

BI410/510: Microbial Ecology
Mon & Wed 4:00 – 5:20 via Zoom

Dr. Krista McGuire (she, her, hers)
Virtual office hours: Thu 2:30-3:30; by appointment
kmcguire@uoregon.edu
<https://mcguiremicrobialecology.com/>

Course Description: In this course you we will explore current approaches in microbial ecology for testing hypotheses using experimental approaches. Most studies in microbial ecology are descriptive, as we are still uncovering community assembly patterns of microbial communities in a variety of ecosystems that are still largely undescribed. However, in many systems that are now well characterized, experiments can be done to elucidate the mechanisms underlying microbial community assembly patterns and links between structure and function. For each class, students will read primary literature articles describing an experimental study on the topic for that class. The class format will include a brief overview of the theory or system highlighted for the current week, and the remainder of the class will be discussion-based. Students will also be able to choose one class in which they choose the system and papers for discussion. At the end of the term, students will write a research proposal for an experimental study in a system of their choice that is designed to test one or more hypotheses in microbial ecology.

Learning Objectives:

Students who complete this course will be able to:

1. Apply general ecological principles to microbial systems
 2. Articulate the ecological mechanisms that shape microbial communities across a variety of habitats
 3. Read, synthesize, and analyze primary scientific literature in microbial ecology
 4. Devise an experimental test of ecological principles in microbial communities through independent work
 5. Learn how to craft a compelling research proposal
 6. Communicate scientific ideas in both oral and written form
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Grading: Total of 300 points for the course

Discussion leading	30
Participation	50
Proposal abstract	20
Final proposal	100
Presentation of proposal	100

TOTAL 300

Special needs: Please notify me in the first week of the course if you have special needs or a documented disability that will interfere with your ability to perform course activities.

Week	Date	Topic	Background reading(s)	Due
1	30-Mar	Introductions and overview of microbial ecology and methods	Xu 2006; Jessup 2004	Topic assignments
	1-Apr	Colonization and succession	Fierer et al. 2010	
2	6-Apr	Microbial dispersal	Nemergut et al. 2013	
	8-Apr	Microbial interactions: synergy	Tan et al. 2017	
3	13-Apr	Microbial interactions: antagonism	Hibbing et al. 2010	
	15-Apr	Microbial mutualisms 1: animal systems	Costello et al. 2012	
4	20-Apr	Microbial mutualisms 2: plant systems	Friesen et al. 2011	
	22-Apr	Linking microbial structure and function: C & N cycling	Bell 2019; Falkowski et al. 2008	
5	27-Apr	Microbial responses to climate change 1: precipitation	Zhou et al. 2018	Proposal abstract
	29-Apr	Microbial responses to climate change 2: temperature	Cavicchioli et al. 2019	
6	4-May	Terrestrial ecosystems	Fierer 2017	
	6-May	Marine ecosystems	Strom 2008; Richards et al. 2012	
7	11-May	Freshwater ecosystems	Zeglin 2015	
	13-May	Agricultural ecosystems	Toju et al. 2018	
8	18-May	Urban ecosystems	Fulthorpe et al. 2018	
	20-May	Microbial applications: bioremediation	Jacob et al. 2018	
9	25-May	Synthetic microbial communities	Zomorrodi et al. 2016	
	27-May	Student proposal presentations		
10	1-Jun	Student proposal presentations		
	3-Jun	Student proposal presentations		Final proposal

Assigned readings for background

- Bell, T. 2019. Next-generation experiments linking community structure and ecosystem functioning. *Environmental Microbiology Reports* **11**:20-22.
- Cavicchioli, R., W. J. Ripple, K. N. Timmis, F. Azam, L. R. Bakken, M. Baylis, M. J. Behrenfeld, A. Boetius, P. W. Boyd, A. T. Classen, T. W. Crowther, R. Danovaro, C. M. Foreman, J. Huisman, D. A. Hutchins, J. K. Jansson, D. M. Karl, B. Koskella, D. B. M. Welch, J. B. H. Martiny, M. A. Moran, V. J. Orphan, D. S. Reay, J. V. Remais, V. I. Rich, B. K. Singh, L. Y. Stein, F. J. Stewart, M. B. Sullivan, M. J. H. van Oppen, S. C. Weaver, E. A. Webb, and N. S. Webster. 2019. Scientists' warning to humanity: microorganisms and climate change. *Nature Reviews Microbiology* **17**:569-586.
- Costello, E. K., K. Stagaman, L. Dethlefsen, B. J. M. Bohannan, and D. A. Relman. 2012. The application of ecological theory toward an understanding of the human microbiome. *Science* **336**:1255-1262.
- Falkowski, P. G., T. Fenchel, and E. F. Delong. 2008. The microbial engines that drive Earth's biogeochemical cycles. *Science* **320**:1034-1039.
- Fierer, N. 2017. Embracing the unknown: disentangling the complexities of the soil microbiome. *Nature Reviews Microbiology* **15**:579-590.
- Fierer, N., D. Nemergut, R. Knight, and J. M. Craine. 2010. Changes through time: integrating microorganisms into the study of succession. *Research in Microbiology* **161**:635-642.
- Friesen, M. L., S. S. Porter, S. C. Stark, E. J. von Wettberg, J. L. Sachs, and E. Martinez-Romero. 2011. Microbially mediated plant functional traits. *Annual Review of Ecology, Evolution, and Systematics* **42**:23-46.
- Fulthorpe, R., J. S. MacIvor, P. Jia, and S. L. E. Yasui. 2018. The Green Roof Microbiome: Improving Plant Survival for Ecosystem Service Delivery. *Frontiers in Ecology and Evolution* **6**.
- Hibbing, M. E., C. Fuqua, M. R. Parsek, and S. B. Peterson. 2010. Bacterial competition: surviving and thriving in the microbial jungle. *Nature Reviews Microbiology* **8**:15-25.
- Jacob, J. M., C. Karthik, R. G. Saratale, S. S. Kumar, D. Prabakar, K. Kadirvelu, and A. Pugazhendhi. 2018. Biological approaches to tackle heavy metal pollution: A survey of literature. *Journal of Environmental Management* **217**:56-70.
- Jessup, C. M., R. Kassen, S. E. Forde, B. Kerr, A. Buckling, P. B. Rainey, and B. J. M. Bohannan. 2004. Big questions, small worlds: microbial model systems in ecology. *Trends in Ecology & Evolution* **19**:189-197.
- Nemergut, D. R., S. K. Schmidt, T. Fukami, S. P. O'Neill, T. M. Bilinski, L. F. Stanish, J. E. Knelman, J. L. Darcy, R. C. Lynch, P. Wickey, and S. Ferrenberg. 2013. Patterns and Processes of Microbial Community Assembly. *Microbiology and Molecular Biology Reviews* **77**:342-356.
- Richards, T. A., M. D. M. Jones, G. Leonard, and D. Bass. 2012. Marine fungi: their ecology and molecular diversity. Pages 495-522 in C. A. Carlson and S. J. Giovannoni, editors. *Annual Review of Marine Science*, Vol 4. Annual Reviews, Palo Alto.
- Strom, S. L. 2008. Microbial ecology of ocean biogeochemistry: A community perspective. *Science* **320**:1043-1045.
- Tan, C. H., K. W. K. Lee, M. Burmolle, S. Kjelleberg, and S. A. Rice. 2017. All together now: experimental multispecies biofilm model systems. *Environmental Microbiology* **19**:42-53.
- Toju, H., K. G. Peay, M. Yamamichi, K. Narisawa, K. Hiruma, K. Naito, S. Fukuda, M. Ushio, S. Nakao, Y. Onoda, K. Yoshida, K. Schlaeppi, Y. Bai, R. Sugiura, Y. Ichihashi, K. Minamisawa, and E. T. Kiers. 2018. Core microbiomes for sustainable agroecosystems. *Nature Plants* **4**:247-257.
- Xu, J. P. 2006. Microbial ecology in the age of genomics and metagenomics: concepts, tools, and recent advances. *Molecular Ecology* **15**:1713-1731.

- Zeglin, L. H. 2015. Stream microbial diversity in response to environmental changes: review and synthesis of existing research. *Frontiers in microbiology* **6**:15.
- Zhou, Z. H., C. K. Wang, and Y. Q. Luo. 2018. Response of soil microbial communities to altered precipitation: A global synthesis. *Global Ecology and Biogeography* **27**:1121-1136.
- Zomorodi, A. R., and D. Segre. 2016. Synthetic Ecology of Microbes: Mathematical Models and Applications. *Journal of Molecular Biology* **428**:837-861.

Campus resources to support your learning

Tutoring and Academic Engagement Center (<https://engage.uoregon.edu/services/>) Drop-in math and writing support in addition to tutoring, study skills support, and Class Encore. Located in the 4th Floor Knight Library (541) 346-3226, engage@uoregon.edu.

Counseling Center Call anytime to speak with a therapist who can provide support and connect you with resources. Located on the 2nd Floor of the Health Center(541)346-3227

Accessible Education Center The University of Oregon is working to create inclusive learning environments. The instructor believes strongly in creating inclusive learning environments. If there are aspects of the instruction or design of this course that result in barriers to your participation, please notify us as soon as possible. You are also encouraged to contact the Accessible Education Center. If you are not a student with a documented disability, but you would like for us to know about class issues that will impact your ability to learn, we encourage you to come visit during office hours so that we can strategize how you can get the most out of this course. Located on the 1st Floor of Oregon Hall (541) 346-1155, uoaec@uoregon.edu

Center for Multicultural Academic Excellence (CMAE) mission is to promote student retention and persistence for historically underrepresented and underserved populations. We develop and implement programs and services that support retention, academic excellence, and success at the UO and beyond. We reaffirm our commitment to all students, including undocumented and tuition equity students. Located on the 1st Floor of Oregon Hall (541) 346-3479, cmae@uoregon.edu

The *UO Access Shuttle* is an on-campus ride service provided at no cost to students with conditions that limit mobility. More information and a sign-up form can be found on the parking & transportation department website: <https://parking.uoregon.edu/content/access-shuttle>.

Class Courtesy

Please arrive in class on time. Late arrivals distract the instructor and the other students. Please turn off cell phones during the class meeting times. Use your laptop only for class activities. Do not leave class early unless you have cleared it with the instructor in advance. Ask questions if you did not hear or understand something.

Class rosters are provided to the instructor with the student's legal name. I will gladly honor your request to address you by an alternate name or gender pronoun. Please advise me of this preference early in the quarter (or before) so that I may address you properly.

Open inquiry, freedom of expression, and respect for difference are fundamental to a comprehensive and dynamic education. We are committed to upholding these ideals by encouraging the exploration, engagement, and expression of divergent perspectives and diverse identities. Classroom courtesy and sensitivity are especially important with respect to individuals and topics dealing with differences of race, culture, religion, politics, sexual orientation, gender, gender variance, and nationalities. Our classroom is a learning environment, and as such should be a safe, inclusive and respectful place. Being respectful

also includes using preferred pronouns for your classmates. Disrespecting fellow students as well as combative approaches, tones and/or actions are not acceptable. Please make me aware if there are classroom dynamics that impede your (or someone else's) full engagement.

Academic integrity

All students will be expected to adhere to the University's guidelines on academic integrity as outlined in the Student Conduct Code: <https://policies.uoregon.edu/vol-3-administration-student-affairs/ch-1-conduct/student-conduct-code>. As detailed in the policy, academic misconduct means the violation of university policy involving academic integrity. This includes cheating ("any act of deception by which a student misrepresents or misleadingly demonstrates that the student has mastered information on an academic exercise that the student has not mastered"), and plagiarism ("using the ideas or writings of another as one's own.") The instructor has a zero tolerance policy for academic dishonesty. All persons involved in academic dishonesty will be disciplined in accordance with University regulations and procedures.

Discrimination and Harassment

Prohibited Discrimination and Harassment

Any student who has experienced sexual assault, relationship violence, sex or gender-based bullying, stalking, and/or sexual harassment may seek resources and help at safe.uoregon.edu. To get help by phone, a student can also call either the UO's 24-hour hotline at 541-346-7244 [SAFE], or the non-confidential Title IX Coordinator at 541-346-8136. From the SAFE website, students may also connect to Callisto, a confidential, third-party reporting site that is not a part of the university.

Students experiencing any other form of prohibited discrimination or harassment can find information at respect.uoregon.edu or aaeo.uoregon.edu or contact the non-confidential AAEO office at 541-346-3123 or the Dean of Students Office at 541-346-3216 for help. As UO policy has different reporting requirements based on the nature of the reported harassment or discrimination, additional information about reporting requirements for discrimination or harassment unrelated to sexual assault, relationship violence, sex or gender based bullying, stalking, and/or sexual harassment is available at [Discrimination & Harassment](#).

Reporting

The instructor of this class is a Student-Directed Employee. As such, **if you disclose to me, I will respond to you with respect and kindness. I will listen to you, and will be sensitive to your needs and desires. I will not judge you. I will support you.** As part of that support, I will direct students who disclose sexual harassment or sexual violence to resources that can help. **I will only report the information shared to the university administration when you as the student requests that the information be reported** (unless someone is in imminent risk of serious harm or is a minor). Please note the difference between 'privacy' and 'confidentiality.' As a Student-Directed Employee I can offer privacy because I am not required to report certain information to the university. However, I cannot be bound by confidentiality in the same way that a counselor or attorney is. Confidential resources such as these means that information shared is protected by federal and state laws. Any information that I as a student-directed employee receive may still be accessed by university or court proceedings. This means, for example, that I could still be called as a witness or required to turn over any related documents or notes that I keep.

Please note also that I am required to report all other forms of prohibited discrimination or harassment to the university administration. Specific details about confidentiality of information and reporting obligations of employees can be found at titleix.uoregon.edu.

Mandatory Reporting of Child Abuse

UO employees, including faculty, staff, and GEs, are mandatory reporters of child abuse. Child abuse pertains to individuals who are under the age of 18. This statement is to advise you that your disclosure of information about child abuse to the instructor may trigger my duty to report that information to the designated authorities. Please refer to the following links for detailed information about mandatory reporting: [Mandatory Reporting of Child Abuse and Neglect](#).

Safe Ride
541-346-7433 ext 2
pages.uoregon.edu/saferide

Safe Ride is an **assault prevention shuttle** that works to provide free, inclusive, and accessible alternatives to traveling alone at night for **UO students, faculty, and staff**.

We are a schedule-ahead service and riders can (1) call once we open to schedule a ride with a dispatcher or (2) leave a voicemail on the day of their ride request. We do not call riders ahead of time to confirm due to capacity constraints, but riders are always welcome to call us to double-check that their ride was scheduled. We are a feminist, 'for-the-students/by-the-students' organization and operate out of the Women's Center in EMU 12F.

Operating hours:

Spring term Sunday - Thursday | 7p - midnight

Friday + Saturday | 7p - 2a

Summer term Sunday - Thursday | 9p - midnight

Friday + Saturday | 9p - 2a

Fall/Winter term Sunday - Thursday | 6p - midnight

Friday + Saturday | 6p - 2a

Policy and rules:

1. We are a **schedule-ahead service**, we **do not call ahead**, and we can only wait for riders for 5 minutes at their pick-up time and location.
2. We only give rides to groups of **3 or fewer** to prioritize groups that are at higher risk.
3. We are a **free service** and do not accept tips.