BIOL 4608/6608: Prokaryotic Molecular Genetics

Fall Semester 2014MWF 11:05-11:55 AM Location: CE 204

Instructor

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Overview

If you are interested in the history, mechanisms, and application of bacterial genetics, then this class is for you. I have designed my course to convince you that the study of bacteria is not something of the past, but rather a vibrant and important field today that continues to inform research in many areas. Prokaryotes serve as model systems for understanding cellular functions common to more complex organisms. Much of our understanding of the genetic code, inheritance, transcription, translation and gene regulation has been revealed by studying bacteria. In the first half of the course we will discuss many of these fundamental molecular mechanisms uncovered by historical and current discoveries. Bacteria are also interesting in their own right! They perform an incredible array of activities on our planet: as essential participants in Earth's ecology, as cellular factories for useful product production, as beneficial inhabitants of our own bodies, and also as causative agents of many diseases. In the latter half of the course we will integrate the principles learned in the beginning of the course to reveal elegant regulatory networks used by bacteria to sense and respond to their surroundings and accomplish such diverse tasks. Finally, my goal for this course is to illustrate in an engaging and informative manner how scientific progress advances… by people building on what is known and moving science forward step by step.

Prerequisites

Genetics (BIOL 2344) or Honors Genetics (BIOL 2354) are required background for undergraduates taking this course.

Course Learning Outcomes

By the end of this course, you will be able to…

a. Critically read primary literature and analyze results from experiments.
b. Compare and contrast mechanisms of transcription and post-transcriptional initiation and termination in bacteria.
c. Explain how bacteria adapt to their environment by changing their gene expression.
d. Illustrate gene expression pathways that depict results obtained from experiments with defined mutants.
e. Design a genetic screen or selection to dissect a particular bacterial pathway.
f. Generate a novel testable hypothesis based on the available experimental data.
g. Reflect on peer presentations of scientific material.

Resources

- Snyder, Reverend, Peters & Henkin. 2013. *Molecular Genetics of Bacteria*, 4rd ed.
  ** at GT bookstore, or available for rent or purchase (hardcover or e-versions) online through multiple sources.*
- Primary literature and review articles as assigned
  ** available in the resources folder on T-square.*
- T-square (http://www.tsquare.gatech.edu)
  ** you are responsible for checking T-square daily for updates to the schedule and reading material.*

Evaluation

• Class participation (in-class activities, assessments)	15%
• Presentation/critique (oral / written)	10%
• First take-home exam	25%
• Second take-home exam	25%
• Cumulative final take-home exam	25%

Class Participation and Assessment

You are expected to read the required material for each class and come ready to participate and contribute. Your participation grade will be assessed through a variety in-class exercises that will include small-group activities, polling* (http://www.polleverywhere.com/), and "cold calling". Participation in the discussions and questioning during student presentations is also expected and will be included in your participation grade. Much of the information needed to succeed on the exams will be provided orally in class, but will not be present in the Powerpoint presentations. Traditionally, those who do well in the course attend class regularly, participate, and do not rely solely on the textbook and the PowerPoint presentations available on T-square.

**Poll Everywhere* responses are submitted by visiting a specific web site, or by sending text messages.*

Presentation/critique

Graduate students, typically in groups of 2 or 3, will be assigned by the instructor and responsible for presenting one Supplemental research paper (indicated in blue on the class schedule). Students work together to design a 40-45 min Powerpoint presentation on the paper and relevant background information, which is presented in class on the date assigned. About 5-10 minutes are allowed for questions. All students that are not presenting that day will fill out an oral presentation assessment form (available at the course T-square site) of the presentation and turn it in at the end of class. The presentation grade for each group will be derived from the average of the assessment grade from your peers (50%) and from the instructor (50%). The grade from your presentation represents 10% of your course grade.

Each undergraduate in class will select one of the Supplemental research papers and independently write a critical review of that paper. The instructor will indicate a date when undergraduates must decide on which paper they will write a critique. Undergraduates who do not choose a paper by that date will be assigned one by the instructor. A digital copy of the critique is to be sent to the instructor via e-mail by the beginning of class on the day of the presentation. The written critical review by undergraduate students will be graded by the instructor using the critique rubric (available at the course T-square site). The critique represents 10% of your course grade.

Take-home exams

There will be three take-home exams during the semester. Each exam will count for 25% of your course grade. You are given about 1 week to complete each exam. All three exams will include questions that require analysis and interpretation, not regurgitation. The exams are designed so that the answers will not be ones you can simply find in a textbook, but may very well be based on simulated data I provide for a hypothetical experiment. You are expected to work on each exam alone, but you may use the textbook, PowerPoints, lecture notes, and research papers to aid in the completion of your exams. Exam 1 will cover material covered up to the exam, and exam 2 will test students on the material following exam 1. The final exam will be cumulative and cover material from the entire course, with an emphasis on the material covered in the latter third of the course. However, since the topics discussed after exam 2 rely on your knowledge of the earlier material, a comprehensive understanding of the course material will be required for the final exam.

Academic Integrity and the Honor Code

Students are reminded of the obligations and expectations associated with the Georgia Tech Academic Honor Code and Student Conduct Code, available on-line at:

http://www.osi.gatech.edu/

Learning Accommodations

Classroom accommodations will be made for students with disabilities to participate fully in the course activities and meet course requirement. These accommodations must be arranged in advance in accordance with the ADAPTS office:

http://adapts.gatech.edu

Class Schedule

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Fall 2014

#	day	date	topic	reading material due for this class: supplemental material	Snyder/Champness, 4th ed.
1	M	8/18/14	Introduction to "Prokaryotic" Genetics	Whitman (2) ; Pace (2)	Intro p.1-12, CH1 p. 53-66
2	W	8/20/14	DNA structure and replication	Watson & Crick; Franklin & Gosling	CH1 p. 13-30
3	F	8/20/14	Chromosomal replication & the nucleoid	Thanbichler	CH1 p. 31-53
4	M	8/25/14	Mutations, mutagenesis I		CH3 p. 125-133, 137-149
5	W	8/27/14	Mutations, mutagenesis II		CH3 p. 149-173
6	F	8/29/14	DNA repair		CH11 p. 433-53
-	**M**	**9/1/14**	**LABOR DAY**		
7	W	9/3/14	DNA repair (continued)		
8	F	9/5/14	Transcription		CH2 p. 71-84
9	M	9/08/13*	Proteins and translation		CH2 p. 84-105
10	W	9/10/13*	Protein folding and export	Shuman	CH2 p. 105-16, CH14 p. 585-94
11	F	9/12/14	Protein folding and export 2		
12	M	9/15/14	Plasmids		CH4
13	W	9/17/14	Conjugation	Chen, et al.	CH5
14	F	9/19/13	Transformation		CH6
-	***M***	***9/22/24****	***presentation / critique 1***	***Meibom, et al.***	
15	W	9/24/14	Generalized Transduction, phage trxn & replic		CH7 p.314-21, 265-89
16	F	9/26/14	Lytic phage, phage genetics		CH7 p.289-309
17	M	9/29/14	Lysogenic phage/Lambda		CH8 p. 323-40
-	W	10/1/11	**section 1 wrap up + EXAM 1**		
-	***F***	***10/3/14***	***presentation / critique 2 +***	***Waldor&Mekalanos,CH8 p347-9***	
18	M	10/6/14	Transposons and transposition		CH9 p361-87
19	W	10/8/14	Site-specfic recombination		CH9 p387-402
20	F	10/10/14	Homologous recombination I		CH10
-	**M**	**10/13/14**	***FALL BREAK***		
21	W	10/15/14	Homologous recombination II		CH11 p. 453-70
22	F	10/17/14	Transcriptional regulation-negative	Jacob	CH12 p. 472-86
23	M	10/20/14	Transcriptional regulation-positive		CH12 p. 487-97
24	W	10/22/14	Attenuation/post transcriptional regulation		CH12 p. 497-503
25	F	10/24/14	Protein secretion (type I, II)		CH14, p. 595-98
26	M	10/27/14	Protein secretion (type III)	Schroeder & Hilbi	CH14 p. 598-600
27	W	10/29/14	Protein secretion (type IV)	Cascales & Christie	CH14 p. 600
-	***F***	***10/31/14***	***presentation / critique 3***	***Vogel, et al.***	
-	M	11/3/14	**section 2 wrap-up + EXAM 2**		
28	W	11/5/14	sRNA regulation - negative	Majdalani,et al; Papenfort & Vogel	CH13 p. 560-62
29	F	11/7/14	sRNA regulation - positive		
30	M	11/10/14	CRISPRs	Wiedenheft et al, Pennisi	CH7 p. 311-14
-	***W***	***11/12/14****	***presentation / critique 4***	***Bikard, et al.***	
31	F	11/14/14*	Signal transduction pathways	Mascher, et al.	CH13 p. 539-40
32	M	11/17/14	Signal transduction pathways II		
33	W	11/19/14	Global regulation: envelope stress	Ruiz & Silhavy	CH14 p. 566-68
34	F	11/21/14	Global regulation: quorum sensing (QS)	Greenberg; Ng & Bassler	CH13, 575-78
-	***M***	***11/24/14***	***presentation / critique 5***	***Lenz, et al.***	
35	W	11/26/14	Global regulation: catabolite repression	Busby & Ebright	CH13 p. 525-35
-	**F**	**11/28/14**	***THANKSGIVING***		
36	M	12/1/14	V. cholerae QS sRNAs	Bardill et al; Zhao et al	
37	W	12/3/14	V. cholerae QS, chitin, & natural competence	Antonova et al	
-	**F**	**12/5/14**	**RECAP/ TAKEHOME FINAL (EXAM 3)**		
	M	**12/8/14**	**FINAL**		
	W	**12/10/14**	**EXAM**		
	F	**12/12/14**	**WEEK**		

** guest instructor or visitor*