

UO Honors College: Introduction to Mammalian Microbiomes.

Instructor: Dr. Sue (Ishaq) Pellegrini

Draft syllabus, 12/16/2018

Course Objectives:

1. Introduce students to basic concepts, techniques, historical background, terminology, and technology of microbial ecology.
2. Familiarize students with online resources, including sequence and other databases, as well as analysis tools.
3. Discuss how host-associated microbiomes are shaped by the anatomy and lifestyle of the host, and how the microbiome can reflect onto the host.
4. Review current literature on host-associated microbial ecology.

Class format: In-class lectures will be used to introduce background information and basic concepts, largely in the first half of the class period, followed by guided discussions.

Readings: All reading material will be provided as journal articles online and will reflect current literature in host-associated microbial ecology. Students will be required to read more basic reading before class, and more detailed or technical reading after class, per each lecture.

Homework: Homework will be assigned regularly and may be submitted online or in class. These will include written essays/discussion, “posters”, article reviews, drawn concept network maps, or will involve exploration of microbial ecology online resources such as databases (ex. NCBI, MG-RAST, GRC. Some of the homework will be used to create portions of the final project.

(HW subset) **Article Summaries:** Summarize a journal article (scientific, review, or perspective/opinion ok) on a recent class topic in 1-2 paragraphs. You may use an article from class or of your own choosing, be sure to include the citation. You must summarize the background/hypothesis, at least one method, and the main results in simplified language so that a member of the general public could follow it. For extra credit, post your corrected assignment and link to the original article to a social media site and send me a link or screen shot.

Take Home Exams: essay-style exam will be used to test comprehension of the lectures and homework readings

Final Project:

Solo version: Students will create a public outreach presentation in the format of their choice: written essay (1 pg), pamphlet or poster, presentation (5 min), etc. If choosing the pamphlet, poster, or presentation, IN ADDITION, students must submit a long-form description of their topic, approximately 1/2 page (not including citations). The aim is to discuss a particular aspect, ecosystem, problem, or unanswered question in host-associated microbiomes, and to present it in a way that would promote scientific literacy to the general public. Students may use material they generated in assignments or take home exam, but you may not submit it these in the exact same format – you will need to rewrite them in some way. Students will be graded on the quality of information, the creativity of the presentation, and the effectiveness of their communication.

Group version: Students may opt to work in groups of up to three, to generate a short manuscript-style written submission, with the goal of submitting this manuscript to Frontiers for Young Minds under the Biodiversity designation as a Core Concept: <https://kids.frontiersin.org/specialties/biodiversity>. Your final project submission should follow journal guidelines: <https://kids.frontiersin.org/participate/authors>. Students who opt for this final project will be main authors on this publication, and I will be last author, as I will facilitate editing and submission.

Grading: Discussion in class: 15pts, Homework: 30pts, Take Home Exam: 30pts, Final Project: 25pts

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Lecture Schedule:

Date	No.	Title, Objective, Assignments
	Intro	Introduction to the course, explanation of the syllabus and course expectations, finding course materials, troubleshooting technical difficulties.
<u>Introduction to Microbial Ecology Theory and Technology</u>		
	# 1	<i>"Who's there? Major players in the microbial world."</i> An overview on different microorganisms. <ul style="list-style-type: none">➤ Discussion: role of scientists in communicating science➤ Reading: Gilbert_2014_life in a world without microbes➤ Reading: Caumette_2015_Historical elements of microbial ecology, section 2.1 and 2.3
	# 2	<i>"A brief history on the discovery of microorganisms."</i> The discovery of microorganisms, a historical perspective on microbial ecology, the development of microbial theories, and a look at environmental selection. <ul style="list-style-type: none">➤ Discussion: Elitism, recognition, and credit for intellectual property➤ Reading: Prosser_2007_ ecological theory in microbial theory➤ Reading: Caumette_2015_Historical elements of microbial ecology, section 2.3 onwards➤ Assignment (3pts): Learn to use NCBI, due 10/1 by midnight. Instructions on Canvas.
	# 3	<i>"DNA technology and how it changed our view of the world"</i> A historical perspective and explanation of DNA technology. <ul style="list-style-type: none">➤ Due: Learn to use NCBI, due by midnight➤ Reading: Clarridge_2004_16S and clinical microbiology, up to "Basics of sequencing"➤ Video prep for next class: https://www.youtube.com/watch?v=MvuYATh7Y74➤ Assignment (3pts): Article Summary, due 10/3 by midnight
	# 4	<i>"Sequencing technology and how it revolutionized microbial ecology"</i> Explanation of current sequencing technology and technical comparisons thereof, with discussion on how different platforms have different applications. Explanation whole-genome sequencing and gene annotation with KEGG, COG, etc. <ul style="list-style-type: none">➤ Due: Article Summary, due by midnight➤ Reading: Clarridge_2004_16S and clinical microbiology, "Basics of sequencing" to "clinical microbiologist's dilemma"➤ Assignment (3pts): Learn to use MG-RAST, due 10/8 by midnight. Instructions on Canvas.
	# 5	<i>"An introduction to phylogeny and bioinformatics, the concept of species and how our understanding of diversity is changing"</i> Explanation of phylogenetics, how to calculate and interpret genetic diversity, and the discussion of what constitutes a species. <ul style="list-style-type: none">➤ Discussion: how do we describe a microbial community?➤ Due: Learning to use MG-RAST, due by midnight➤ Reading: Clarridge_2004_16S and clinical microbiology, "clinical microbiologist's dilemma" to end➤ Reading: de Queiroz_2005_ modern concept of species➤ Assignment (3pts): make a concept map on microbial ecology and technology following the examples provided on Canvas. Due 10/10 IN CLASS.
	# 6	<i>"Other methods of profiling microbial communities"</i>

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		Information on other microbial profiling techniques, include cell stains, biomarkers, flow cell, FISH and fluoroscopy, SEM/TEM, RAMAN. <ul style="list-style-type: none">➤ Due: concept map on microbial ecology, due in class➤ Reading: Valm_2012_CLASI-FISH➤ Take Home Exam (15pts): directions on Canvas, due 10/17 online
Digestive Tract Ecosystems		
	# 7	<i>"The oral microbiome"</i> <ul style="list-style-type: none">➤ Reading: Proctor_2017_nose mouth throat➤ Video prep for next class: https://www.niddk.nih.gov/health-information/digestive-diseases/digestive-system-how-it-works
	# 8	<i>"Monogastrics, ceca, and intestines"</i> <p>Anatomy of the intestines and the gut microbiome of monogastrics.</p> <ul style="list-style-type: none">➤ Due: Take Home Exam, due by midnight➤ Reading: Clayton_2016_captivity primate microbiome➤ Reading: Moeller_2014_human gut microbiome
	# 9	<i>"Ruminants- bacteria"</i> <p>The rumen bacterial community, and overview of its importance to the herbivore.</p> <ul style="list-style-type: none">➤ Discussion: wild, captive, and domestic and the impact on native gut microbes.➤ Reading: Review in preparation, Garcia-Marcorro_DRAFT_Saccharomyces (Canvas).➤ Reading: Henderson_2015_core rumen microbiome, up to "associations between rumen microbes"➤ Assignment (3pts): Choose a ruminant species discussed in Henderson et al. 2015 and summarize results in a paragraph, due 10/24 by midnight
	# 10	<i>"Ruminants- fungi, protozoa, and archaea, as well as the effects of acidosis"</i> <p>Bacteria aren't the only members of the gut community.</p> <ul style="list-style-type: none">➤ Discussion: ruminant physiology and global animal production➤ Due: ruminant summary, by midnight➤ Reading: Henderson_2015_core rumen microbiome, "associations between rumen microbes" and "Methods"➤ Assignment (3pts): Come up with a 3-sentence elevator speech, deliver next class
	# 11	<i>"Horizontal and vertical transmission of microbes"</i> <p>Breastmilk and the development of the neonate GI microbiome, Discussion of horizontal and vertical transmission of microbes.</p> <ul style="list-style-type: none">➤ Due: Give rapid-fire elevator speeches.➤ Video: Yeoman et al. 2018: https://sueishaqlab.org/2017/08/11/presentation-on-maternal-influences-on-the-calf-digestive-tract-from-jam-2016-available/➤ Reading: Yeoman_2018_effect of colostrum on calf rumen
	# 12	<i>"Host-microbe interactions in the gut."</i> <p>GI tract microbiome and medication efficacy, interactions with epithelia and immune system, and hygiene.</p> <ul style="list-style-type: none">➤ Discussion: should we eat dirt?➤ Reading: Liu_2007_Hygiene hypothesis and asthma➤ Reading: Scudellari_2017_cleaning up hygiene hypothesis➤ Assignment (3pts): Article Summary, due 11/5 by midnight
	# 13	<i>"Effect of diet on the gut microbiome"</i> <ul style="list-style-type: none">➤ Due: Article Summary, due by midnight

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		<ul style="list-style-type: none">➤ Reading: Singh_2017_influence of diet➤ Assignment (3pts): make a concept map following the examples provided on Canvas. Due 11/7 IN CLASS.
	#14	<p><i>“Probiotics, prebiotics, and synbiotics”</i></p> <p>A look at what these are, federal regulations, assessment of efficacy.</p> <ul style="list-style-type: none">➤ Discussion: ethical concerns of probiotics and fecal-microbial transplant➤ Due: concept map, due in class➤ Reading: Gupta_2016_FMT in perspective➤ Take Home Exam (15pts): directions on Canvas, due 11/14 online
Skin and Vaginal Ecosystems		
	# 15	<p><i>“Factors driving the skin microbiome, and discussion of trouble with primers”</i></p> <ul style="list-style-type: none">➤ The shift to using the 16S rRNA V3-V4 region has come with some problems, including primers that don’t amplify <i>Propionibacterium</i>- one of the primary members of skin.➤ Reading: Kong_2017_skin microbiome➤ Reading: RodriguesHoffman_2014_skin microbiome dogs
	# 16	<p><i>“Humans and microbiology of the built environment”</i></p> <ul style="list-style-type: none">➤ Due: Take Home Exam, due by midnight➤ Reading: Meadow_2014_classroom surfaces human contact➤ Assignment (3pts): Article Summary, due 11/19 by midnight
	# 17	<p><i>“Vaginal microbiome, metabolome, and birth mode”</i></p> <p>The vagina and some surprising studies on smoking.</p> <p>A discussion on conflicting studies regarding the effect of birth method on the developing microbiome of infants, and the importance of longitudinal studies for health outcomes.</p> <ul style="list-style-type: none">➤ Discussion: does birth mode matter and should we have neonatal probiotics?➤ Reading: Neu_2011_birth mode hygiene hypothesis➤ Assignment (5pts of final project): Turn in an outline/description of your final project, about 1 paragraph of text or outline of slides. Due 11/21 by midnight
Lung Ecosystem		
	# 18	<p><i>“Lung microbiome and the difficulty of sampling.”</i></p> <p>Discussions on the lung microbiome and a cautionary tale of making assumptions about a place you can’t actually get to.</p> <ul style="list-style-type: none">➤ Due: Outline of final project, due by midnight➤ Reading: Dickson_2015_lung microbiome➤ Blog: https://blog.education.nationalgeographic.org/2017/12/07/talking-evolution-the-challenge-of-influenza-part-1/amp/?_twitter_impression=true➤ Blog: https://blog.education.nationalgeographic.org/2017/12/08/talking-evolution-the-challenge-of-influenza-part-2/➤ Assignment (3pts): Article Summary, due 11/26 by midnight
	# 19	<p><i>“Environmental Microbes and Health”</i></p> <p>A look at how environmental microbial diversity influences health, air quality, and how to improve our environmental microbial exposures. Cloud microbiomes, and transmission of epidemics in dust.</p> <ul style="list-style-type: none">➤ Discussion: air quality, city planning, and income inequality➤ Due: Article summary, due by midnight➤ Reading: Ege_2011_env microbes and childhood asthma➤ Reading: Griffin_2007_desert dust and human health

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	#20	➤ “Now what? Where the field of host-associated microbiomes is headed, and relevant careers.”
	Exam period	➤ Final Project Due, hand in materials or give presentation (see Final Project Description)