

## **Microbial Physiology 11:682:503—spring 2019**

Instructor: Prof. Jeff Boyd

Email: [jeffboyd@SEBS.rutgers.edu](mailto:jeffboyd@SEBS.rutgers.edu)

Address:

Department of Biochemistry and Microbiology

Lipman Hall Room 122

76 Lipman Dr.

New Brunswick, NJ 08901

Office hour: Wednesday at 4 PM.

### **Format:**

Spring semester

Two 80-minute lectures per week. Tuesday and Thursday from 3:55-5:15 in FS-101

### **Course Description:**

Microbial Physiology is an intensive course with the goal of integrating biochemistry and genetics to enhance the understanding of the microbial cell and the robust and diverse nature of life. This course is intended to be a capstone class for the microbiology major. It will provide the instructors with the opportunity to re-address the learning goals of the microbiology major and address general scientific misconceptions before student graduation. This course is targeted to “advanced” juniors or seniors majoring in microbiology, biochemistry, biotechnology, and related fields, as well as graduate students.

Microbial physiology is a broad subject area and this course will attempt to provide a balance between the breadth of subjects addressed and the depth at which the subjects are discussed. The course has three overarching topics: 1. central metabolism and energy conservation, 2. macromolecular biogenesis and function and, 3. integration of metabolic events. The introductory lectures will address metabolic functions that are common to most organisms. The lectures will then progress to address metabolic functions that are the “exception to rule” to highlight the diversity of the microbial world. Students will learn about current events in the subject of microbial physiology and modern techniques used to examine metabolism. They will also learn about how the metabolic potential of micro-organisms has been harnessed to address problems facing society. Active teaching techniques, such as think-pair-share questions will be employed throughout the semester to aid in discussions, help improve student retention, assess student learning, and address common scientific misconceptions.

After completing this class, students will have the theoretical background and understanding of microbial physiology that is necessary to conduct microbiological laboratory research. It will also enhance the student’s ability to engage the public on microbiology issues.

**Basis for evaluation:**

-Three written examinations (350 points total): Two 100-point exams and one 150-point final exam. One-fourth to one third of the material covered in the final exam will be new material.

-In class participation (50 points): This includes attendance and participation in discussions on lecture topic. Each class missed without prior notification or a valid excuse will result in a 10-point deduction.

-Weekly literature summary (140 points): Every Thursday one or two primary literature article will be provide via the Sakai site. Typically, only one article will be provided, but if the articles are short and on the same subject two articles will be provided. Graduate students are required to read the article and write a succinct report about the article. The report should be between 400 and 800 words in length and include a brief background of the topic and a synopsis of the significance of the topic and findings. Note that the article summaries are a significant portion of your grade so take them seriously.

-Pre-proposal (100 points): An NSF style pre-proposal will be due Friday, May 4th. The topic of the pre-proposal will be: "Exploring the physiology of [my favorite microbe]." The proposal should: 1. provide background on the organism; 2. articulate the key question that you are asking and state your hypotheses; and 3. provide a brief description of your experimental approach. The pre-proposal should be between 3-5 pages in length. It is not necessary to elaborate on the materials and methods used.

-Extra credit (  $\leq 10$  points): Confusing topics questions (1 point per week for a total of 10 points). Students can submit an email to the instructor on or before Friday outlining areas of confusion from the topics that were covered in the lectures from that week. The instructor will re-address these topics prior to the start of the first lecture of the following week.

Two exams	200
One final exam	150
Weekly literature summary	140
Pre-proposal	100
In class participation	50

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Total 640 points (plus 10 possible extra credit points)

**Textbook and course material:**

The Physiology and Biochemistry and Prokaryotes by David White. Important note: this textbook is not required but could be used as a guild if students would like some additional reading material. If used, I would suggest purchasing the third or fourth edition which can be found used for a reasonable price. Lecture notes and readings will be posted on Sakai prior to individual classes, but lecture notes may be subject to

change before the lecture itself. The changes, if any, will not be drastic. The lecture notes and discussions in class will be the basis for evaluation.

**Short description for course catalog:**

Microbial Physiology is an advanced undergraduate course with the goal of integrating biochemistry and genetics to enhance the understanding of the microbial cell and the robust and diverse nature of life.

**Exam Dates**

Exam 1. February 18

Exam 2. April 2

Final Exam: to be announced

**Topic outline and Working syllabus:**

Please note that every class that has taken this course ends at a different section of the lecture notes. Therefore, the topics and sections are somewhat elastic and new material and subject could be discussed and added at any time. All of the topic below will be covered if time permits.

**Topics to be covered in Section one:**

What is life? What is a cell? What is physiology? Eukaryotic and Prokaryotic cell structure and function, thermodynamics and oxidation/reduction reactions, Chemiosmotic theory, proton motive force, Electrochemical energy, Respiration, ATP generation, Photosynthesis, Fermentation

**Topics to be covered in Section two:**

Central metabolism; glycolysis, TCA cycle, Entner-Doudoroff, Pentose Phosphate Pathway, beta-oxidation

**Topics to be covered in Section three:**

Nitrogen Cycles, Sulfur Cycle, Iron oxidation/reduction, acetogenesis, methanogenesis, C1 metabolism.

**Topics to be covered in Section four:**

locomotion, cellular adhesion, cell-to-cell communication, environmental sensing, physiological adaptation

**Academic Integrity**

This course will follow the Rutgers policy on academic integrity that was enacted on 10/2/2008. The policy states:

As an academic community dedicated to the creation, dissemination, and application of knowledge, Rutgers University is committed to fostering an intellectual and ethical environment based on the principles of academic integrity. Academic integrity is essential to the success of the University's educational and research missions, and

violations of academic integrity constitute serious offenses against the entire academic community. The principles of academic integrity require that a student:

- properly acknowledge and cite all use of the ideas, results, or words of others.
- properly acknowledge all contributors to a given piece of work. make sure that all work submitted as his or her own in a course or other academic activity is produced without the aid of impermissible materials or impermissible collaboration.
- obtain all data or results by ethical means and report them accurately without suppressing any results inconsistent with his or her interpretation or conclusions.
- treat all other students in an ethical manner, respecting their integrity and right to pursue their educational goals without interference. This requires that a student neither facilitate academic dishonesty by others nor obstruct their academic progress.
- uphold the canons of the ethical or professional code of the profession for which he or she is preparing.

Adherence to these principles is necessary in order to ensure that:

- everyone is given proper credit for his or her ideas, words, results, and other scholarly accomplishments.
- all student work is fairly evaluated and no student has an inappropriate advantage over others.
- the academic and ethical development of all students is fostered.
- the reputation of the University for integrity in its teaching, research, and scholarship is maintained and enhanced.

Failure to uphold these principles of academic integrity threatens both the reputation of the University and the value of the degrees awarded to its students. Every member of the University community therefore bears a responsibility for ensuring that the highest standards of academic integrity are upheld.

The University administration is responsible for working with faculty and students to foster a strong institutional culture of academic integrity, for providing effective educational programs that create an understanding of and commitment to academic integrity, and for establishing equitable and effective procedures to deal with allegations of violations of academic integrity. The faculty shares with the administration the responsibility for educating students about the importance and principles of academic integrity. Faculty members are expected to inform students of the efforts to minimize academic dishonesty, and to respond appropriately to violations of academic integrity. Faculty members are strongly encouraged to provide a statement concerning academic integrity and a link to the Academic Integrity Policy on their course syllabi.

Students are responsible for understanding the principles of academic integrity and abiding by them in all aspects of their work at the University. Students are also encouraged to help educate fellow students about academic integrity and to bring all alleged violations of academic integrity they encounter to the attention of the appropriate authorities.

To promote a strong culture of academic integrity, Rutgers has adopted the following honor pledge to be written and signed on examinations and major course

assignments submitted for grading: On my honor, I have neither received nor given any unauthorized assistance on this examination (assignment). In addition, students are required to take an online tutorial and pass an online examination on academic integrity in their first semester at Rutgers and to affirm periodically that they understand the Rutgers Academic Integrity Policy and will abide by it in all their academic work.