Environmental Microbiology 6155: MICROBIAL ECOLOGY & EVOLUTION

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https://u.osu.edu/viruslab/
https://openwetware.org/wiki/SWES-MEL

Please email us through Carmen. Office hours are by emailed appointment. Do not leave voice mails as they may not be received.

Credit hours: 3. From the Ohio Department of Higher Education guidelines, this equates to ~3 hrs of in-class time each week, and “requires students to work at out-of-class assignments an average of two hours for every hour of formalized instruction”.

Lecture time/location: F 9:30am-12:30pm, location Biological Sciences 676.

I. Course objective/goals: The course will cover, at a graduate level and focused around key primary literature, the ecology and evolution of microbes. We will explore essential methods and concepts, and ongoing ‘unknowns’ in the field. In this course, the term “microbial” is shorthand for prokaryotes + viruses.

We will cover the following overarching scientific themes:

- Microbial ecology: What are the patterns and drivers of microbial communities? How do we grapple with scale, & statistical power? What are approaches to time series analyses, and to multi-disciplinary systems datasets (including WCGNA analyses)? What ‘central dogma’ considerations should inform our interpretation of multi-omic experiments? What are the defining ecological characteristics, at the microbial scale, of oceans, soils, and engineered systems?

- Microbial evolution: How is selection examined in microbes, and what is known about microbial evolutionary rates and processes? How are lineages traced, and their relationships examined?

- Microbial evolution in an ecological context: How can the above concepts be applied in unified systems frameworks, such as for understanding symbioses, or the co-evolution of viruses & microbes, or microbial metabolic hand-offs & their evolution?

The course learning objectives for this material are:

- Develop knowledge of foundational concepts and methods in microbial ecology and evolution.
- Explore principles of sound experimental design in these fields.
- Learn how to read, summarize, and critique primary literature in these fields.
- Improve professional communication skills as a scientist: writing & presenting, peer-evaluation of writing & presenting, and leading scientific discussions.

The course learning objectives specifically support these Microbiology PhD Program learning goals:

- Broad Knowledge: PhD graduates of Microbiology should be able to demonstrate a broad base of knowledge in several areas.
- In-Depth Knowledge: PhD graduates of Microbiology should be able to demonstrate in-depth in an area of interest. This course advances this goal for students continuing in these areas of study.
- Effective Communication. PhD graduates of Microbiology should be able to effectively communicate science through oral and written presentations to both scientific and general audiences.
II. Required materials:
This class is focused around key concepts in Microbial Ecology & Evolution, fields which are continually evolving. Therefore, and as a graduate-level course, we will read primary literature rather than a text book. Readings will be posted on Canvas. You will be expected to access this site regularly in order to prepare for class. It is your responsibility to turn on your notifications in Canvas so you receive alerts or emails when Announcements are made or assignments are posted.

III. Grading:

30% Weekly write-ups (13 weeks)
10% Peer evaluation of weekly write-ups
40% Presentations (20% for first presentation, 20% for second)
5% Peer evaluation of presentations
10% In-class participation in discussions
5% Learning objectives write-ups

Primary literature discussions are the heart of this course. To support these discussions, there will be lectures by the professors, presentations by students, and at-home viewing and reading assignments, to introduce foundational concepts and methods.

Homework.
A. Preparation: we will read 1-3 papers each week, and some weeks we will view videos or short supplementary writing to support the weekly topic.

B. Weekly write-ups: to provide an opportunity to synthesize the information in the assigned paper(s), each week you will write a short writing assignment with the following structure:

- 1 paragraph summarizing each of the paper(s) (i.e. 1 paragraph per paper). What was the key Q it was addressing and why is it important? What was their experimental design and approach? And what were there key findings?
- A short list of the “muddiest points” – what questions do you have about the paper(s).
- A short list of “axes of connection” to other research or concepts – how does this paper(s) relate to other papers or ideas covered in this course, in your own research, or in other classes, or elsewhere (including mainstream media)?

You will turn these write-ups in on Carmen, and bring 1 printed copy to class.

<table>
<thead>
<tr>
<th>Weekly Write-ups rubric:</th>
<th>Criteria</th>
<th>Rating</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Key Qs stated &amp; concisely contextualized</td>
<td>3: clearly stated goals of all assigned papers and gave quick context</td>
<td>1: mentioned a single goal without context</td>
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<td></td>
<td>Experimental approach</td>
<td>3: clearly identified the essential experimental approach of the papers at a summary-level (ie not every step of protocols)</td>
<td>1: just lists some of methods or tools used, without overarching approach.</td>
</tr>
<tr>
<td></td>
<td>Findings</td>
<td>3: concisely articulated the key findings of the paper</td>
<td>1: states a single finding</td>
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<tr>
<td></td>
<td>Quality of writing</td>
<td>2: easy to read, clearly laid out</td>
<td>1: could follow, but there were some confusing sections.</td>
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</tbody>
</table>
C. Peer evaluation of weekly write-ups: Assessing our colleagues’ work is one of the best ways of improving our own. Each week you will assess a write-up from a different peer, using the same grading rubric as the instructors, and adding 1 sentence per criteria justifying your score. These will be due the following week.

Peer evaluations rubric:

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Scored the rubric</th>
<th>Rating</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concisely justified each score.</td>
<td>1: filled in the rubric</td>
<td>3: Only provided justifying sentences for a subset of the scores, and/or sentences did not actual relate to evaluate of criteria.</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>0: did not complete</td>
<td>0: did not explain scores</td>
<td>1</td>
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</table>

Presentation. You will give 2 presentations during the semester. Presentations will be 15-20 minutes, with open question and discussion time afterwards. (1). You will sign up to present on a topic (a method, concept, or paper) related to the syllabus and assigned readings; the list of these options will be provided on the first day of class. The goal of your presentation will be to deliver a primer on the assigned topic to your peers, these will directly feed into improved paper discussions. You are encouraged but not required to arrange a meeting with an instructor the week before your presentation to go over your slides. (2). The last day of class, we will each present on connecting the semester’s material to concepts in our everyday lives (see syllabus). You may select any topic.

Presentation rubric:

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Points (60)</th>
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<tbody>
<tr>
<td>Content</td>
<td></td>
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<tr>
<td>Organization</td>
<td>A</td>
</tr>
<tr>
<td>Organization clear from the start, &amp; followed</td>
<td>Organization presented and mostly adhered to</td>
</tr>
<tr>
<td>Concept conveyance</td>
<td>Concepts are clearly conveyed, with succinct explanations, appropriate examples, and informative visual aids</td>
</tr>
<tr>
<td>Referencing</td>
<td>Literature &amp; knowledge sources referenced</td>
</tr>
<tr>
<td>Accuracy</td>
<td>The information presented is correct</td>
</tr>
<tr>
<td>Timeliness</td>
<td>Talk fit within allotted timeframe</td>
</tr>
<tr>
<td>Q &amp; A</td>
<td>Qs addressed with thought, some known answers, and engaged group brainstorming when answers not known</td>
</tr>
<tr>
<td>Slides</td>
<td>Slides uncluttered, easy to follow</td>
</tr>
<tr>
<td>Style</td>
<td>Graphics consistently attributed to their source</td>
</tr>
<tr>
<td>Source attribution</td>
<td>Professional bearing, no nail-biting, swaying, etc</td>
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Verbally | (after the first 5”) Minimal ‘ums’, cogent verbiage, content matches slide content | Generally smooth delivery, a few rough spots | Periodically distracted; reads from notes | Frequently loses place; verbiage does not match slides

Rapport | Maintains eye contact, “presence” in the space, facial expressions, use of laser pointer to help guide audience | Generally engaged with audience | Spends long periods with back to audience looking at slides; spends long periods looking down or out of window, or with eyes closed | No eye contact

You will evaluate your peers’ presentations using an in-class evaluation sheet based on the above rubric, and with time to write down comments about their performance. Full completion of the evaluation sheet, with comments, will earn full credit; partial completion partial credit; no completion will get zero credit.

**Participation.** Show up on time and prepared, and participate in class. Because these are discussions, it is OK if you dislike speaking up with answers, or feel you know less than the rest of the class - you can still participate, by bringing your pithy questions to the group.

**Participation Rubric**

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<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C/D</th>
<th>F</th>
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<tbody>
<tr>
<td><strong>Preparation</strong></td>
<td>Arrives on time fully prepared every class session</td>
<td>Arrives mostly, if not fully, prepared (ongoing)</td>
<td>Inconsistent preparation</td>
<td>Rarely or never prepared</td>
</tr>
<tr>
<td><strong>Participation</strong></td>
<td>Plays an active role in discussions (ongoing)</td>
<td>Participates constructively in discussions (ongoing)</td>
<td>When prepared, participates constructively in discussions</td>
<td>Comments vague if given; frequently demonstrates lack of interest</td>
</tr>
<tr>
<td><strong>Contribution to Class</strong></td>
<td>Comments advance level and depth of dialogue (consistently)</td>
<td>Makes relevant comments based on assigned material (ongoing)</td>
<td>When prepared, relevant comments are based on assignments</td>
<td>Demonstrates a noticeable lack of interest</td>
</tr>
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Courtesy of Jesse Kwick; Adapted from The Teaching Professor, March 2005.

YOU WILL POSITIVELY AFFECT YOUR PARTICIPATION GRADE BY:
1. Becoming more active and/or making more effective comments that raise overall level of discussion.
2. Asking thoughtful questions that will enhance discussion and engage peers.
3. Listening carefully to, supporting, and engaging your peers in discussion.

YOU WILL NEGATIVELY AFFECT YOUR PARTICIPATION GRADE BY:
1. Not attending class (unexcused), or arriving to class late.
2. Using electronic devices (e.g. cell phone, iPad, computer, etc.) for personal, non-class related reasons.
3. Dominating class discussions, thereby restricting others’ participation.
4. Making offensive, and/or disrespectful comments during discussions.

**Learning objectives write-ups.** At the beginning and end of the course you will be required to complete short writing assignments (no more than 1 page single-spaced) self-evaluating your strengths and weaknesses in each of the areas covered by the 4 course learning objectives, based on the 3 overarching themes. At the start of the course you will evaluate your knowledge coming in, describe how these knowledge and training areas fit into your longer term research and career goals, and the areas you are most excited to learn about, and identify your strategy for succeeding in the course. We will read a summary of learning styles to help frame this. At the end of the course, you will reflect on which areas you advanced your knowledge and in what ways, and what learning strategies worked for you.
### IV. Course Outline

<table>
<thead>
<tr>
<th>Week</th>
<th>Date</th>
<th>Topic</th>
<th>Readings</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Jan 11</td>
<td>The microbial species concepts. What to count? The term ‘population’ in ecology vs. in evolution</td>
<td>1. OX Cordero, MF Polb. 2014 Explaining microbial genomic diversity in light of evolutionary ecology (2014). Nature Reviews Microbiology, 12, pages 263–273</td>
</tr>
<tr>
<td>7</td>
<td>Feb 22</td>
<td>Habitat comparisons</td>
<td>T.B.D. as critical new papers only just arising in this area</td>
</tr>
</tbody>
</table>
8  Mar 1  Population genetics and communities
2. T.B.O. as critical new papers only just arising in this area

9  Mar 8  Experimental evolution

10  Mar 15  Spring break

11  Mar 22  Guest discussion lead by Matt Anderson: Evolution of microbial eukaryotes  
T.B.D. by guest lecturer

12  Mar 29  How do viruses fit into the frameworks discussed so far?

13  Apr 5  Metabolic hand-offs and their evolution

14  Apr 12  Co-evolution of hosts and symbionts/parasites

15  Apr 19  Applying course concepts to your everyday life (e.g. cheese, wastewater treatment, agriculture, wine, antibiotic resistance, etc.)
Each person presents for 15".

Apr 22  Last day of spring semester classes

Apr 25 – May 1  Final exam period; no exam for this course.

Due to the dynamic nature of this class, this syllabus is subject to revision as the semester proceeds. Announcements will be made on Carmen. Students are responsible for being aware of any changes.

V. Academic integrity. It is the responsibility of the Committee on Academic Misconduct to investigate or establish procedures for the investigation of all reported cases of student academic misconduct. The term “academic misconduct” includes all forms of student academic misconduct wherever committed; illustrated by, but not limited to, cases of plagiarism and dishonest practices in connection with examinations. Instructors shall report all instances of alleged academic misconduct to the committee (Faculty Rule 3335-5-487). For additional information, see the Code of Student Conduct http://studentaffairs.osu.edu/csc/

Title IX makes it clear that violence and harassment based on sex and gender are Civil Rights offenses subject to the same kinds of accountability and the same kinds of support applied to offenses against other protected categories (e.g., race). If you or someone you know has been sexually harassed or assaulted, you may find the appropriate resources at http://titleix.osu.edu or by contacting the Ohio State Title IX Coordinator, Kellie Brennan, at titleix@osu.edu.

VI. Communication: Students are responsible for announcements made in class, available on the course’s website or sent by e-mail. Late assignments will not be accepted without prearrangement with TA or instructor. Assignment due dates will be explicitly noted and followed, including turned in at the start of class or via Canvas at an assigned time.
VII. Disability Services.
The University strives to make all learning experiences as accessible as possible. If you anticipate or experience academic barriers based on your disability (including mental health, chronic or temporary medical conditions), please let me know immediately so that we can privately discuss options. To establish reasonable accommodations, I may request that you register with Student Life Disability Services. After registration, make arrangements with me as soon as possible to discuss your accommodations so that they may be implemented in a timely fashion. SLDS contact information: slds@osu.edu; 614-292-3307; slds.osu.edu; 098 Baker Hall, 113 W. 12th Avenue.