Micro 6080: Advanced Microbial Genetics
3 credit hours
Spring 2020

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Class time: Wednesday, Friday 2:20-3:40

Class location: Jennings 136

Office hours: call, e-mail or ask before or after class to arrange an appointment.

Class format: Classes will meet in person and will be a mixture of lecture and discussion.

Course description: This 3-credit course will provide an up-to-date overview of molecular mechanisms of gene regulation and methodology used to address the outstanding questions in the field. We will discuss the key experimental techniques (both classic and emerging) used to investigate these mechanisms, focusing on their advantages and limitations. We will learn how to choose the one that suits your needs among these techniques and discuss research articles that use them to test a particular hypothesis or to conduct a broad survey of gene expression profiles.

Students enrolled in Micro 6080 are assumed to have a basic understanding of microbial genetics and molecular biology, at least to the level of Microbiology 4130. There is no required textbook. Most of the lecture material will be based on very recent journal (reviews and research) articles. Students are responsible for information given in class; pdf files of lecture slides will be made available in Canvas.

Course objectives: Upon successful completion of this course, students will be able to:

- Understand that modern microbial genetics is rapidly evolving to utilize novel experimental and computational approaches needed to address medical and environmental challenges.
- Describe general approaches used to study microbial systems and argue what advantages and disadvantages each approach has.
- Explain the principles of commonly used methods; understand the difference between analysis of global cellular responses and studies of a defined regulatory element.
- Design experimental approaches to address an outstanding question. Understand the utility of model systems and explain when their use is justified.
- Explain how studies of bacteriophages contributed to development of bacterial genetics.
- Understand sources of genetic diversity and control of genome integrity.
- Describe the steps in RNA synthesis and provide examples of protein factors and small molecule effectors that affect each of these steps.
- Distinguish common patterns of transcriptional control.

- Describe examples of specific and global regulators; highlight differences and similarities.
- Understand the diversity of regulators: accessory proteins, RNAs, metabolites, etc.
- Describe how different bacteria can use different strategies to control analogous pathways.
- Describe mechanisms of post-transcriptional control of different classes of RNAs.
- Understand the basic mechanism of protein synthesis, identify different steps and the key players in the process. Describe strategies that cells use to control translation in response to metabolic needs and environmental stresses.
- Understand that genome replication, DNA repair, and gene expression processes occur concurrently and are coordinately regulated.
- Distinguish different secretion systems in bacteria; explain how these systems are exploited by pathogens. Understand the pathways of genetic exchange in bacteria.
- Give examples of successful antibiotics and common mechanisms of antibiotic resistance.
- Explain different approaches used to identify new antimicrobial agents.

Assignments:

Midterm: an open-book in-class exam based on a recent research article (#5); the article will be provided a week in advance.

Final: a take-home exam that will be distributed a week in advance. It will test the students' understanding of the course concepts. **The final exam is due at noon of April 22, 2020**, preferably by email; late submissions will not be accepted except under extenuating circumstances.

Manuscript review: students will review a research manuscript; due in three weeks post-assignment.

Papers for discussion: We will discuss five research articles (#2, 3, 4, 8 and 9) in depth. Two students will lead the discussion, but everyone is expected to read each paper. A short introduction, typically beyond what is written in the paper, is expected. Major conclusions of the paper should be presented and outstanding open questions raised.

Debate: We will discuss two additional articles (#6 and 7) as a group. Two students will lead the discussion.

Answers to P1 questions: Each student will give a short (~10 min) presentation addressing one of the assigned questions about bacteriophage P1 (related to paper #1).

Grading: the final grade will be calculated from an **open-book midterm (25 %), take-home final (25 %), manuscript review (15 %); P1 answer (15 %) and class participation (20 %)**, using the following guidelines and a standard OSU scheme. The grades will not be curved.

A **(93-100 %)** Outstanding performance; exceptional depth of understanding of the material; in-depth understanding of the assigned paper.

A- **(90-92.9 %)** Better than expected performance; additional depth of understanding of course concepts; above-average understanding of the assigned paper.

B+ **(87-89.9 %)** Expected performance; solid understanding of course concepts and the assigned

paper.

B **(83-86.9 %)** Adequate performance; only a few gaps in understanding and in presentation of the assigned paper.

B- **(80-82.9 %)** Marginally acceptable performance; significant flaws in understanding of course concepts; poor presentation of the assigned paper.

C+ **(77-79.9 %)** Serious flaws in understanding of course concepts; poor presentation of the assigned paper.

C **(73-76.9 %)** Unacceptable performance; lack of understanding of course concepts and the assigned paper.

Grades below B- indicate very serious deficiencies and are almost unprecedented. If you feel that your performance in this class is poor and your background knowledge is insufficient, arrange a meeting with the instructor to find ways to correct the deficiencies.

Class policies

- Students should silence all mobile devices and refrain from texting and emailing while in class.
- The use of mobile devices to view class materials is expected and welcomed.
- If you need to miss a class, let the instructor know in advance, unless this is an emergency, and make sure that you review the class materials.

Accommodations and support:

Any student who feels they may need accommodation based on the impact of a disability should arrange an appointment with the instructor as soon as possible so that we can discuss the situation and make appropriate arrangements. Please contact the Office of Student Life Disability Services (614-292-3307) to discuss accommodation options (http://www.ods.ohio-stae.edu/).

The Ohio State University offers a range of services to assist students experiencing elevated stress levels. Students experiencing personal problems or situational crises are encouraged to contact Counseling and Consultation Service (CCS; ccs.osu.edu), which provides a range of free and confidential mental health services to students. 24 hour emergency help is also available through the National 24/7 Prevention Hotline at 1-800-273-TALK or atsuicidepreventionlifeline.org. In addition, Wellness Coaching (go.osu.edu/wellnesscoaching) is a free service provided by the Office of Student Life that takes an empowering, strength-based approach to building your capacity to face challenges and navigate life transitions.

Academic integrity:

Academic integrity is essential to maintain excellence in all educational and scholarly activities. The OSU Committee of Academic Misconduct (COAM; http://oaa.osu.edu/coam/home.html) expects that *"all students have read and understand 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 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), and copying the work of another student*."

If I suspect a student of academic misconduct, I am obligated by University Rules to report these suspicions to COAM. Violations of the Code of Student Conduct by COAM can lead to sanctions ranging from receiving a failing grade in the course to suspension or dismissal from the University. If you have any questions about what constitutes academic misconduct, please contact me directly.