Fall 9-1-2021

BIOM 450.01: Microbial Physiology

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Microbial Physiology (BIOM 450)
Autumn Semester, 2021

Meeting time: 11:00 – 12:20 TR
Meeting place: HS 411
Instructor: Dr. Patrick R. Secor
Office hours: By appointment
Office location: HS 513C
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Overview
Microbial physiology explores the life-supporting functions and processes that allow microbial cells to grow and reproduce. In this course, students will explore how the functions and processes allow microbes to occupy every niche on Earth, contribute to human health and disease, and are exploited for biotechnological and agricultural applications.

Exams and quizzes
There will be no high stakes midterm or final exams in this course. Instead, you will be given multiple lower-stakes quizzes on a weekly basis throughout the semester. Quizzes will be worth 20 points each and will be worth a total of **200 points. Quizzes will be assigned every Thursday and due each Tuesday**, unless otherwise noted in the schedule below or in class. The lowest quiz score may be dropped.

The format for quizzes will be variable and may include a combination of multiple choice, short answer, and essay questions. Some quizzes may be offered through Moodle. You may be asked to draw general diagrams, cellular structures, etc. During class, specific emphasis may be placed on things that will end up on a quiz. Attend class to hear what material will be emphasized.

Scientific communication
Communicating with the public, your employer, colleagues, and peers is an essential part of any scientific discipline or career. We will do this through the lens of microbial physiology. **Two hundred (200) points** will come from in-class and out-of-class scientific communication assignments. Each assignment will be worth 20 points. Late assignments will not be accepted (see sentence below for more on this). You may drop your lowest score. Assignments could be a targeted review of the scientific literature, a summary of recently published results, a summary of scientific seminars here at UM, and presentations to the class. You will participate in the peer review of some of your classmate's work. We will also set aside time to discuss plagiarism, scientific misconduct, misinformation, and other relevant topics. Full details of each assignment will be given to you during class time.

Writing assignments will accepted at the beginning of class as a hard copy, Word document, or Google doc. Presentations will be submitted as a PowerPoint file or Google Slides. Electronic files will be submitted to Patrick.secor@mso.umt.edu.

Lost laptops, corrupted files, or any other excuse for an electronic file not being turned in on time will not be accepted. Save backups to the cloud or email important documents to yourself.

Grading
Performance will be evaluated by a classical grading system of: A (90-100%); B (80-89%); C (70-79%); D (60-69%); F (<60%). Your percentage will be calculated based on the number of points earned from quizzes (200 pts) and scientific communication assignments (200 pts) out of a **total of 400 points**.

Preparation
Attending class is essential as lectures, current events, and peer review require discussion. Reading assigned materials **before** class is required. Recommended readings will also be offered. General Microbiology (BIOM 360) and six hours of Chemistry/Biochemistry are prerequisites for this course. *If you have not taken these courses you must obtain instructor approval.*

Textbook / Moodle / Resources
We will rely on the primary literature; no text book required. Course materials including PDFs of journal articles will be available to download on Moodle.

Accessibility Syllabus Statement:
The University of Montana assures equal access to instruction through collaboration between students with disabilities, instructors, and the Office for Disability Equity (ODE). If you anticipate or experience barriers based on disability, please contact the ODE at: (406) 243-2243, ode@umontana.edu, or visit www.umt.edu/disability for more information. Retroactive accommodation requests will not be honored, so please, do not delay. As your instructor, I will work with you and the ODE to implement an effective accommodation, and you are welcome to contact me privately if you wish.

Academic integrity policy
Academic misconduct will be reported and handled as described in UM's Student Conduct Code. All students must practice academic honesty. Academic misconduct is subject to an academic penalty by the course instructor and/or a disciplinary sanction by the University. All students need to be familiar with the UM Student Conduct Code, available online at:
http://www.umt.edu/vpesa/Dean%20of%20Students/default.php

Dropping courses
Dropping courses or changing grade status will strictly follow UM policies and procedures, which are described in the course catalog. Students cannot change to an audit after the 15th day of instruction. In addition, dropping the course or changing the grading status (to CR/NCR) are not automatically approved after the 30th day of the semester. These may be requested by petition, but the petition must be accompanied by documentation of extenuating circumstances. Requests to drop or change grading status to benefit a student's GPA will not be approved.

COURSE SCHEDULE*:

Date	*All dates and assignments are tentative and subject to change.
Week 1: Aug 31	Introduction, overview of basics, microbiology by the numbers.
Week 2: Sep 7	The essential ingredients for life: water, carbon, nutrient, and energy cycles **Tues Sep 7, writing assignment due beginning of class:** Write a few paragraphs (1 page) describing why water is essential to life.
Week 3: Sep 14	Respiration and redox chemistry: aerobic and anaerobic respiration **Thurs Sep 16: Writing assignment due beginning of class:** Write a brief (1-2 pages) review of respiration with an emphasis on how microbes use alternative terminal electron acceptors (i.e., not oxygen). Be sure to cite the primary literature.
Week 4: Sep 21	Respiration and redox chemistry: phenazines **Tuesday Sept 21: Summary due at beginning of class:** Sanders et al., Extracellular DNA Promotes Efficient Extracellular Electron Transfer by Pyocyanin in *Pseudomonas aeruginosa* Biofilms. *Cell Host and Microbe*, 2020
Week 5: Sep 28	**Tuesday Sept 28**: Discuss life as a graduate student with current UM PhD students (Dr. Secor out of town) **Thursday Sept 30: Choose a topic for your review paper, discuss with class, begin outlining.** This counts as a writing assignment. We will also discuss plagiarism and scientific misconduct.
Week 6: Oct 5	Microbial stress responses: Starvation and genetic logic circuits **Tuesday Oct 5: Summary due at beginning of class:** Boutte and Crosson, Bacterial lifestyle shapes stringent response activation, *Trends in Microbiology*, 2013
Week 7: Oct 12	**Tues Oct 12:** Microbial stress responses: DNA damage, microbial diversity, H-NS and prophage induction, antimicrobial tolerance vs resistance **Thurs Oct 14: In-class peer review of your draft review.** This is worth 20 points. Bring your draft to class printed out without your name (3 pages 12pt 1” margin double spaced minimum)
Week 8: Oct 19	Microbial corrosion **Tuesday Oct 19: Summary due at beginning of class:** A shallow water ferrous-hulled shipwreck reveals a distinct microbial community. Frontiers in Microbiology, *Frontiers in Microbiology*, 20 **Guest lecture, Thurs Oct 21**: Dr. Erin K Fields, U of Eastern Carolina

Week 9: Oct 26	Tripartite phage-host-microbe interactions. **Tuesday Oct 26: Summary due at beginning of class:** Bordenstein and Bordenstein, Eukaryotic association module in phage WO genomes from Wolbachia, *Nature Communications*, 2016 **Guest lecture, Thurs Oct 28:** Camilla de Mattos, PhD candidate, UM, Polyamines: Underappreciated molecules central to cellular life processes
Week 10: Nov 2	**Nov 2, Election Day. No class. Go vote.** **Guest lecture, Thurs Nov 4**: Lincoln Lewerke, PhD candidate, University of Washington. Microbial sociobiology—Quorum sensing biofilms, polymicrobial communities
Week 11: Nov 9	**Tues Nov 9: Summary of Lincoln's lecture due beginning of class.** Microbial sociobiology—The social lives of microbes Cheaters, Bacteriophage sociobiology **Thurs Nov 11 Veterans Day, no class**
Week 12: Nov 16	**Tues Nov 16, Summary due at beginning of class**: Millman et al., Bacterial Retrons Function In Anti-Phage Defense, *Cell*, 2020 Bacteria immune systems: CRISPR, Restriction modification, cGas-STING, Retrons, and more
Week 13: Nov 23	**Nov 24-26 Thanksgiving, no class.**
Week 14: Nov 30	Microbes in human health and disease **Guest lecture, Thurs Dec 2**: Dr. Jenny Wachter, Rocky Mountain Labs Lyme disease lecture

Week 15: Dec 7	**Tues Dec 7: Summary of Dr. Wachter's lecture due beginning of class.** Microbes in industry, biotechnology, and food **Wed Dec 10 last day of regular fall semester classes**
Week 16: Dec 13	**Finals week:** No class, no exam

Important dates for the 2021 fall semester:
https://www.umt.edu/registrar/calendar/autumn-2021.php

Learning outcomes

TOPICS	LEARNING OUTCOMES
Introduction / overview	–Professor and student introductions. –Familiarize students with course expectations, assessment tools, grading, and learning resources. –Revisit material students should already be familiar with.
Bacteriophage	–Learn basic phage terms –Understand phage lifecycles –Learn different strategies of replication –Learn the different outcomes of a phage infection –Understand how phages contribute to disease processes –Explain how bacteria and their phages influence human health and disease in the gut –Understand the importance of phages in our understanding of basic molecular biology principals
Microbial genetic regulation	–Learn basic feedback mechanisms –Compare repression versus induction –Learn how gene transfer can occur in bacteria –Understand how bacteria integrate new genetic material into existing genetic circuits without killing the cell
Quorum sensing and sociobiology	–Learn how bacteria coordinate group behavior and how this is important in: • Disease • Biotech • Environment –Appreciate that microbes are social creatures
Stress responses	–Learn how different stresses are handled by different microbes including stresses caused by: • Starvation • pH • Osmotic shift • DNA damage
Redox biology	–Understand the basics of redox chemistry –Learn how redox-active metabolites influence basic microbial functions and disease processes
Tripartite interactions	–Contrast commensalism, mutualism, parasitism –Survey microbial communities in various animals –Understand how commensals interact with host immune

	systems –Learn some of the ways that commensals are essential to some host processes –Discover what makes a microbe commensal vs a pathogen (what happens when your appendix bursts?)
Microbes in Biotech	–Be familiar with new and emerging technologies in the field and how microbiology was essential for their development
Antibiotic resistance mechanisms	–Discover how antibiotics kill bacteria and how antibiotic resistance emerges from susceptible bacterial populations –Contrast antimicrobial tolerance and resistance