Course Syllabus

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ENV H 409/509

Microbiome and Environmental Health

Spring Quarter, 2019, 3 credits

Tuesday and Thursday, 2:30 – 3:50 PM

Room: GNOM S060 (Foege)

INSTRUCTORS: Gerard A. Cangelosi

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OFFICE HOURS: By Appointment

COURSE DESCRIPTION:

This course will present and review the current science behind microbiome impacts on environmental public health. The course will define human and environmental microbiomes; describe the methods used to characterize these microbiomes, and discuss the impact of microbiomes on the health and well-being of human populations. The course will also examine factors that have been suggested to modulate microbial populations, host-microbe interactions, and the dynamics of microbiome populations. This course will be of use to public health and health care professionals, microbiologists, civil and environmental engineers, environmental scientists, and those generally interested in understanding the health relevance of news reports on the microbiome.

LEARNING OBJECTIVES:

On completion of this course, both undergraduate (409) and graduate (509) students will be able to:

1. Recognize and differentiate the composition of human and environmental microbiomes;
2. Discuss potential interactions between microbiomes;
3. Describe the role of sampling in microbiome studies;
4. Compare and contrast DNA/RNA sequencing approaches to characterize a microbiome;
5. Discuss bioinformatics approaches to characterizing microbiome and metagenome sequence data;
6. Explain the importance of metadata associated with a published microbiome;
7. Recognize and list functional roles of microbiome in a state of good health and well-being for humans;
8. Outline host-microbiome interactions and functional roles that impact health;
9. Identify and characterize specific disease states (chronic, environmental, and infectious disease) associated with microbiome composition or function;
10. Evaluate the weight of evidence to support connections between microbiome and health;
11. Identify and categorize intrinsic and extrinsic factors that modulate a microbiome;
12. Diagram the relationships between host, microbiome, and environmental factors.

In addition, graduate students (509) will be able to:

13. Critically assess and evaluate the literature on a topic of interest relevant to the course.
14. Synthesize the available research on a microbiome-related topic and develop a comprehensive review for a scientifically literate audience.

TEXTS AND REFERENCES: There is no required text book. Readings and course materials will be drawn from current research and new materials. All readings will be made available through the Canvas course site or handed out in class.

CLASS PARTICIPATION: Although students will not be graded on class attendance, students will be expected to participate in classroom discussion and in-class group learning activities for course credit.

COURSE FORMAT: Class periods will be dedicated to either interactive lectures or student-led discussions and group work. The course will be divided into 4 modules: 1) Characteristics of human and environmental microbiomes, 2) methods for analysis of human, animal, and environmental microbiomes, 3) the role of microbiome in human health (e.g. specific disease states, health optimization, drug metabolism, nutrient

availability, interaction with immune system), and 4) the impacts of the environment, diet, and other factors on modulating the microbiome.

GRADING: Numerical grades will typically be distributed according to the following scale:

%	GP	%	GP	%	GP
96%	4	86%	3	76%	2
95%	3.9	85%	2.9	75%	1.9
94%	3.8	84%	2.8	74%	1.8
93%	3.7	83%	2.7	73%	1.7
92%	3.6	82%	2.6	72%	1.6
91%	3.5	81%	2.5	71%	1.5
90%	3.4	80%	2.4	70%	1.4
89%	3.3	79%	2.3	69%	1.3
88%	3.2	78%	2.2	68%	1.2
87%	3.1	77%	2.1	67%	1.1
				66%	1

It is expected that most students will perform at a level of ~3.5.

Students Registered for ENVH 409: Points will be available according to the following percentage breakdown:

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Reading and Lecture Comprehension (20%): Each week students are responsible for writing one multiple choice question that is based on one of the lectures or reading materials for that week. Multiple choice questions should have 4-5 possible choices and only one correct answer. The correct answer should be indicated and a short explanation of why that answer is correct.

Module quizzes (20%): Students will have the opportunity to complete online end of module quizzes. Quizzes will consist of 3-5 questions that must be successfully answered to unlock readings for next module.

Midterm Exam (25%): A midterm exam (open book, online) will cover the first 10 lectures and will consist of multiple choice and true/false-explain questions.

Class Participation (10%): Class participation will be measured through Poll Everywhere questions (1-3 per lecture). Full credit will be obtained by submitting answers to at least 80% of the questions.

Final Exam (25%): A final exam will be offered on (6/11, 4;30-6:20, Location TBD). The exam will be comprehensive and will consist of multiple choice and true/false-explain questions. The exam will be open book and open note.

Students registered for ENVH 509 Points will be available according to the following percentage breakdown:

Reading Comprehension (10%): Each week students are responsible for writing one multiple choice question that is based on one of the lectures or reading materials for that week. Multiple choice questions should have 4-5 possible choices and only one correct answer. The correct answer should be indicated and a short explanation of why that answer is correct.

Module quizzes (20%): Students will have the opportunity to complete online end of module quizzes. Quizzes will consist of 3-5 questions that must be successfully answered to unlock readings for next module.

Class Participation (10%): Class participation will be measured through Poll Everywhere questions (1-3 per lecture). Full credit will be obtained by submitting answers to at least 80% of the questions.

Midterm Exam (20%): A midterm exam (open book, online) will cover the first 10 lectures and will consist of multiple choice and true/false-explain questions.

Critical Review (20%): Graduate students will have the opportunity to complete an in-depth (but focused), critical review of the literature on a specific topic relevant to the course. Topics must be approved by the instructors. The review will consist of a 10-page (single spaced, 10 pt Ariel font, 1/2 inch margins) manuscript on the chosen topic. Critical Reviews should show synthesis and evaluation of the peer reviewed literature. Manuscripts must be formatted consistent with the Applied and Environmental Microbiology instructions for authors for a minireview (**http://aem.asm.org/site/misc/ifora.xhtml (http://aem.asm.org/site/misc/ifora.xhtml)**).

Final Exam (20%): A final exam will be offered on (6/11, 4;30-6:20, Location TBD). The exam will be comprehensive and will consist of multiple choice and true/false-explain questions. The exam will be open book and open note.

CLASSROOM CLIMATE: The UW School of Public Health seeks to ensure all students are fully included in each course. We strive to create an environment that reflects community and mutual caring. We encourage students with concerns about classroom climate to talk to your instructor, your advisor, a member of the departmental or SPH Diversity Committee and/or the program director. **DCinfo@uw.edu (mailto:DCinfo@uw.edu)** is a resource for students with classroom climate concerns.

ACCESS AND ACCOMMODATIONS: Your experience in this class is important to me. If you have already established accommodations with Disability Resources for Students (DRS), please communicate your approved accommodations to me at your earliest convenience so we can discuss your needs in this course.

If you have not yet established services through DRS, but have a temporary health condition or permanent disability that requires accommodations (conditions include but not limited to; mental health, attention-related, learning, vision, hearing, physical or health impacts), you are welcome to contact DRS at 206-543-8924 or uwdrs@uw.edu or **disability.uw.edu (http://depts.washington.edu/uwdrs/)** . DRS offers resources and coordinates reasonable accommodations for students with disabilities and/or temporary health conditions. Reasonable accommodations are established through an interactive process between you, your instructor(s) and DRS. It is the policy and practice of the University of Washington to create inclusive and accessible learning environments consistent with federal and state law.

ACADEMIC INTEGRITY STATEMENT: Students at the University of Washington (UW) are expected to maintain the highest standards of academic conduct, professional honesty, and personal integrity.

The UW School of Public Health (SPH) is committed to upholding standards of academic integrity consistent with the academic and professional communities of which it is a part. Plagiarism, cheating, and other misconduct are serious violations of the University of Washington Student Conduct Code (WAC 478-120). We

expect you to know and follow the university's policies on cheating and plagiarism, and **the SPH Academic Integrity Policy (http://sph.washington.edu/students/academicintegrity/)**. Any suspected cases of academic misconduct will be handled according to University of Washington regulations. For more information, see the University of Washington Community Standards and Student Conduct website.

COURSE RULES:

1. Come to class, please try to let us know ahead of time if you cannot make it.
2. Arrive on time.
3. Turn in assignments on time.
4. Come to class prepared (keep up with reading).
5. Be courteous (no newspapers, no audible personal electronic devices).
6. Food and drinks are welcome (but keep it quiet).
7. Refrain from unnecessary talking.
8. ASK QUESTIONS.
9. Try to remain awake (at least no snoring please).
10. Let us know how I am doing. If we are moving too fast, not being clear, or otherwise not getting the message across, we need to know.

COURSE SCHEDULE (SUBJECT TO REVISION)

Date	Sess.	Topic	Reading	Instructor
		Module 1: What is a Microbiome?		
Tue 4/2	1	Introduction	**Frank et al.** Chapter 1 in The Human Microbiome (Ethical, Legal and Social Concerns)- The Human Microbiome: Science, History, and Research; **Betts and Shelton-Davenport**-New insights into microbiome study for environmental health	Cangelosi, Bumgarner

Thur 4/4	2	The Human Microbiome	**Gligorov et al.** Chapter 2 in the Human Microbiome (Ethical, Legal, and Social Concerns)- Personal Identity: Our Microbes, Ourselves; **Lloyd-Price et al** (2016). The healthy human microbiome. *Genome Medicine*, *8*, 51.	Cangelosi
Tue 4/9	3	Environmental Microbiomes	**Frank et al** Chapter 2 and 3 Microbiomes of the Built Environment.	Cangelosi
		Module 2: How to Characterize a Microbiome?		
Thur 4/11	4	High Throughput Sequencing Methods	**Van Dijk et al**- Ten years of next-generation sequencing technology; **Mardis**- Next-Generation Sequencing Platforms	Bumgarner
Tue 4/16	5	Sequencing Targets, Transcriptomics	• **Characterization of the Gut Microbiome Using 16S or Shotgun Metagenomics Jovel, et.al., Frontiers in Microbiology, 7:1-17(2016)** • **Interrogating the microbiome: experimental and computational considerations in support of study reproducibility, Poussin et. al., Drug Discovery Today 23(9),1644-1657(2018).**	Bumgarner
Thur 4/18	6	Molecular Biology Primer; Sampling, Preparation, and Extraction Methods	**Pollock et. al.** "The Madness of Microbiome: Attempting To Find Consensus “Best Practice” for 16S Microbiome Studies"	Bumgarner
Tue 4/23	7	Interpreting microbiome data – Software and methods for 16S (or other marker gene) analysis	**Nilakata et al** - A review of software for analyzing molecular sequences: Escobar-Zepeda Analysis of sequencing strategies and tools for taxonomic annotation: Defning standards for progressive metagenomics	Bumgarner
Thur 4/25	8	Practicum	Data analysis of selected data sets	Bumgarner

Tue 4/30	9	Interpreting shotgun metagenomics data	Comprehensive benchmarking and ensemble approaches for metagenomic classifiers	Bumgarner
		Module 3. Role of Microbiomes in Health		
Thur 5/2	10	The vaginal microbiome	**Vaneechoutte** -The human vaginal microbial community; Srinivasan et al. - Bacterial communities in women with bacterial vaginosis: high resolution phylogenetic analyses reveal relationships of microbiota to clinical criteria.	David Fredricks
Tue 5/7	11	Establishment, changes and stability of the human microbiome	**Blaser and Dominguez-Bello**, The Human Microbiome before Birth;Yatsunenko et.al - Human gut microbiome viewed across age and geography; Sinha et.al. - Quantification of Human Microbiome Stability Over 6 Months: Implications for Epidemiologic Studies	Bumgarner
Thur 5/9	12	Direct health effects - gut microbiome	**John and Mullin**- Gut microbiome and obesity; **Turnbaugh PJ.** Microbes and Diet-Induced Obesity: Fast, Cheap, and Out of Control. Cell Host Microbe. 2017 Mar 8;21(3):278-281	Cangelosi
Tue 5/14	13	The oral microbiome	**McLean** - Advancements toward a systems level understanding of the human oral microbiome;	Jeff McLean
Thur 5/16	14	Indirect health effecs - Toxin and Pharmaceutic Metabolism	**Klassen and Cui**- Mechanisms of How the Intestinal Microbiota Alters the Effects of Drugs and Bile Acids; **https://nas-sites.org/emergingscience/meetings/microbiome2/**	Cui
Tue 5/21	15	Indirect health effecs - Behavioral, Neurological, and Infectious Diseases	**Eisenstein**- Bacterial Broadband; **Emeran et al** - Gut Microbes and the Brain: Paradigm Shift in Neuroscience	Cangelosi

Thur 5/23	16	Indirect health effects – bile acid metabolism	TBD	Cui
		Module 4. What factors modulate the MIcrobiome		
Tue 5/28	17	Host factors	**Levy et al**-Metagenomic cross-talk: the regulatory interplay between immunogenomics and the microbiome; **Goodrich JK,** et al. Human genetics shape the gut microbiome. Cell. 2014 Nov 6;159(4):789-99. PMC4255478. **Velly H, et al.** Mechanisms of cross-talk between the diet, the intestinal microbiome, and the undernourished host. Gut Microbes. 2017 Mar 4;8(2):98-112. PMC5390823.	Cangelosi
Thur 5/30	18	Diet and Nutrition	**Biesalski**- Nutrition meets the microbiome: micronutrients and the microbiota;	William DePaolo
Tue 6/4	19	Impacts of global environmental change	**TBN**	Cangelosi
Thur 6/6	20	Wrap-up		Cangelosi, Bumgarner
Tue 6/11 4:30-6:20		Final Exam		

Course Summary:

Date	Details	
Tue Apr 2, 2019	**Reading Assignment, Session 1 (Introduction)** (https://canvas.uw.edu/courses/1290740/assignments/4714671)	due by 2:30pm

Date	Details	
Thu Apr 4, 2019	Reading Assignment, Session 2 (Human Microbiome) (https://canvas.uw.edu/courses/1290740/assignments/4714672)	due by 2:30pm
Tue Apr 9, 2019	Reading Assignment, Session 3 (Environmental Microbiomes) (https://canvas.uw.edu/courses/1290740/assignments/4714674)	due by 2:30pm
Wed Apr 10, 2019	Reading and Lecture Comprehension Assignment - WEEK 1 (https://canvas.uw.edu/courses/1290740/assignments/4714680)	due by 2:30pm
Wed Apr 17, 2019	Reading and Lecture Comprehension Assignment - WEEK 2 (https://canvas.uw.edu/courses/1290740/assignments/4714827)	due by 2:30pm
Thu Apr 18, 2019	Reading Assignment, Session 4 (High Throughput Sequencing Methods) (https://canvas.uw.edu/courses/1290740/assignments/4714676)	due by 2:30pm
	Reading Assignment, Session 5 (Molecular Biology Primer; Sampling, Preparation, and Extraction Methods) (https://canvas.uw.edu/courses/1290740/assignments/4714675)	due by 2:30pm
Sun Apr 21, 2019	Module 1 quiz (https://canvas.uw.edu/courses/1290740/assignments/4790102)	due by 11:59pm
Thu Apr 25, 2019	Reading Assignment, Session 8 (Bioinformatics Pipelines I - Data Management, Databases, Biopipeline frameworks, Assembly, Alignment) (https://canvas.uw.edu/courses/1290740/assignments/4714678)	due by 2:30pm
Fri Apr 26, 2019	Reading and Lecture Comprehension Assignment - WEEK 3 (https://canvas.uw.edu/courses/1290740/assignments/4714885)	due by 5pm
Wed May 1, 2019	Reading and Lecture Comprehension Assignment - WEEK 4 (https://canvas.uw.edu/courses/1290740/assignments/4714887)	due by 2:30pm
Thu May 2, 2019	Reading Assignment, Session 10 (Direct Health Effects - Gut Microbiome) (https://canvas.uw.edu/courses/1290740/assignments/4714662)	due by 2:30pm
Wed May 8, 2019	Reading and Lecture Comprehension Assignment - WEEK 5 (https://canvas.uw.edu/courses/1290740/assignments/4715711)	due by 2:30pm
Thu May 9, 2019	Reading Assignment, Session 12 (early life microbiomes, neurological effects, harmful algae blooms) (https://canvas.uw.edu/courses/1290740/assignments/4714664)	due by 2:30pm
Wed May 15, 2019	Reading and Lecture Comprehension Assignment - WEEK 6 (https://canvas.uw.edu/courses/1290740/assignments/4715783)	due by 2:30pm

Date	Details	
Thu May 16, 2019	Reading Assignment, Session 13 (Direct Health Effects - Other Microbiomes) (https://canvas.uw.edu/courses/1290740/assignments/4714665)	due by 2:30pm
	Reading Assignment, Session 14 (Indirect Health Effects - Toxin and Pharmaceutic Metabolism) (https://canvas.uw.edu/courses/1290740/assignments/4714666)	due by 2:30pm
Tue May 21, 2019	Reading Assignment, Session 15 (Population Health and One Health) (https://canvas.uw.edu/courses/1290740/assignments/4714667)	due by 2:30pm
Wed May 22, 2019	Reading and Lecture Comprehension Assignment - WEEK 7 (https://canvas.uw.edu/courses/1290740/assignments/4715787)	due by 2:30pm
Thu May 23, 2019	Reading Assignment, Session 16 (Diet and Nutrition) (https://canvas.uw.edu/courses/1290740/assignments/4714668)	due by 2:30pm
Tue May 28, 2019	Reading Assignment, Session 17 (Host Factors) (https://canvas.uw.edu/courses/1290740/assignments/4714669)	due by 2:30pm
Wed May 29, 2019	Reading and Lecture Comprehension Assignment - WEEK 8 (https://canvas.uw.edu/courses/1290740/assignments/4715795)	due by 2:30pm
Thu May 30, 2019	Reading Assignment, Session 18 (Environmental Factors) (https://canvas.uw.edu/courses/1290740/assignments/4714670)	due by 2:30pm
Wed Jun 5, 2019	Reading and Lecture Comprehension Assignment - WEEK 9 (https://canvas.uw.edu/courses/1290740/assignments/4715799)	due by 2:30pm
	Session 1 reading (https://canvas.uw.edu/courses/1290740/assignments/4714401)	
	Session 10: Thursday, May 2 (Fredericks) (https://canvas.uw.edu/courses/1290740/assignments/4715501)	
	Unnamed Quiz (https://canvas.uw.edu/courses/1290740/assignments/4792141)	