Microbiology 201: Molecular Biology of the Bacterial Cell
Harvard Medical School, Spring 2019

Tuesday and Thursday 10AM-12PM, NRB 1031

Course Description and Objectives: This course is devoted to bacterial structure, physiology, genetics, and regulatory mechanisms. The class consists of lectures and group discussions emphasizing methods, results, and interpretations of classic and contemporary literature.

Our goal is for students to be able to

- Understand mechanisms by which bacteria grow and divide
- Describe and evaluate classic and modern experimental approaches for probing bacterial biology
- Design and critically evaluate experimental studies
- Clearly communicate technical and conceptual aspects of experimental studies

Instructors: David Rudner (rudner@hms.harvard.edu, 432-4455), Thomas Bernhardt (thomas_bernhardt@hms.harvard.edu, 617-466-9851, Simon Dove (simon.dove@childrens.harvard.edu, 919-2888)

Curriculum Fellow: Deepali Ravel (deepali_ravel@hms.harvard.edu, 432-1871)

Office Hours: By appointment.

Assignments and Grading: Students will receive a letter grade for this course. Final grades will be based on the following components:

Problem sets (60%)
Students will complete three problem sets. Each will be worth 20% of the final grade.

Participation (40%)

Class participation will count 40% towards your final grade. It is also vital to the success of the course as a whole. Classes are always much more interesting, fun, and effective if there is active discussion. During the lecture portion of the class, we will ask a fair number of questions of you. We want to explore how things were discovered and get your thoughts on how you might have approached a particular problem had you been involved in the research.

During the paper discussions, we will randomly (via lottery) call on members of the class to come to the front of the room to present figures from the assigned readings. All participants (matriculated students and auditors) will have their names in the lottery. We strongly feel that one of the keys to success in science is the ability to effectively communicate ideas and results when you are in front of groups (large and small). The more practice you have at this the better. Before we get into the details of each paper we will first discuss the overall goals of the paper. Be prepared to describe the general questions being addressed by the paper and how the work fits into the context of the field at the time the study was performed.

You should organize your presentation of figures to the group as follows:

1) State the question being addressed or the goal of the particular experiment.

2) Explain the experimental set-up. What methods were used? How was the experiment performed? What were the important controls? A diagram of the set-up is often helpful to communicate what was done, so be prepared to sketch out the experimental set-up on the board if asked to do so.

3) Describe the experimental results. What was the key result?

4) Finally, explain what the authors concluded from the experiments and whether or not you agree and why. Are there alternative explanations? Are there controls missing that would strengthen the conclusion?

Once we finish presenting the figures, we will have a general discussion of the paper as a whole. Be prepared to discuss the general conclusions from the work, the broader implications of it, and what the next steps are in the line of investigation.

If you need to miss class, let the current lecturer and curriculum fellow know in advance. Absences in which you don't let us know (barring emergency), will result in a reduced participation grade. If you miss more than one class, you will be asked to write a 1-page (single-space) summary of the assigned papers your missed.

Note about auditing: Auditors are welcome but must obtain prior approval of the course director. Because class discussion forms the core component of the course, auditors are expected to complete course readings and actively participate in class discussions.

Learning Community:

Our goal is for this to be an open, collaborative, equitable, and inclusive learning community.

Community Standards
We acknowledge that the instructors, students, and authors of course materials all come to this course with their own diverse backgrounds and biases. Members of this class are expected to:
• share their own knowledge and perspectives
• value each other's opinions and communicate in a respectful manner
• approach the instructors if elements of the course content, instruction, or course participants are barriers to this being an inclusive learning environment

Accessibility
Harvard University complies with federal legislation for individuals with disabilities and offers reasonable accommodations to qualified students with documented disabilities and temporary impairments. To make a request for reasonable accommodations in a course, students must first connect with their local disability office. The primary point of contact for GSAS students is the Accessible Education Office (www.aeo.fas.harvard.edu). The HMS Director of Disability Services, Timothy Rogers (timothy_rogers@hms.harvard.edu) is another potential source of accommodation information for PhD students and is the primary contact for MD and master's students.

Accommodations are determined through an interactive process and are not retroactive. Therefore, students should contact their local disability office as soon as possible, preferably at least two weeks before accommodations are needed in a course. Students are strongly encouraged to discuss their access needs with their instructors; however, instructors cannot independently institute individual accommodations without prior approval from the disability office. Student privacy surrounding disability status is recognized under FERPA. Information about accommodations is shared on a need-to-know basis, and with only those individuals involved in instituting the accommodation.

Academic Integrity

All work in this course is governed by the academic integrity policies of GSAS (https://gsas.harvard.edu/codes-conduct/academic-integrity) and HMS (https://mastersstudenthandbook.hms.harvard.edu/409-academic-dishonesty-and-plagiarism). It is the students' responsibility to be aware of these policies and to ensure that their work adheres to them both in detail and in spirit. Unless otherwise specified by the instructor, the assumption is that all work submitted must reflect the student's own effort and understanding. Students are expected to clearly distinguish their own ideas and knowledge from information derived from other sources, including from collaboration with other people. If you have a question about how best to complete an assignment in light of these policies, ask the instructor for clarification.

Academic and other Support Services
We value your well-being and recognize that as a graduate student you are asked to balance a variety of responsibilities and potential stressors: in class, in lab, and in life. If you are struggling with experiences either in- or outside of class, there are resources available to help. Jackie Yun, the GSAS Director of Student Services (617-495-5005) is available to assist students navigating academic or personal difficulties and to connect students to university resources. HILS PhD students have access to free academic tutoring which can be arranged through the DMS office. A variety of academic support services are also available to GSAS students through the Bureau of Study Counsel (https://bsc.harvard.edu/) and the Center for Writing and Communicating Ideas (https://gsas.harvard.edu/center-writing-and-communicating-ideas).

Also, **all students have access to Counseling and Mental Health Services** (CAMHS) available in Longwood, Cambridge or remotely via webcam or phone. The use of CAMHS is included in the student health fee, regardless of insurance, at no additional cost. More information is available at https://camhs.huhs.harvard.edu or by calling the main office at 617-495-2042. Urgent care can be reached 24/7 at 617-495-5711.

Micro 201 Key Concepts List

Below is a list of information and concepts with which we think you should be familiar at the start of this course to get the most out of it. If you need a refresher in any of these areas you can consult a biology textbook, research them on-line, or attend a supplemental lecture given by the course Curriculum Fellow, Deepali Ravel. This lecture will be held during the 2nd week of the course at a time TBD.

- Eukaryotes vs. Prokaryotes
- Basics of a growth curve: Optical Density (OD), log-phase, lag-phase
- How does DNA get into the bacterial cell?
  Transduction vs. Transformation vs. Conjugation
- Plaque vs. Colony
- Anatomy of a bacterial gene:
  promoter (-10 and -35 elements), +1, ribosome binding site, translational start site, terminators
- Operon structure
- Translationally coupled genes
- Coupled transcription-translation

Course schedule (subject to change):

01/29	**Class 1:** (Bernhardt)	**Protein Secretion and the Sec system**
01/31	**Class 2:** (Bernhardt)	**The cell envelope and lipoprotein transport**
02/05	**Class 3:** (Bernhardt)	**Envelope stress responses**
02/07	**Class 4:** (Bernhardt)	**Peptidoglycan and cell shape determination**
02/12	**Class 5:** (Bernhardt)	**Cell division and its control**
02/14	**Class 6:** (Bernhardt)	**Cell motility and trans-envelope machines**
02/19	**Class 7:** (Bernhardt)	**Oxidative stress and metal homeostasis**
02/21	**Class 8:** (Bernhardt)	**Phage vs. Host Transcription and its regulation**
	(problem set handed out)	
02/26	**Class 9:** (Rudner)	**DNA replication and its control**
02/28	**Class 10:** (Rudner)	**Plasmids and their segregation**
03/05	**Class 11:** (Dove)	**Transcription and its regulation**
03/07	**Class 12:** (Dove)	**Transcription and its regulation continued**
03/12	**Class 13:** (Rudner)	**Chromosome organization/segregation**
03/14	**Class 14:** (Rudner)	**Recombination/Repair and the SOS-response**
	SPRING BREAK	
03/26	**Class 15:** (Rudner)	**Toxin-antitoxin (TA) systems**
03/28	**Class 16:** (Rudner)	**Cell-cell Signaling**
04/02	**Class 17:** (Rudner)	**Checkpoints**
04/04	**Class 18:** (Rudner)	**Development**
	(problem set handed out)	
04/09	**Class 19:** (Ravel)	**Protein folding and protein quality control**
04/11	**Class 20:** (Dove)	**Trans-translation and protein degradation**
04/16	**Class 21:** (Dove)	**RNA degradation**
04/18	**Class 22:** (Dove)	**Small RNAs**
04/23	**Class 23:** (Dove)	**Small RNAs continued**
04/25	**Class 24:** (Dove)	**Second Messengers**
04/30	**Class 25:** (Dove)	**Bistability and phase variation**
	(problem set handed out)	