BIOL 403 – Microbial Ecology

General Course Syllabus (as of July 2020)

NOTE: BIOL 503 is the same as BIOL 403 microbial ecology, with the addition of an annotated bibliography assignment.

Course description
Microbes are all around us. The influence of microbes on the health of ecosystems and hosts is frequently in the media. This course covers concepts from ecological theory and helps students connect observed microbial patterns to expectations from theory. We will also introduce evolutionary theory and consider symbiotic interactions from the microbial perspective. Students practice being good scientists by developing their research skills and critical thinking skills that are the foundation of successful research. Students will develop critical reading skills through guided assignments reading primary literature, including: current microbial ecology papers, papers with flawed analyses or conclusions, controversial hypotheses and common misconceptions. In labs students will become familiar with data analysis of large microbial datasets in R. These datasets are mostly unpublished, and students will work with researchers that collected the data (students and postdocs at UBC). Labs will provide students with the tools to conduct a research project in microbial ecology, and project development will be a central theme of the course.

Course objectives
Upon successful completion of this course, you should be able to:

1. Apply fundamental principles of ecology to explain microbial distribution patterns
2. Develop conceptual models for the acquisition of symbionts on ecological and evolutionary timescales.
3. Appreciate microbial diversity and microbial contributions to host biology and ecological processes.
4. Analyze microbial community data, and implement appropriate statistical analyses to evaluate hypotheses.
5. Use available microbial community data to design and conduct a research project informed by fundamental principles of ecology.
6. Integrate findings from research project with previous results in scientific literature to critically assess hypotheses and draw inferences.

Text and Resources: There is no textbook for this course. Instead we will use scientific literature and other resources that will be posted on Canvas.

Assessment	% of Grade
Intellectual contributions (participation in class, lab, and preparation for group discussions)	15
Paper reading assignments	15
Research paper milestones	18
Final research paper	32
Laboratory assignments	20

Course policies
Intellectual contributions will be assessed at 85% for full marks (e.g., one lab and three classes can be missed for full marks). Late assignments will be penalized at 5% per day.
Academic dishonesty in any form will not be tolerated; this includes cheating and plagiarism. It is particularly important when working in groups to properly acknowledge all sources of information and ideas and to write in your own words. It is acceptable and expected that you will talk to classmates, get feedback on ideas, be inspired by other projects or approaches, share sources; science is collaborative. However, it is not ok to copy and paste or directly use the work of others. Code should also be written in your own words, and snippets of shared code need to be properly attributed to the class scripts, TA, or classmates. Err on the side of disclosing sources. Cases of academic dishonesty may result in a mark of zero for assignments and/or referral President's Advisory Committee on Student Discipline.

Research Project, Milestones, and Lab assignments
The overall aim for this course to help you become good scientists. Thus, assessment is centered on developing research skills and critical thinking skills that are foundation of successful research. To meet this objective, a large portion of the course will be focused on designing, conducting, and communicating a research project on an aspect of microbial ecology. Throughout the term there will be a series of milestones developing and refining portions of the research project with feedback from the teaching team and through peer review. The milestones and research project timeline are described in detail in the "Guidelines for Research Papers" document. Labs are mandatory and will help you develop the computational, analytical, and data management skills you need to conduct your research project and provide time for research. You will have a lab assignment each week on one aspect of these skills.

Intellectual contribution:
Regular peer feedback is one of the most important tools in science for developing and refining ideas and ensuring high quality final products. So, I expect full and engaged participation in class: I want you to argue, constructively criticize, praise, question and explore. In this course, it's ok to not know the answer at any given moment; but if you don't know something you should know, then I want you to learn it and report back. That's how science actually works.

Analysis of papers
We will critically analyze and discuss scientific papers throughout the course. You will be assigned the paper in advance and expected to read and analyze the paper prior to class. You will be provided with a rubric and guidance on how to approach analyzing the paper. As you read the paper, you will fill out a template with answers to some simple questions about the paper that will help you focus your reading. You will hand in your answers before class as a PDF on Canvas. Do not worry if you can't entirely understand the paper. The important thing is to demonstrate that you made a good attempt. In class we will work in groups to solidify understanding of the paper and articulate critiques of the authors approach, results (figure analysis) and interpretation of results.

Topics covered include:
1. Dominant processes in ecological community assembly
2. Broad patterns of microbial diversity, with inference about the processes that generate patterns
3. Core microbiome: How to identify and why the core is more likely to be functionally important to a host or ecosystem.
4. How to develop a hypothesis
5. Functional redundancy and evaluating explanations for this common pattern.
6. Methods for measuring biodiversity, and potential pitfalls

7. Theories for the evolution of host-microbe relationships, including debating controversial hypotheses.
8. Symbiosis as a spectrum from mutualist to pathogen
9. Mechanisms underlying host-microbe interactions
10. Examples of host-microbiome systems (Seagrass, plants, mammalian gut).
11. Potential applications of microbiome manipulation in health or agriculture.

Laboratory topics

Week	Topic
2	Sampling field trip and project brainstorm
3	Intro to R and tutorial.
4	Alpha diversity and collectors curves
5	Beta diversity: PERMANOVA and NMDS
6	Taxonomy plots
7	Developing a workflow script
8	Differentially abundant taxa (DESeq)
9	Project work
10	Indicator species and core taxa
11	Project work
12	Project work

University Policies:

UBC provides resources to support student learning and to maintain healthy lifestyles but recognizes that sometimes crises arise and so there are additional resources to access including those for survivors of sexual violence.
UBC values respect for the person and ideas of all members of the academic community. Harassment and discrimination are not tolerated nor is suppression of academic freedom.
UBC provides appropriate accommodation for students with disabilities and for religious, spiritual and cultural observances.
UBC values academic honesty and students ae expected to acknowledge the ideas generated by others and to uphold the highest academic standards in all of their actions.

Details of the policies and how to access support are available on the UBC Senate website.