**ANIMSCI 5090 – Gut Microbiology**

7 WK Session 1 of each Spring semester; TuTh, 1:00 – 2:50 pm, 210 Animal Sciences Bldg.

2 Credits

**COURSE DESCRIPTION**

This course will provide students the opportunities to learn about the major microorganisms of the gastrointestinal tract of animals and humans, their metabolism and functions, interactions with each other and with hosts, and impact on host nutrition and health. Contemporary research technologies, including metagenomics, metatranscriptomics, bioinformatics, and metabolomics, will also be taught. Furthermore, students will develop skills to solve problems and design research projects related to the gut microbiome.

**COURSE FORMAT:**

This course will use a hybrid delivery method of instruction; lectures will be delivered in-person as well as via video conference using Zoom.

**PREREQUISITES:** MICRO 4000.01 or 4000.02 or 4100, and BIOCHEM 4511, and GPA >2.0 in MICRO and BIOCHEM coursework, or permission of instructor.

**INSTRUCTOR:** Zhongtang Yu

Office: Room 110E, Animal Sciences Bldg.

Phone: 614-292-3057

Email: yu.226@osu.edu

Office Hours: Generally available, but please call or email to make an appointment

**LEARNING OBJECTIVES**

1. Gain knowledge on the common microbes indigenous to the intestinal tract of humans and animals

2. Understand the fundamental metabolism, especially catabolism, underpinning digestion of feed/food, and ecology of major guilds of gut microbes

3. Understand the interactions between host and gut microbes and how such interactions affect host nutrition and health

4. Understand the current research technologies (metagenomics, metatranscriptomics, metabolomics, and bioinformatics) and be aware of the research directions and needs in gut microbiology

Students are expected to achieve the above learning objectives by attending the lectures, reading chapters of the recommended readings and contemporary papers related to the topics covered in the class, and completing the design of a research project

**RECOMMENDED READINGS**

There is no required textbook, but students are asked to read select chapters of the following books that are highly relevant to the class.

1. The Physiology and Biochemistry of Prokaryotes, 4th ed. By David White, 2012. Web-E- Book (OSU Library call number: QR88.W48 2012eb). Oxford University Press, ISBN 1628701579.

2. The Human Microbiome Handbook. Ed. By J. Tetro and E. Allen-Veroe, 2016. DEStech Publications, Inc. ISBN: 978-1-60595-159-1.

3. The human microbiota and microbiome. by J. R. Marchesi, 2014, CABI, ISBN: 9781780640495. Web-E-Book (QR46 .H86 2014eb).

4. The Rumen Microbial Ecosystem, by P.N. Hobson, C.S. Stewart, Springer, 1997. Blackie Academic & Professional, ISBN-13: 9780751403664.

5. Bioinformatics and Data Analysis in Microbiology, ed.by Ö. T. Bishop. Caister Academic Press, 2014. ISBN: 9781908230737. Web-E-Book (QR60 .B56 2014eb).

**LECTURE TOPICS**

**Introduction: anaerobes and their unique ways of life**

* Cellular morphology and classification/taxonomy: review
* Anaerobic central metabolism
* Anaerobic way of life: Energy conservation
* Cultivation of anaerobic microbes

**Gut as a unique habitat for microbiota**

* The gastrointestinal tract as an environment for gut microbiota
* Early colonization of the gut
* The major/predominant taxa of gut microbes

**Microbial digestion of food and feed ingredients**

* Cellulose digestion and cellulolytic microbes
* Hemicellulose digestion and hemicellulolytic microbes
* Starch digestion and amylolytic microbes
* Carbohydrate fermentation pathways and fermentation products
* Protein digestion and proteolytic microbes
* Amino acid fermentation
* Lipid digestion and lipolytic microbes
* Fermentation profiles and shifts
* Fate and importance of fermentation products

**Research on gut microbiome: ~omics**

* Study subjects and model animals
* Sampling and nucleic acid extraction
* Metagenomics, metatranscriptomics, and metabolomics
* Bioinformatic and phylogenetic analysis of gut microbiota: QIIME2, PICRUSt2, databases, Multivariate analyses, data visualization and presentation.
* Quantification of individual taxa or groups of gut microbes

**Assignment: Design a research project on gut microbiome**

**Microbial interactions in the gut**

* Interaction among gut microbes
* Interaction between host and microbiota
* Dysbiosis and enteric diseases
* GI microbiome and extraintestinal health and diseases

**Manipulations of gut microbiota**

* Antimicrobials
* Prebiotics
* Probiotics
* Fecal microbiota transplantation

**Current research interest in gut microbiota**

* Animal gut microbiome
* Human gut microbiome

**Research needs and directions of the gut microbiome**

* Student presentation of study designs (presentations will start in the last two weeks of the class, with each class having several presentations before lecture).

**Final exam**

**EXAMINATION AND GRADING CRITERIA**

**Research project design**: 200 points

Each student is expected to write a short research proposal, which includes background information and hypothesis (40 points), specific objectives (10 points), rationales and significance (20 points), study design (60 points), and expected outcomes (20 points).

Each student will also prepare slides and present his or her study design in the class. Each presentation will be graded based on slides (10 points), presentation (30 points), and answers to questions (10 points).

**Final exam:** 200 points

The final exam is a comprehensive exam covering all the topics of the entire class.

Letter grades will be assigned according to the following percentage:

A: 93.0 - 100% C: 73.0 - 76.9%

A-: 90.0 - 92.9% C-: 70.0 – 72.9%

B+: 87.0 – 89.9% D+: 66.0 - 69.9%

B: 83.0 – 86.9% D: 60.0 - 65.9%

B-: 80.0 - 82.9% E: <60.0%)

C+: 77.0 – 79.9%

Make-up exam and presentation: There will be NO makeup exam or presentation except under extraordinary circumstances (e.g., illness). Well- documented justification (e.g., proof from doctors) will be needed for any make-up exam.

**University Policies**

**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. You are also welcome to register with Student Life Disability Services (SLDS) to establish reasonable accommodations. 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.

**Academic Misconduct:** Academic integrity is essential to maintaining an environment that fosters excellence in teaching, research, and other educational and scholarly activities. Thus, The Ohio State University and the Committee on Academic Misconduct (COAM) expect that all students have read and understood the University’s Code of Student Conduct and that all students will complete all academic and scholarly assignments with fairness and honesty. Students must recognize that failure to follow the rules and guidelines established in the University’s Code of Student Conduct and this syllabus may constitute “Academic Misconduct.”

The Ohio State University’s Code of Student Conduct (Section 3335-23-04) defines academic misconduct as: “Any activity that tends to compromise the academic integrity of the University, or subvert the educational process.” Examples of academic misconduct include (but are not limited to) plagiarism, collusion (unauthorized collaboration), copying the work of another student, and possession of unauthorized materials during an examination. Ignorance of the University’s Code of Student Conduct is never considered an “excuse” for academic misconduct. Thus, it is recommended that you review the Code of Student Conduct and, specifically, the sections dealing with academic misconduct. If the instructor suspects that a student has committed academic misconduct in this course, he is obligated by University Rules to report his suspicions to the Committee on Academic Misconduct.

If COAM determines that you have violated the University’s Code of Student Conduct (i.e., committed academic misconduct), the sanctions for the misconduct could include a failing grade in this course and suspension or dismissal from the University. If you have any questions about the above policy or what constitutes academic misconduct in this course, please contact me or visit oaa.osu.edu/coam/home.html.