BIOL 4607/6607: Molecular Biology of Microbes: Disease, Nature, and Biotechnology

Fall Semester 2016 MWF 11:05-11:55 AM Location: CE 204

Instructor

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Overview

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. Bacteria are a diverse set of organisms that are essential to the web of life of earth. They also serve as model systems for understanding cellular functions common to more complex organisms, and much of our understanding of the genetic code, inheritance, transcription, translation and gene regulation has been revealed by studying bacteria. In the beginning of this course we will discuss many fundamental processes uncovered by historical and current discoveries in model organisms. In the latter half we will integrate these to reveal elegant regulatory networks used by bacteria to sense and respond to external information and accomplish diverse tasks. We will cover molecular mechanisms pathogenic bacteria use to cause disease in humans, and bacteria in the environment use to interact with their surroundings and other organisms. Biotechnology applications that have arisen from our discoveries of bacterial mechanisms will also be highlighted. The focus of the course is on experimental approaches. As a result, my larger 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

Biological Principles (BIOL 1510) or Honors Biological Principles (BIOL 1511) 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, analyze experimental results, and reflect on peer presentation of scientific material.
b. Explain how bacteria adapt to their surroundings using gene expression pathways that can be depicted based on results from experiments with defined mutants.
c. Design a genetic screen or selection to dissect a particular bacterial pathway.
d. Understand distinct and shared mechanisms employed by pathogenic bacteria to cause human diseases.
e. Appreciate ubiquitous environmental microbes that have been exploited as model organisms.
f. Articulate biomolecular processes in bacteria harnessed to develop useful technologies.
g. Generate a novel testable hypothesis based on available experimental data.

Resources

- Snyder, Reverend, Peters & Henkin. 2013. *Molecular Genetics of Bacteria*, 4rd ed.
- Primary literature and review articles as assigned
- T-square (http://www.tsquare.gatech.edu)

Evaluation

- Class participation (in-class activities, assessments) 25%
- Presentation/critique (oral / written) 10%
- First take-home exam 20%
- Second take-home exam 20%
- 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 short quizzes on the reading material, small-group activities, 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.

Presentation/critique

Graduate students, typically in groups of 2-3, will be assigned by the instructor and responsible for presenting one Supplemental research paper (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 on T-square) 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 (blue on class schedule) 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 will be graded by the instructor using the critique rubric (available on T-square). The critique represents 10% of your course grade.

Take-home exams

There will be three take-home exams during the semester. The first two count 20% and the cumulative final 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 later material.

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 Office of Disability Services:
http://disabilityservices.gatech.edu/

2016 course schedule

	date	day	topic	supplemental reading	textbook reading
	8/22/16	M	Introduction, DNA structure, Molecular Basics	Watson & Crick; Franklin & Gosling	CH1 p.1-12, 53-66
	8/24/16	W	DNA replication, and the chromosome (antibiotics)	Thanbichler et al	CH1 p.13-53
	8/26/16	F	Mutants and mutations		CH3 p.125-33, 137-53
	8/29/16	M	Isolating mutants		CH3 p.153-167
	8/31/16	W	DNA repair		CH11 p.433-53
	9/2/16	F	mRNA, transcription and sigma factors		CH2 p.71-84
	9/5/16	**M**	**LABOR DAY**		
	9/7/16	W	Translation and proteins (antibiotics)	Wilson	CH2 p.84-105 116-120
	9/9/16	F	Protein folding and export	Shuman	CH2 p.105-16, CH14 p.585-94
	9/12/16	M	Plasmids - replication and copy number		CH4 p.183-202
	9/14/16	W	Plasmids - partitioning, cloning vectors		CH4 p.205-212
	9/16/16	F	Conjugation	Chen et al	CH5 p.219-226, 232-235
	9/19/16	M	Transformation		CH6
	9/21/16	W	presentation/critique 1	Meibom et al	***Brian!***
	9/23/16	F	Bacteriophage replication		CH7 p.314-21, 265-89
	9/26/16	M	Lytic bacteriophage, phage genetics	Faruque et al	CH7 p.289-309
	9/28/16	W	Lysogenic bacteriophage: Lambda		CH8 p.323-40
	9/30/16	F	presentation/critique 2 , **EXAM 1**	Waldor & Mekalanos	***Ellie and Rachana***
	10/3/16	M	Transposons and transposition		CH9 p.361-78
	10/5/16	W	Transposon mutagenesis, screens/selections		CH9 p.382-387
	10/7/16	F	Recombination (site-specific and homologous)		CH9 p.387-392
	10/10/16	**M**	**FALL BREAK**		
	10/12/16	W	Recombation (homologous)		CH10 p.403-416
	10/14/16	F	Transcriptional regulation: negative	Jacob	CH12 p.472-86
	10/17/16	M	Transcriptional regulation: positive		CH12 p.487-97
	10/19/16	W	post transcriptional regulation	Papenfort & Vogel, Weber	CH12 p.497-505
	10/21/16	F	Hfq dependent small RNAs	Majdalani et al	CH13 p.560-70
	10/24/16	M	presentation/critique 3	Lenz, et al	***Luz and Kai***
	10/26/16	W	Protein secretion (type I and II)		CH14 p.595-600
	10/28/16	F	Protein secretion (type III)	Puhar & Sansinetti	
	10/31/16	M	Protein secretion (type IV)	*Cascales & Christie*	
	11/2/16	W	presentation/critique 4	Vogel, et al	***Simon and Mary Beth***
*	11/4/16	F	Protein secretion (type VI)	Ho et al	
*	11/7/16	M	**Dr. Hammer's TEDx talk**	youtube.com/watch?v=vfmNBFDPZUM	
*	11/9/16	W	Signal transduction, **EXAM 2 handed out**	Mascher et al	CH13 p.539-40
*	11/11/16	F	CRISPR: biology	Barrangou & Marraffini	CH7 p.311-14
*	11/14/16	M	CRISPR Cas9: biotechnology	Doudna & Charpentier	
	11/16/16	W	intracellular second messenger: ci-di-GMP	Hengge	
	11/18/16	F	c-di-GMP: biofilms	Hammer & Bassler, Zhao et al	
	11/21/16	M	presentation/critique 5	Bikard, et al	***Liu***
	11/23/16	**W**	**THANKSGIVING**		
	11/25/16	**F**	**THANKSGIVING**		
	11/28/16	M	Quorum sensing (QS): *Vibrio fischeri, V. harveyi*	Hastings; Greenberg; Kolter	
	11/30/16	W	QS: *V. cholerae* (G-), *Staph aureus* (G+)	Miller, et al and Ji, et al	
	12/2/16	F	QS-based therapeutics	LaSarre & Federle	
	12/5/16	M	Hammer lab work; **FINAL EXAM handed out**	McNally et al	
	12/7/16	W	**READING PERIOD**		
	12/9/16	F			
	12/14/16	F	final exam due by 11AM per registrar's office >	http://www.registrar.gatech.edu/students/exams.php	

BIOL 4607
WRITTEN REVIEW AND CRITIQUE OF RESEARCH PAPER

You are to write a review and critique of a research paper. The page limit is six pages (double spaced) The title page is not included in the page limit. Adhere to the guidelines below. Each section will be graded as described. Except foer the title, label each section of your document: ABSTRACT, BACK

TITLE PAGE	**TOTAL : 4**
Article title, and authors	1
One line summary	2
Your name, date, and course listing	1

SUMMARY/ABSTRACT (no more than 250 words, or ½ a page)	**TOTAL: 16**
Introductory statement	4
Summary of the authors' major material and methods	4
Summary of their major results	4
A brief interpretation of results	4

*I expect that the SUMMARY/ABSTRACT section will be written in your own words and should not duplicate statements from the paper you are critiquing. This section should be able to stand alone.

BACKGROUND (approx. 1 page)	**TOTAL: 10**
A brief summary of the relevant background they provide	5
The purpose of the study	5

EXPERIMENTAL APPROACH AND FINDINGS (approx. 2 pages)	**TOTAL: 30**
The experimental methods	10
The commonly used techniques	10
The major observations	10

CRITICAL REVIEW/ORIGINAL ANALYSIS (approx. 2 pages) **TOTAL: 40**

Is the problem clearly stated? Is this problem an important one in the field?
Does the introduction give sufficient background to help you understand the study?
-(Too narrow? Too broad? Biased? Cited properly?)
Is the methodology well described and appropriate? Were sufficient controls included?
Is a reasonable model given to explain their results?
Were there unexpected results? Is a satisfactory explanation given for them?
Do the authors describe the implications of their study to the field? Do you agree or disagree?
What impressed you in the article? Concerned you?
What is your overall assessment of the article?

*I expect you to address these questions in the CRITICAL REVIEW/ORIGINAL ANALYSIS section.

TOTAL: 100

WAYS TO LOSE POINTS	
Length of review is longer than the maximum allowed	-10
Hand in critique late	-10/day
Misspelling of word, run-on or incomplete sentence, sentence that makes no sense	-1 per

Reviewer's' name: _____

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SPEAKER EVALUATION FORM

Presentation Date: _____

Presentation Title: _____

Presenters' name(s): _____

	excellent 5	very good 4	good 3	fair 2	poor 1		total
Mechanics of Communication (10)							
Were the speakers familiar with the A/V equipment?						→	
Were the slides easy to read and not overcrowded?							
Presentation (25)							
Was the talk well presented? (typos, slide order, time management?)						→	
Did presenters speak loud enough and avoid unnecessary audible "caesura" (uh, errs, um)							
Did speakers strive to keep the audience's attention? (eye contact, voice/expression, inflection?)							
Were speakers attentive to needs of a general audience? (ex: this may sound like "X" but…, can you see in back?)							
Did speakers avoid jargon when simple phrases suffice? (ex: explain technical acronyms, avoid confusing phrases?)							
Content (50)							
Did the talk have a distinct introductory, middle and concluding section?						x 2.5 =	
Was the introduction and background material adequate and make audience curious?							
Were the results explained clearly, accurately, and simply?							
Did the conclusion summarize the main point, and make clear what should be taken away from the talk?							
Questions (5)							
Did the talk stimulate interesting questions and were they answered adequately?						→	
Group dynamics (10)							
Did each group member contribute sufficiently to the presentation?						x 2.0 =	

Strengths: _____

Suggestions for improvement: _____

Overall Evaluation _____

TOTAL

* this assessment form will be returned to presenters after TOTALs are recorded