during our course time.

Lectures: Thursday 2:00 – 3:20 pm, York Hall 3010

Course website: This class will be run from the Canvas site (canvas.ucsd.edu). Important class announcements will be provided in class or on Canvas. **Check Canvas often** for course information and reading assignments. If you have not yet used Canvas, you can refer to the student help guides and videos, which are located on the left-side menu's help section (the question mark icon). Should you need any technical assistance with Canvas, please email servicedesk@ucsd.edu. In the header of the email, please write "Canvas". Make sure to include your name, course title and section, as well as your contact information in the email body.

Grading: There are no exams in this course. You will be graded based on the following:

Participation: Read and reflect on the required readings in advance. Come prepared to discuss readings in class. (15%)

Write an Abstract: You will be given peer-reviewed literature without abstracts and asked to write an abstract. This will be a group assignment to be completed during class with a final submission on Canvas. (10%)

Group Presentation: Divide into 10 groups. Smaller groups should consist of at least one PhD student. You will present with your group a pre-selected piece of the primary research literature to the class. You will have 40 minutes as a group to present this research to the class, address questions from the audience, and lead a class discussion about the study. (20%)

Research Summary Statements: Select 5 of the 10 student presentations and write up a three-sentence summary of the key findings of the paper **and** what in your opinion would be the most exciting new avenues of research to explore inspired by this paper. (25%)

Final Paper: Carefully read an original research article of your choice in the field of microbial ecology and write up a 'News & Views' type of perspective piece similar to what you might read in *Scientific America* or a Commentary for a research article in *Science* or *Nature*. Your paper must be your own independent work and must not exceed 3 pages single spaced, 12-point Times New Roman font with 1" margins (20%).

Peer Review: You will write a peer review of one of your classmate's final papers (10%). More details about what this review should entail will be provided in Canvas.

Missed Assignments: There are no make-up assignments. If you do not submit assignments by the assigned date and time posted on Canvas, you will receive a 10-point deduction for every 24 hours that have elapsed past the deadline. If you miss a deadline due to an unavoidable emergency (e.g. serious illness, etc.), you must provide valid documentation to avoid these point deductions.

Grades: Your final letter grade will be based on your total percentage in this course. If you get over 90% you will receive a grade in the A range (A-, A, A+), over 80% you will receive a grade in at least the B range (B-, B, B+), etc. If needed to adjust the distribution of letter grades upwards, grades will be based on a curve. The curve will only be used (if it is used) to move letter grade thresholds down, so it can only help your grade, not hurt it. For those taking the class pass/no pass (P/NP), the minimum final grade to receive a grade of P is a C-. The final course curve, if there is one, will be based on the students that are enrolled in the course at the end of the quarter.

Lectures: Attending class is required for mastering the material, receiving participation credit and hearing about important announcements. Do not expect to miss class consistently and be able to do well in this course. Please turn off cell phones before each lecture. There will be no podcasting of this course and lecture notes will not be posted. If you miss a class, ask to borrow notes from a classmate.

Textbook Readings: There is no textbook for this course.

Readings from the Scientific Literature: Reading assignments from the primary literature can be found in Canvas. Each lecture will include a portion of the class dedicated to discussing the primary literature. You will need to read these articles carefully in advance of lecture so that you can participate actively in discussion and any questions you may have can be addressed.

Academic Dishonesty. Students that commit academic dishonestly will receive an F in the course. Think carefully before you act by asking yourself: 1) is what I'm about to do or submit for credit an honest, fair, respectful, responsible & trustworthy representation of my knowledge and abilities at this time and, 2) would my instructor approve of my action? You are the only person responsible for your behavior, so, if you are unsure, don't ask a friend — ask your instructor, instructional assistant, or the Academic Integrity Office. For more information on academic integrity at UCSD, please see: <http://senate.ucsd.edu/Operating-Procedures/Senate-Manual/Appendices/2>

Posting or selling course materials. You should consider all lecture and course materials the same as copyrighted materials. You do not own these materials and therefore are not entitled to distribute any course materials on public websites like Course Hero. Students who are found to distribute any materials will be referred to the Academic Integrity Office.

Enrollment questions. Administrative, advising, or registration questions should be submitted via the Virtual Advising Center (vac.ucsd.edu).

Students with special circumstances. UC San Diego, as an institution, and I, as the instructor of this course, are committed to full inclusion in education for all persons. Services and reasonable accommodations are available to students with temporary and permanent disabilities, to students with DACA or undocumented status, to students facing mental health issues or other personal situations, and to students with other kinds of learning needs. Please feel free to let me know if there are circumstances affecting your ability to participate in class. Some resources that might be of use include:

- Office for Student with Disability:

<https://students.ucsd.edu/well-being/disability-services/index.html>

- UCSD CAPS (Counseling & Psychological Services):

<https://wellness.ucsd.edu/CAPS/Pages/default.aspx>

- UCSD Undocumented Student Services:

<https://uss.ucsd.edu/>

Note: a list of campus resources can be found here:

<https://students.ucsd.edu/sponsor/undoc/resources/index.html>

- Learning Strategies Center:

<https://commons.ucsd.edu/academic-support/learning-strategies/index.html>

Students requesting accommodations and services due to a disability for this course will need to provide a current Authorization for Accommodation (AFA) letter issued by the Office for Students with Disabilities (OSD), prior to eligibility for requests. Receipt of AFAs in advance is necessary for appropriate planning for the provision of reasonable accommodations. OSD Academic Liaisons also need to receive current AFAs. For more information, contact the OSD at (858) 534.4382 (V); (858) 534-9709 (TTY); osd@ucsd.edu, or <http://osd.ucsd.edu>. All of these arrangements should be made within the first two weeks of the quarter.

If you are having academic difficulty, OASIS (<http://oasis.ucsd.edu/>) can often help. OASIS provides tutoring, as well as classes in study skills and time management. If you are having personal difficulties, do not hesitate to seek help at Counseling and Psychological Services (CAPS): (<https://wellness.ucsd.edu/CAPS/Pages/default.aspx>), which is free to students. They can help you get over many types of hurdles.

Other Problems or Concerns. If you have serious medical or personal problems during the quarter, the university allows medical withdrawals. Contact the Biology Student Affairs Advising Services office at 858-534-0557 or go to their website.

Course Schedule

Week 1: Thursday, September 22

Class Theme: Introduction to Microbial Ecology

- Introductory lecture on microbial ecology.
- Discussion about Doolittle perspective.

Recommended Reading to be read in advance of class on Week 1:

- Doolittle WF. 2000. Uprooting the tree of life. *Scientific America* 282(2):90-95.
- Hug et al. 2016. A new view of the tree of life. *Nature Microbiology* 1(5):1-6.

Week 2: Thursday, September 29

Class Theme: Methods in Microbial Ecology

- Lecture on methods in microbial ecology.
- Discussion about Prosser review.

Required Reading to be read in advance of class on Week 2:

- Prosser. 2020. Putting science back into microbial ecology: A question of approach. *Philosophical Transactions* 375(1798):20190240.

Week 3: Thursday, October 6

Class Theme: Approaches to Studying Microbial Ecology

- Lecture on approaches to studying microbial ecology.
- Discussion about Bauermeister review.

Required Reading to be read in advance of class on Week 3:

- Bauermeister A et al. 2022. Mass spectrometry-based metabolomics in microbiome investigations. *Nature Review Microbiology* 20(3):143-160.

Week 4: Thursday, October 13

Class Theme: Structure of a Scientific Paper

- Short lecture discussing structure of scientific papers
- Abstract Writing group activity.

Required Reading:

- Lueders T et al. 2006. Identification of bacterial micropredators distinctively active in a soil microbial food web. *Applied and Environmental Microbiology* 72(8): 5342-5348.
- Czárán TL 2002. Chemical warfare between microbes promotes biodiversity. *Proceedings of the National Academy of Sciences* 99(2):786-790.
- Berglund J 2007. Efficiency of a phytoplankton-based and a bacterial-based food web in a pelagic marine system. *Limnology and Oceanography* 52(1):121-131.

Week 5: Thursday, October 20

Class Theme: How microbes expand our understanding of Ecology

- Lecture on how microbes effect physiological, behavioral, population, and community ecology
- Discussion about Kastman et al. paper.

Required Reading:

- Kastman EK et al. 2017. Biotic interactions shape the ecological distributions of *Staphylococcus* species. *mBio* 7(5):e01157-16.

Deadline: Abstract writing assignment due through Canvas by 11:59 PM today.

Week 6: Thursday, October 27

Class Theme: Symbioses: host-microbe interactions.

2:00 – 2:40 Student presentation by Group 1: Moeller et al. 2016.

2:40 – 3:20 Student presentation by Group 2: McCutcheon and Moran. 2011.

Required Readings:

- Moeller AH et al. 2016. Co-speciation of gut microbiota with hominids. *Science* 353(6297):380-382.
- McCutcheon JP and NA Moran. 2012. Extreme genome reduction in symbiotic bacteria. *Nature Reviews Microbiology* 10(1):13-26.

Deadline: Submit the peer-reviewed study you would like to use for the foundation of your final paper. Selections are due through Canvas by 11:59 PM.

Week 7: Thursday, November 3

Class Theme: Microbial Community Structure.

2:00 – 2:40 Student presentation by Group 3: Lafferty et al. 2008.

2:40 – 3:20 Student presentation by Group 4: Martiny 2006.

Required Readings:

- Lafferty KD et al. 2008. Parasites in food webs: the ultimate missing links. *Ecology Letters* 11(6): 533-546.
- Martiny JB et al. 2006. Microbial biogeography: Putting microorganisms on the map. *Nature Reviews Microbiology* 4(2):102-112.

Week 8: Thursday, November 10

Class Theme: Microbial Community Assembly

2:00 – 2:40 Student presentation by Group 5: Nemergut et al. 2013.

2:40 – 3:20 Student presentation by Group 6: Shade et al. 2012.

Required Readings:

- Nemergut DR et al. 2013. Patterns and processes of microbial community assembly. *Microbiology and Molecular Biology Reviews* 77(3):342-356.
- Shade A et al. 2012. Fundamentals of microbial community resistance and resilience. *Frontiers in Microbiology* 3:417.

Deadlines: First Draft of Final Paper due through Canvas by 11:59 PM today.

Week 9: Thursday, November 17

Class Theme: Microbial Ecosystem Ecology

2:00 – 2:40 Student presentation by Group 7: Graham et al. 2016.

2:40 – 3:20 Student presentation by Group 8: Hayer et al. 2022.

Deadlines: Peer Review due through Canvas by 11:59 PM today.

Required Readings:

- Graham et al. 2016. Microbes as engines of ecosystem function: when does community structure enhance predictions of ecosystem processes? *Frontiers in Microbiology*.
- Hayer et al. 2022. Microbes on decomposing litter in streams: entering on the leaf or colonizing in the water? *The ISME Journal* 3:717-725.

Week 10: No class, Happy Thanksgiving!

Week 11: Thursday, December 1:

Class Theme: Applied Microbial Ecology

2:00 – 2:40 Student presentation by Group 9: Singer et al. 2003.

2:40 – 3:20 Student presentation by Group 10: Kueneman et al. 2016.

Deadlines: Final Paper submitted through Canvas by 11:59 PM today.

Required Readings:

- Singer et al. 2003. Secondary plant metabolites in phytoremediation and biotransformation. *Trends in Biotechnology*.
- Kueneman JG et al. 2016. Probiotic treatment restores protection against lethal fungal infection lost during amphibian activity. *Proceedings of the Royal Society B* 283(1839):20161553.