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

Spring Semester 2021 MWF 11:00-11:50 AM

Mode: hybrid
In-person sessions: CE 204
Remote sessions: gatech.bluejeans.com/518295401

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 knowledge 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 (BIOS 1107/1207+lab or BIOL 1510/1511) 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 serve 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.

Required Course Material

- Snyder, Peters, Henkin & Champness. 2013. *Molecular Genetics of Bacteria*, 4rd ed.
- Primary literature and review articles as assigned and provided at canvas.gatech.edu.
- Learning Catalytics subscription at learningcatalytics.com.
  - If you already have a Mastering or MyLab account for another course, check first to see if you have free access to Learning Catalytics.
  - If not, purchase for $12 for the semester at learningcatalytics.com. Select the Register link, indicate you are a student, and select “No, I am not using Learning Catalytics with a MyLab or Mastering product”)

Evaluation

- Class participation 10%
- In class quizzes, Learning Catalytics assessments, take home problem sets 20%
- Presentation/critique (oral / written) 10%
- Two take-home exams (20% each) 40%
- Cumulative final take-home exam 20%

Academic Honor Code and Plagiarism: All students are expected to abide by the Academic Honor Code www.honor.gatech.edu. We take the Honor Code very seriously and are required to report any potential violations. Examples of Honor Code violations include copying a current or former student's exam and plagiarism. Everything that you write or create in this course, including test answers, homework, and in-class work, must be original content created by you, not copied from another source. Copying words or even ideas of someone else is plagiarism. Any suspected plagiarism will be submitted to the Office of Student Integrity for evaluation.

Class Participation, Attendance, and Assessments: You are expected to read the required material for each class and come ready to participate and contribute. During class, you will be assessed with short quizzes on the reading material and Learning Catalytics questions. Occasional homework assignments are designed to prepare you for exams. During synchronous remote instruction, you are required to log into BlueJeans and keep your camera on for the duration of class. In class participation will be graded on your effort and responses to questions asked by "cold calling" as follows: 0 - absent or silent, 1 – an attempted answer, 2 – a modest answer, 3 – an excellent answer. Much of the information needed to succeed on exams will be provided orally in class, but not in the Powerpoint slides. 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 Canvas. If an excused absence is provided, students will not be penalized for lack of participation and can make up assignments. See the institute's attendance policy http://www.catalog.gatech.edu/rules/4/

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 to the 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 Canvas) 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. Graduate students unable to present due to an excused absence will be allowed to join a later group or have the opportunity to present a later paper alone to make up the missed assignment.

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 Canvas). The critique represents 10% of your course grade. 10 points are deducted for each day the assignment is late.

Take-home exams: There will be three take-home exams that each count 20%. The third exam is the final exam and is cumulative, with an emphasis on the later material. You are given about 1 week to complete each exam. All exams will include questions that require analysis and interpretation, not regurgitation. Undergraduates are given more flexibility to

choose which questions to answer on exams. Graduate students are typically assigned which questions they are to answer. 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. Students with an excused absence during the week of the exam will be given additional an additional day(s) to complete the take home exam.

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/

Spring 2021 course schedule (also available in Canvas module)

		date	day	topic	supplemental reading	textbook reading
		1/15/21	M	Introduction		
	*	**1/18/21**	**M**	**MLK JR day**		
	1	1/20/21	W	DNA structure	Watson; Franklin	p.1-12, 53-66
	2	1/22/21	F	DNA replication, the chromosome	Viollier	p.13-26, 31-34
	3	1/25/21	M	Mutants and mutations		p.125-33, 137-53
	4	1/27/21	W	Isolating mutants		p.153-167
	5	1/29/21	F	DNA repair		p.433-53
	6	2/1/21	F	mRNA, transcription, sigma factors		p.71-84, 541-543
	7	2/3/21	W	Translation and proteins		p.84-105, 116-120
	8	2/5/21	F	Protein export	Shuman	p.586-590
	9	2/8/21	M	Conjugation	Chen	p.219-226, 232-235
	10	2/10/21	W	Plasmids and cloning vectors		p.183-212
	11	2/12/21	F	Transformation		p. 247-264
	*	***2/15/21***	***M***	***presentation/critique 1***	***Meibom***	***Chen, Queen, Collins***
	*	**2/17/21**	**W**	**REVIEW 1**		
EXAM 1 lectures 1-11	12	2/19/20	F	Bacteriophage replication		p.314-21, 265-89
	13	2/22/20	M	Lytic bacteriophage, phage genetics	Faruque	p.289-309
	14	2/24/20	W	Lysogenic bacteriophage: Lambda		p.323-340
	15	2/26/20	F	SARS-CoV2	TBD	
	16	3/1/21	M	Transposons (Tns) and transposition		p.361-378
	17	3/3/21	W	Tn mutagenesis, screens/selections	***Hammer***	p.382-387
	*	***3/5/21***	***F***	***presentation/critique 2***		***Hersey, Thomas***
	18	3/8/21	M	Recombination (site-specific)	Jacob	p.387-392
	19	3/10/21	W	Recombination (homologous)		p.403-416
	20	3/12/21	F	Transcriptional regulation: negative	Papenfort; Weber	p.472-486
	21	3/15/21	M	Transcriptional regulation: positive	Majdalani	p.487-497
	22	3/17/21	W	Post transcriptional regulation		p.497-505
	23	3/19/21	F	regulatory small RNAs	***Lenz***	p.560-570
	*	***3/22/21***	***M***	***presentation/critique 3***		***Kay, Benitez, Yoo***
	*	**3/24/21**	**W**	***(no instruction day)***		
	*	**3/26/21**	**F**	**REVIEW 2**		
EXAM 2 lectures 12-23	24	3/29/21	M	Protein secretion (type I II and III)	Puhar	p.595-600
	25	3/31/21	W	Protein secretion (type IV)	Cascales	
	26	4/2/21	F	Protein secretion (type V and VI)	Ho	
	27	4/5/21	M	Signal transduction	Mascher	p.539-540
	*	***4/7/21***	***W***	***presentation/critique 4***	***Basler***	***Kim, Wimberly, O'Connor***
	28	4/9/21	F	CRISPR: biology/biotechnology	Barrangou 1; Doudna	p.311-314
	*	***4/12/21***	***M***	***presentation/critique 5***	***Barrangou 2***	***Milner, Li, Edmiston***
	30	4/14/21	W	Quorum Sensing	Hastings; Greenberg; Kolter	
	31	4/16/21	F	QS: *V. cholerae*, *Staph aureus*	Miller; Ji	
	*	***4/19/21***	***M***	***presentation/critique 6***	***Swem, et al***	***Patterson, Randhawa***
	32	4/21/21	W	Catabolite repression	Busby	p.526-535
	33	4/23/21	F	Hammer lab research	Crisan 1, Crisan 2	
	*	4/26/21	M	**REVIEW 3**		
EXAM 3 FINAL all lectures (w emphasis on 24>)		4/28/21	W			
		4/30/21	F			
		5/3/21	M			
		5/5/21	**F**	**final exam due by 11:59 PM per registrar >**	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: _____

BIOL 4607/6607

Molecular Biology of Microbes: Disease, Nature, and Biotechnology

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**