

Term Information

Effective Term Autumn 2021

General Information

Course Bulletin Listing/Subject Area Microbiology
Fiscal Unit/Academic Org Microbiology - D0350
College/Academic Group Arts and Sciences
Level/Career Graduate
Course Number/Catalog 7719
Course Title Microbiome in Health and Disease
Transcript Abbreviation Micrbm Hlth & Dis
Course Description This course is designed to introduce students to host-associated microbial communities (specifically human and animal hosts) and their roles in host health and disease.
Semester Credit Hours/Units Fixed: 2

Offering Information

Length Of Course 14 Week
Flexibly Scheduled Course Never
Does any section of this course have a distance education component? No
Grading Basis Letter Grade
Repeatable No
Course Components Lecture
Grade Roster Component Lecture
Credit Available by Exam No
Admission Condition Course No
Off Campus Sometimes
Campus of Offering Columbus

Prerequisites and Exclusions

Prerequisites/Corequisites None.
Exclusions Not open to students with credit for VETPREV 7719
Electronically Enforced No

Cross-Listings

Cross-Listings Cross-listed in VETPREV

Subject/CIP Code

Subject/CIP Code 26.0502
Subsidy Level Doctoral Course
Intended Rank Masters, Doctoral

Requirement/Elective Designation

The course is an elective (for this or other units) or is a service course for other units

Course Details

Course goals or learning objectives/outcomes

- Design a microbiome study and identify the strengths and limitations of varying study types
- Describe and identify strengths and weaknesses of in vivo, in vitro, and in silico techniques used for studying the microbiome
- Critically interpret microbiome data and communicate your critique constructively
- Apply, as relevant, key ecological concepts to microbiome study design and interpretation
- Identify and explain the potential and risks of microbiome-associated diagnostics and therapeutics

Content Topic List

- Introduction to the host-associated microbiome
- How do we study the host-associated microbiome?
- Microbial community acquisition
- Factors that shape the gut microbiome: Diet
- Other factors that shape the microbiome
- Microbial community dynamics
- Microbial interactions with the immune system
- The gut microbiome and metabolic disease
- Gastrointestinal pathogens and the gut microbiome
- Cancer and the microbiome
- Antimicrobial resistance in the gut microbiome
- The gut-brain axis
- Microbiota targeted therapies
- Clinical diagnostics / commercial profiling

Sought Concurrence

Yes

Attachments

- VETPREVMICRO7719-Syllabus[91].pdf: Syllabus
(Syllabus. Owner: Kwiek, Jesse John)
- Letter of Support VETPREV 7719.M7719.pdf: VETPREV concurrence to cross list
(Concurrence. Owner: Kwiek, Jesse John)
- LG_Map_M7719.pdf: M7719 objectives mapped to PLG
(Other Supporting Documentation. Owner: Kwiek, Jesse John)
- Cover_letter.docx copy.pdf: Cover letter
(Cover Letter. Owner: Kwiek, Jesse John)

Comments

COURSE REQUEST
7719 - Status: PENDING

Last Updated: Vankeerbergen, Bernadette
Chantal
02/26/2021

Workflow Information

Status	User(s)	Date/Time	Step
Submitted	Kwiek, Jesse John	02/26/2021 10:03 AM	Submitted for Approval
Approved	Kwiek, Jesse John	02/26/2021 10:03 AM	Unit Approval
Approved	Vankeerbergen, Bernadette Chantal	02/26/2021 01:30 PM	College Approval
Pending Approval	Jenkins, Mary Ellen Bigler Hanlin, Deborah Kay Oldroyd, Shelby Quinn Hilty, Michael Vankeerbergen, Bernadette Chantal	02/26/2021 01:30 PM	ASCCAO Approval



26 February 2021

RE: Microbiology 7719: Microbiome in Health and Disease

Dear Colleagues,

The Department of Microbiology would like to add a new course to our graduate program, Microbiology 7719: **Microbiome in Health and Disease**. This course is designed to introduce students to host-associated microbial communities (specifically human and animal hosts) and their roles in host health and disease. This course is currently offered as VETPREV 7719, so this proposal is to have an existing course cross listed in Microbiology (see Letter of Support from Chair Thomas Whittum). In the broader Microbiology Graduate program, the course serves as an elective, likely to be taken during the second year of graduate studies, and forms part of an emerging cluster of Microbiome-focused electives in our program (along with the computational-focused M8161). We thank you for your consideration.

Regards,

Jesse J. Kwiek
Associate Professor
Vice Chair for Teaching & Undergraduate Affairs
Department of Microbiology
476 Biological Sciences Building
484 West 12th Avenue, Columbus, OH 43210
kwiek.2@osu.edu; Phone: 614-292-3256; Fax: 614-292-8120

Microbiome in Health and Disease (VETPREV 7719/M7719)

Format: Seminar, 2 contact hours/week

Instructors

Dr. Vanessa L. Hale, Assistant Professor, Veterinary Preventive Medicine
Dr. Patrick Bradley, Assistant Professor, Microbiology

Dr. Vanessa Hale

Email: hale.502@osu.edu

Office: A196 Sisson Hall

Phone: 614-247-8377

Office Hours (Zoom or in-person): By appointment

Dr. Patrick Bradley

Email: Bradley.720@osu.edu

Office: 440A Biological Sciences

Phone: 614-292-2120

Office Hours: By appointment

Lecture time and location: TBD

Course Description: This course is designed to introduce students to host-associated microbial communities (specifically human and animal hosts) and their roles in host health and disease. We will focus heavily on the gut microbiome and will explore the interactions between host and microbes. We will also examine methodologies used to examine, predict, evaluate, or manipulate microbiota within the context of host health.

Course Objectives

- Design a microbiome study and identify the strengths and limitations of varying study types
- Describe and identify strengths and weaknesses of in vivo, in vitro, in silico, and analysis techniques used for studying the microbiome
- Critically interpret microbiome data and communicate your critique constructively
- Apply, as relevant, key ecological concepts to microbiome study design and interpretation.
- Identify and explain the potential and risks of microbiome-associated diagnostics and therapeutics.

Text: This course will be based on primary literature for which links and PDFs will be provided weekly. No other texts are required for this course.

Grading:

Assignment	Points	Percent
FINAL PROJECT: Study Design	25	25
Take home quiz 1	25	25
Critical Review of a Manuscript (GROUP, or individual if you opt out)	25	25
Take home quiz 2	25	25
Total	100	100

Letter Grade (Percent)	Points (out of 100)
A (90.0-100%)	90+
B (80.0-89.9%)	80-89.9
C (70.0-79.9%)	70-79.9
D (60.0-69.9%)	60-69.9

FINAL PROJECT - Study Design Project (1-2 pages, 25 points): Establish a scientific question involving a host-associated microbiome and design a study to answer that question. Explain why you chose this approach and the strengths and weaknesses of your approach. You have unlimited funding and may employ any method you see fit.

- Does the design answer the question effectively? (7 points)
- Are appropriate control groups and microbiome controls included? (3 points)
- Review another person's Study Design Project and provide critical feedback, questions, or suggestions for additional data or experiments that could be performed. (2 points)

- Final presentation should be engaging (e.g. include interactive questions, quizzes, scenarios, group work, games etc.). The presentation will be assessed on:
 - Background of topic (5 points)
 - Accurate presentation of strengths and weaknesses or controversies / barriers in relation to this topic (5 points)
 - Clarity of slides, oral delivery, methods to engage the class, ability to field questions, and appropriate references (3 points)
- A more detailed rubric will be provided for guidance.

Critical Review of a Manuscript (GROUP Project) (1-2 pages, 25 points): Provide a well-rounded review of a published manuscript including:

- A summary of the manuscript and its key value to the field and/or critical issues (2 points)
- Assessment of the following:
 - Does this paper provide a background context based on previous literature as well as clear goal / question? (3 points)
 - Is the design sound and does it address the outlined goal / question? (3 points)
 - Are the results clear, logical, displayed effectively? (3 points)
 - Do the conclusions follow appropriately from the results? If not, what further evidence is needed? (3 points)
 - Is the manuscript written clearly? If not, how could it be made more accessible? (3 points)
 - Are there any ethical concerns arising from the use of animals or human subjects in this work? (3 points)
- Manuscript options and a more detailed rubric will be provided for guidance.
- You will be placed into small groups of 2-3 unless you opt out to do this project individually.

Take home quizzes: There will be two take-home quizzes that will cover material from weeks 1-6 and weeks 6-12 (ranges are *inclusive*, meaning the first quiz includes week 6 and the second quiz includes week 12). Quizzes must be submitted by the *beginning* of the class in which they are due, listed below. Late quizzes will only be accepted with an approved excuse. While we highly encourage you to discuss the readings together, the quizzes should be completed by yourself. We suggest budgeting one hour per quiz.

Week	Topic	Assignments
1	Introduction to the host-associated microbiome <ul style="list-style-type: none"> • Host ecosystems (niches) • Oral • Gastrointestinal • Skin • Urogenital • Nasal / Respiratory 	Readings Lloyd-Price et al. 2017, Nature. “Strains, functions and dynamics in the expanded Human Microbiome Project.” https://www.nature.com/articles/nature23889
2	Methods - How do we study the host-associated microbiome? <ul style="list-style-type: none"> • Sample collection considerations • Sample storage / preservation • Sample extraction and controls • Review (covered in M5155) • Composition: 16S, metagenomes <ul style="list-style-type: none"> ○ Functional potential: metagenomes, putative function predictors 	Readings Sarangi et al. 2019, <i>J. of Clinical and Experimental Hepatology</i> . “Methods for Studying Gut Microbiota: A Primer for Physicians” https://www.sciencedirect.com/science/article/pii/S0973688318300604

	<ul style="list-style-type: none"> ○ Function: Metabolome, proteome, transcriptome ● Gnotobiotic models ● Single cell technologies ● Organoids ● Culture and co-culture ● Gut reactor models ● In-silico models 	
3	<p>Methods - How do we study the host-associated microbiome?</p> <ul style="list-style-type: none"> ● 16S / Metagenomic analyses ● Metabolomic analyses ● Correlation vs. causation ● Statistical analysis methods ● Longitudinal analyses 	<p>Readings: Knight et al., 2018. "Best practices for analysing microbiomes" https://www.nature.com/articles/s41579-018-0029-9</p>
4	<p>Microbial community acquisition</p> <ul style="list-style-type: none"> ● Primary and secondary succession ● Early colonization ● Post disturbance colonization ● What is healthy? ● Community stability / stable states 	<p>Readings: York, A. 2019. "<i>Microbiota succession in early life.</i>" <i>Nature</i>. https://www.nature.com/articles/d42859-019-00010-6 AND Option 1: Chen et al. 2020, <i>Microbiome</i>. "Maternal gut microbes shape the early-life assembly of gut microbiota in passerine chicks via nests" https://microbiomejournal.biomedcentral.com/articles/10.1186/s40168-020-00896-9 OR Option 2: Robertson et al. 2019, <i>Trends in Microbiology</i>. "The Human Microbiome and Child Growth – First 1000 Days and Beyond" https://www.cell.com/action/showPdf?pii=S0966-842X%2818%2930204-X</p>
5	<p>Factors that shape the gut microbiome: Diet</p> <ul style="list-style-type: none"> ● How does diet alter the microbiome? ● Co-evolution of hosts / microbial communities related to diet (e.g. seaweed degradation gene) ● Diet and disease (e.g. colorectal cancer, GI pathogens) 	<p>Readings: Hryckowian et al. 2018, <i>Nature Microbiology</i>. "Microbiota-accessible carbohydrates suppress <i>Clostridium difficile</i> infection in a murine model." https://www.nature.com/articles/s41564-018-0150-6 AND Gehrig et al. 2019, <i>Science</i>. "Effects of microbiota-directed food in gnotobiotic animals and undernourished children." https://science.sciencemag.org/content/365/6449/eaau4732 <u>Optional readings:</u> Chassaing et al. 2016, <i>Gut</i>. "Dietary emulsifiers directly alter human microbiota composition and gene expression ex vivo potentiating intestinal inflammation." https://gut.bmj.com/content/66/8/1414 Delsuc et al 2014, <i>Molecular Ecology</i>. https://www.zoology.ubc.ca/~parfrey/parfrey_lab/wp-content/uploads/2017/06/Delsuc_convergence_myrm_microbiome_2013.pdf Hehemann et al., 2012, <i>PNAS</i>. "Bacteria of the human gut microbiome catabolize red seaweed glycans with carbohydrate-active enzyme updates from extrinsic</p>

		<p>microbes.” https://www.pnas.org/content/109/48/19786.short</p>
6	<p>Other factors that shape the microbiome</p> <ul style="list-style-type: none"> • Host genetics • Age • Xenobiotics • Smoking • Chemical exposures (e.g pesticides, plastics) • Drugs (toxicity, activation, inactivation, side effects) • Chemotherapies 	<p>Due: Take-home Quiz 1 Readings: Koppel et al. 2018, <i>eLife</i>. “Discovery and characterization of a prevalent human gut bacterial enzyme sufficient for the inactivation of a family of plant toxins.” https://elifesciences.org/articles/33953 AND Wallace et al. 2015, <i>Chemistry & Biology</i>. “Structure and inhibition of microbiome beta-glucuronidases essential to the alleviation of cancer drug toxicity.” https://www.sciencedirect.com/science/article/pii/S1074552115003257 <u>Optional readings:</u> UIUC, News Bureau, 2020. “Environmental contaminants alter gut microbiome, health” https://www.sciencedaily.com/releases/2020/05/200521112605.htm#:~:text=%22Chemicals%20such%20as%20bisphenols%2C%20phthalates,associated%20with%20adverse%20health%20outcomes.%22 Freire et al. 2020, <i>Scientific Reports</i>. “Longitudinal Study of Oral Microbiome Variation in Twins” https://www.nature.com/articles/s41598-020-64747-1</p>
7	<p>Microbial community dynamics</p> <ul style="list-style-type: none"> • Type of interactions: parasitism, predation, competition, mutualism, commensalism, ammensalism • Keystone species • Predator/prey dynamics • How can community dynamics change in disease? 	<p>Readings: Smith et al. 2019, <i>Frontiers in Ecology and Evolution</i>. “The Classification and Evolution of Bacterial Cross-Feeding”. https://www.frontiersin.org/articles/10.3389/fevo.2019.00153/full OR Arevalo et al. 2019, <i>Cell</i>. “A reverse ecology approach based on a biological definition of microbial populations.” https://www.sciencedirect.com/science/article/pii/S0092867419307366</p>
8	<p>Microbial interactions with the immune system</p> <ul style="list-style-type: none"> • Immune development • Microbe-host signaling • Vaccine responses and the microbiome 	<p>Due: Critical Review of a Manuscript Readings: Hagan et al. 2020, <i>Cell</i>. “Antibiotics-Driven Gut Microbiome Perturbation Alters Immunity to Vaccines in Humans” https://www.cell.com/cell/pdf/S0092-8674(19)30898-0.pdf</p>
9	<p>Inflammatory Bowel Disease, Cancer and the microbiome</p> <ul style="list-style-type: none"> • Interactions between microbes and host cells and the immune system 	<p>Readings: Halfvarson et al. 2017, <i>Nature Microbiology</i>. “Dynamics of the human gut microbiome in inflammatory bowel disease” https://www.nature.com/articles/nmicrobiol20174 OR Wong & Yu 2019, <i>Nature Review Gastroenterology & Hepatology</i>: “Gut microbiota in colorectal cancer: mechanisms of action and clinical applications” https://www-nature-com.proxy.lib.ohio-state.edu/articles/s41575-019-0209-8</p>

10	<p>Distal effects of the microbiome: Cardiovascular disease and the gut-brain axis</p> <ul style="list-style-type: none"> • How do microbes shape host metabolism? • Microbe-host-neuron interactions • Role of microbes in behavior 	<p>Readings: Zhu et al. 2016. <i>Cell</i>. “Gut Microbial Metabolite TMAO enhances platelet hyperreactivity and thrombosis risk”: https://www.sciencedirect.com/science/article/pii/S0092867416301131#undfig1 AND Schmidtner et al. 2019, <i>Translational Psychiatry</i>. “Minocycline alters behavior, microglia and the gut microbiome in a trait-anxiety-dependent manner” https://www.nature.com/articles/s41398-019-0556-9</p> <p><u>Optional readings:</u> Reitmeier et al. 2020, <i>Cell Host & Microbe</i>: “Arrhythmic Gut Microbiome Signatures Predict Risk of Type 2 Diabetes”. https://www.sciencedirect.com/science/article/pii/S1931312820303437</p>
11	<p>Gastrointestinal pathogens and the gut microbiome</p> <ul style="list-style-type: none"> • Invasion, recovery • Susceptibility and colonization resistance (microbial and metabolic) • Gut microbial metabolites • Transmission • Asymptomatic carriage • FMT / Cdiff 	<p>Due: Topic for Final Project Readings: Litvak et al. 2018, <i>Cell Host & Microbe</i>: “Commensal <i>Enterobacteriaceae</i> Protect against <i>Salmonella</i> Colonization through Oxygen Competition” https://www.sciencedirect.com/science/article/pii/S1931312818306309 OR Mullineaux-Sanders et al. 2018, <i>Nature Microbiology</i>. “Sieving through gut models of colonization resistance” https://www.weizmann.ac.il/immunology/elinav/sites/immunology.elinav/files/2018_elinav_nature_micro.pdf</p>
12	<p>Strain variation and transfer</p> <ul style="list-style-type: none"> • Vertical transmission • Horizontal transmission • How to track transfer 	<p>Due: Take-home Quiz 2 Readings: Brito et al. 2019, <i>Nature Microbiology</i>. “Transmission of human-associated microbiota along family and social networks”: https://www.nature.com/articles/s41564-019-0409-6 OR Brooks et al. 2017, <i>Nature Communications</i>. “Strain-resolved analysis of hospital rooms and infants reveals overlap between the human and room microbiome”: https://www.nature.com/articles/s41467-017-02018-w</p>
13	<p>Microbiota targeted therapies</p> <ul style="list-style-type: none"> • Prebiotics / probiotics / synbiotics (for gut and skin) • FMTs • Phage therapy • CRISPER-Cas • Media vs. mechanistic science 	<p>Due: Final Project Presentations</p>
14	<p>Clinical diagnostics / commercial profiling</p> <ul style="list-style-type: none"> • What is on the market now – strengths and limitations 	<p>Due: Final Project Presentations</p>

	<ul style="list-style-type: none"> • Potential of microbiome profiling / metagenomics in clinical practice 	
--	---	--

Course and University Policies

Attendance and Participation: Attendance and participation are strongly encouraged.

Late Assignments: Late assignments will only be accepted with an approved excuse. If you are submitting an assignment that is or will be late, please inform us immediately to request approval for your submission.

Academic Misconduct: 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://studentlife.osu.edu/csc/>.

Mental Health: As a student you may experience a range of issues that can cause barriers to learning, such as strained relationships, increased anxiety, alcohol/drug problems, feeling down, difficulty concentrating and/or lack of motivation. These mental health concerns or stressful events may lead to diminished academic performance or reduce a student’s ability to participate in daily activities. The Ohio State University offers services to assist you with addressing these and other concerns you may be experiencing. If you or someone you know are suffering from any of the aforementioned conditions, you can learn more about the broad range of confidential mental health services available on campus via the Office of Student Life’s Counseling and Consultation Service (CCS) by visiting ccs.osu.edu or calling 614-292-5766. CCS is located on the 4th Floor of the Younkin Success Center and 10th Floor of Lincoln Tower. You can reach an on call counselor when CCS is closed at 614-292-5766 and 24 hour emergency help is also available through the 24/7 National Suicide Prevention Hotline at 1-800-273-TALK or at suicidepreventionlifeline.org.

Diversity: The Ohio State University affirms the importance and value of diversity in the student body. Our programs and curricula reflect our multicultural society and global economy and seek to provide opportunities for students to learn more about persons who are different from them. We are committed to maintaining a community that recognizes and values the inherent worth and dignity of every person; fosters sensitivity, understanding, and mutual respect among each member of our community; and encourages each individual to strive to reach his or her own potential. Discrimination against any individual based upon protected status, which is defined as age, color, disability, gender identity or expression, national origin, race, religion, sex, sexual orientation, or veteran status, is prohibited.

Harassment and Assault: 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.

Accessibility: 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.



February 25, 2021

Department of Microbiology
Ohio State University
Columbus, OH 43210

To Whom it May Concern,

I am writing in support of cross listing VETPRV 7719 and M7719. VETPREV 7719 (Microbiome in Health and Disease, 2.0 credit hours) is a course currently listed through the Department of Veterinary Preventive Medicine with Dr. Vanessa Hale as the course lead. Dr. Hale and Dr. Patrick Bradley in Microbiology have discussed co-teaching this course with equal contribution and launching the course in Fall 2021. They will bring complementary expertise and perspectives to the course, which will critically examine the role of the host-associated microbiomes in animal and human health and disease. This course will become part of the growing [Microbiome Science Training Track](#), which is recognized not only by the OSU Center of Microbiome Science but also nationally by the Microbiome Centers Consortium as a unique, cutting-edge curriculum that is unparalleled at other institutions.

Drs. Bradley and Hale are both Discovery Theme hires within the Infectious Diseases Institute, and this co-taught course embraces both the interdisciplinary and One Health aspects of microbiome science. This course would further offer opportunities for *collaboration and interdisciplinary endeavors* between trainees from different colleges, which is a value core to the Infectious Disease Institute. The cross-listing and co-teaching of Microbiome in Health and Disease (VETPREV 7719 / M7719) would be a strength for both departments and for the student learning experience.

Sincerely,

Thomas E. Wittum, PhD
Professor and Chair
Veterinary Preventive Medicine
Co-Director, Antimicrobial Resistance Program
OSU Infectious Diseases Institute

Mapping Microbiology 7719 Learning Goals to Ph.D. Degree Program Learning Goals

Microbiology Ph.D. Degree Program Learning Goals

PhD graduates of Microbiology should be able to:

1. Demonstrate a broad base of knowledge in several areas, including microbial physiology, genetics, biochemistry, and pathogenesis.
2. Demonstrate in-depth knowledge in an area of interest.
3. Make an original and substantial contribution to the field, as indicated by at least one first-author publication.
4. Effectively communicate science through oral and written presentations to both scientific and general audiences.

Microbiology 7719 Learning Outcomes Mapped to Ph.D. Degree Program Learning Goals

- Design a microbiome study and identify the strengths and limitations of varying study types **(PLG1, Intermediate)**
- Describe and identify strengths and weaknesses of in vivo, in vitro, in silico, and analysis techniques used for studying the microbiome **(PLG1, Advanced)**
- Critically interpret microbiome data and communicate your critique constructively **(PLG4, Intermediate)**
- Apply, as relevant, key ecological concepts to microbiome study design and interpretation. **(PLG1, Advanced)**
- Identify and explain the potential and risks of microbiome-associated diagnostics and therapeutics. **(PLG1, Intermediate)**