

Biol 238: Microbiology

Spring 2019

T,Th 8:10 – 9:30 am

Higley Auditorium

Microbes: The Unseen Majority



Dr. Zachary D. Blount

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Personal Website: www.blount-lab.org

Course Website: Moodle

Office Hours: 10 – 12 MW, 11 – 1 F, or by appointment

Notice: It is your responsibility to know all policies, directions, stipulations, dates, etc. in this syllabus. Read it carefully and seek clarification if there is anything you don't understand.

Communication:

It is best for you to come to office hours so we can talk directly about any issues you might have. If you cannot make it to office hours, email is greatly preferred. Please be sure to include "BIOL 238" in your subject line. I will do my best to answer all emails within 24 hours on weekdays and 48 hours on weekends.

Please do not hesitate to come to me about any issues related to the course and your ability to succeed in it through the term. After all, most things are possible with good communication. I understand that we have busy, hectic lives in which the unforeseen arises. I am more than happy to work with you, but this means that you have to tell me what is going on, and preferably ASAP.

Remember: *Virtually anything is possible with good communication....and nothing without it.*

Course Description and Objectives

Most life on Earth is microbial. Indeed, almost all life in the universe is likely microbial. Moreover, microbes don't just dominate life, they are incredibly important to all life. *They do stuff – amazing stuff!* The great biogeochemical cycles of carbon, nitrogen, oxygen and more are predominantly driven by microbial metabolism. Going to a lower level, all macroorganisms like ourselves are intimately dependent upon microbes. Our skin is covered with them and our guts full of them. New research is coming to show that our microbiome, the half of our cells that are microbes, is a critical part of us, regulating our metabolism, influencing our weight, affecting brains, our moods, perhaps even our thoughts. It gets even more amazing when you consider that our very cells run on energy produced by mitochondria, which descend from bacteria related to *E. coli* that entered into symbiosis with our distant ancestors billions of years ago. Much of our nutrition derives from plants, which make biomass from carbon that they fix using chloroplasts that descent from cyanobacteria. Even the modern human

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world we occupy is the contingent outcome of a history that was determined by innumerable diseases, each caused by microbes. In the end, this is a microbial world – we just live in it.

Microbes were the first life upon the planet, and they will be the last life here, too. Their diversity is astonishing and their capacities are almost beyond belief. There are bacteria that eat oil and breathe uranium, archaea that live in boiling sulfuric acid and grow in salt crystals. There are microbes growing deep beneath the surface of the Earth. The unseen majority is a thing of wonders. In this class we will explore this unseen world of bacteria, archaea, viruses, and unicellular eukaryotes. We will behold its wonders, find out how it works, examine its diversity, and assess its effects. We will focus on the evolution of the members of this world, how that evolution has happened, and how its evolution has affected the evolution of every other form of life. By the end, I hope that you will understand:

- The scope of microbial diversity.
- How microbial life functions at the genetic, structural, metabolic, ecological, and biogeochemical levels.
- How microbial life affects the world as a whole.
- How microbial life affects human health and history.
- How microbes evolve, and how that evolution affects every aspect of the above.
- How we have studied microbes and gotten to our current state of knowledge.
- That microbes are amazing, awesome, and incredible, and it would be foolish, really, to study anything else!

What are your objectives for this course? Take a moment to jot some down:

Course Texts

- *Microbiology: An Evolving Science*

In addition to the required text, there will be occasional shorter readings, book chapters, and journal articles that I will either email out, hand out in class, or post on Moodle. I will notify you when I post additional readings, and you will be responsible for having done all assigned readings by the dates indicated.

Lecture Slides

Lecture slides will be posted to Moodle for your reference. **DO NOT SHARE THESE OUTSIDE THE CLASS!**

Grading, Assignments, and Assessments

Overview

Grading will be considered a matter of giving points, and not of detracting them. Throughout the semester, if you have questions regarding grades, you must come and speak to me in my office. It would be a FERPA violation for me to discuss your grade with you via email.

Assessment Type	Contribution to Final Grade
Class Participation	25%
“Exams” (~5)	50% (~10% each)
Research Project	25% (2% Topic Selection) (3% Outline and Preliminary Reference List) (5% First Draft of Paper) (15% Final Draft of Paper)

Letter Grade Assignment, Subject to Revision (I’m not heartless, I promise!)

Percentage Grade	Letter Grade
96.5 – 100	A+
93.5 – 96.4	A
89.5 – 93.4	A-
86.5 – 89.4	B+
83.5 – 86.4	B
79.5 – 83.4	B-
76.5 – 79.4	C+
73.5 – 76.4	C
69.5 – 73.4	C-
59.5 – 69.4	D
<59.5	F

Class Participation and Quizzes (25% of final course grade)

Microbiology is really, really interesting! It also features some complicated details and ideas. To facilitate your understanding, portions of many class sessions will be set aside for discussion of these details and ideas. Part of your grade will be determined by your contributions to this discussion. What will constitute class participation will vary from class to class, so please come prepared for different kinds of discussions involving the full class or small groups.

If you are very introverted, shy, suffer from issues of social anxiety, or have some other reason that participation might be difficult, please contact me, and we will work out something that will allow you to participate without suffering unduly. (I've been there, so I understand.)

In preparation for class, I expect you to do the reading and to keep written notes upon it. For each class session, please bring a notecard with a few questions that came to you while studying. These should be turned in at the start of class. After I finish talking about the day's material, we will have a brief break so you can wake up. I will go through these questions during this break to see if there is anything that needs to be addressed after the break, during discussion time.

Question Cards – My current plan is to hand out note cards each class session. During or after I am done presenting the day's material, please write down some questions or things that confuse you. These will be turned in at the end of class. Sometimes these questions will be the nuclei for class discussions. I will always look through them to see what hasn't connected and try to correct this at the next class. The point of this is to both get you thinking about the material while it is fresh in your mind, and also to give you a non-intimidating way to make your voice heard.

"Exams" (50% of final course grade)

There will be 5 or so take-home assignments on the material during the semester that will take the place of exams. You will be told whether or not you will be allowed to discuss assignments with each other. The questions on the "exams" will vary. Some will essentially be the sorts of questions that replicate studying so as to make sure that you absorb some material. Others will be thinking and synthesis questions. In yet others you may be required to dig into the academic literature to figure something out. These exams will always need to be typed up and submitted by a Turnitin portal on Moodle.

Research Project (25% of final course grade)

I want you to spend some time investigating some aspect of microbiology on your own. You will therefore do an independent research on some topic in microbiology that you will decide upon in consultation with me. The range of topics on which you may write is broad. If you have an idea, run it by me and we'll talk about it, even if you aren't sure. One caveat is that you must tie your topic to evolution in some way. (Evolution is important.) The central point of this exercise is for you to look deeply into some aspect of the course topic that you find particularly interesting. In the end, you will produce a paper that is fully referenced from scholarly sources of **at least 2500 words (not including references)**.

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To facilitate you doing well on your research project, ensure that you are working on it through the semester, and thus prevent you from having to stay up until 5 am the night before turning in something that likely wouldn't turn out very well anyway, the journey to the finished project will be broken into separate tasks, each of which will contribute points to your grade. Each task builds on the previous, so credit on later parts is contingent upon having done the earlier ones.

PICKING A TOPIC (2% of final course grade): You must discuss your topic ideas with me, either by coming to regular office hours, or, if necessary, by making an appointment outside of office hours (1% of final course grade). We will settle on one, for which you will prepare a short proposal on the topic that you will turn in during class on **February 7** (1% of final course grade). The proposal will be roughly ~1/2 page, and will include your provisional title, as well as 3 or 4 sentences that provide your provisional thesis statement and how you will approach the topic. (Please note that you will not be locked into the thesis and approach you describe here. Theses and approaches invariably change as you get into a project like this and learn more about your subject.) **Proposals will not be accepted if you have not discussed the topic with me first.**

WORKING OUTLINE AND REFERENCE LIST (3% of final course grade): The outline is your provisional scheme for how you will organize your paper. A helpful guide for how to put together an outline may be found online here:

<https://academicguides.waldenu.edu/writingcenter/writingprocess/outlining>

This will make sure that you are thinking out the paper ahead of time, and will give you a chance to get feedback from me on your plans.

The reference list should be a preliminary list of the *scholarly* sources you will consult for and cite in your paper. Note the emphasis on the "*scholarly*" bit. The internet is full of garbage, and random blogs, listicles, social media posts, etc. don't really cut it as proper sources. Peer-reviewed publications are the gold standard here. Here are a couple resources to help you identify what is and isn't a scholarly resource while doing your research:

<https://www.library.illinois.edu/ugl/howdoi/scholarly/>

<http://guides.library.cornell.edu/c.php?g=31867&p=201758>

One way to find scholarly sources is to use Google Scholar (scholar.google.com) instead of standard Google.com searches.

The Kenyon librarians are also good people to go to if you have questions about sources, or if you need help finding sources or getting full-text access to sources you've found:

<https://lbis.kenyon.edu/library-research/research-assistance>

The Kenyon Writing Center is another good resource if you find yourself stuck at any point in the writing process, or if you would like someone to help you go over any piece of your research projects before you submit them:

<https://www.kenyon.edu/directories/offices-services/the-writing-center-2/>

Please format citations according to the *Nature* style guide. This is covered quite well, here:

<https://www.lakeforest.edu/live/files/2383-biology-thesis-guide-nature-style>

Improperly formatted references will not be accepted.

Both your working outline and reference list will be due in hard copy at the beginning of class on February 21.

Formatting: 12-pt. font, double-spaced. Please use Calibri, Cambria, Arial, Helvetica, or Times New Roman. Use of Comic Sans will be grounds for expulsion from the course.

FIRST DRAFT (5% of final course grade): This will be your first stab at the full paper. By first draft, I don't mean that you got it finished right before class. You should revise and polish it before turning it in if you want to get feedback that is useful. (A bit of extra effort put into a draft can make for much better feedback!) Please ensure that the language and tone are professional and appropriate for a scholarly work. A bit of humor is fine, but please be measured and balanced. **Please feel free to make use of the Kenyon Writing Center!** You are turning in a first draft so you can get feedback that will help you figure out where you need to make corrections, bolster arguments, fix formatting issues, and so on before you put together the final draft. You are expected to take any comments, suggestions, or criticisms seriously, and plan to use them to revise and strengthen the paper for your final draft. If you have any questions about this, please come talk to me during office hours.

For the most part, the first draft is a "if you turn it in, you will get full points" assignment. You will lose points if it shows evidence of being slapped together at the last moment, or if it is lacking major components like the cover page, references, or the body of the text. In other words, treat your first draft as you would your final draft in any other class.

You should submit a digital copy in doc, docx, or PDF format via Turnitin on Moodle by midnight on March 28 (i.e. before the 29th). You are responsible for making sure your format is correct, and your file is uncorrupted. Late submissions will not be accepted.

Formatting: 12-pt. font, double-spaced, left-justified, 1" margins. Please use Calibri, Cambria, Arial, Helvetica, or New Times Roman. Use of Comic Sans will be grounds for expulsion from the course.

FINAL DRAFT (15% of final course grade): This will be the final, polished version of your paper, and should be a sterling, shiny example of the best work that you are capable of. It should be free of errors and formatting issues, and should incorporate the feedback you were given earlier. It should be something you feel proud of. I will read it carefully, so give it your all!

You should submit a digital copy in doc, docx, or pdf format via Turnitin on Moodle by midnight on April 18 (i.e. before the 19th). You are responsible for making sure your format is correct, and your file is uncorrupted. Late submissions will not be accepted.

Formatting: 12-pt. font, double-spaced, left-justified, 1" margins. Please use Calibri, Cambria, Arial, Helvetica, or Times New Roman. Use of Comic Sans at this point will be grounds for exile to another dimension populated by Lovecraftian horrors.

Extra Credit

You will be awarded extra credit for attending Biology department seminars on microbiological topics. You will receive 1 point of extra credit for each seminar attended.

Student Responsibilities and Other Policies

Attendance

Attendance is required for all class sessions. You may have one free absence that you can use without excuse, though you will be responsible for all material covered during class as well as any assignments due. You will also lose participation credit for the session. However, each additional absence will result in the loss of one letter grade on your final grade for the course, so I recommend that you use your free absence wisely. Athletes and those with religious practices that will require missing class must notify me of which classes will be missed within the first 2 weeks of the semester. No unanticipated absence may be excused without documentation from the Dean's office.

Email

You are expected to regularly check your Kenyon email regularly, as I may send course related information, notices, papers, etc. via email. Once a day would be optimal.

Technology Policy

Devices, be they laptops, cell phones, or tablets, may not be used in class unless they are needed to accommodate a documented disability or medical condition (See Accommodation Policy, below). Cell phones must also be silenced or put into airplane mode for the duration of class. The first use of such devices without express permission from me will result in a warning. A second use will result in loss of 2/20 of your participation points. Any further use will be punished by expulsion from the class session in which the infraction occurs. **An expulsion due to unauthorized use of devices will be regarded as an unexcused absence no matter when during the session it occurs, meaning that it could cost you a letter grade.**

This policy is not to be mean, or (just) because I am a sour old Gen Xer who is stuck in 1995. Believe it or not, but I have some pretty good reasons for this rule. First, research has shown that multitasking is not really a thing, and attempting it places one under severe cognitive loads that reduce performance. (See: Kushniryk, A. & Levine, K.J. Impact of Multitasking on Listening Effectiveness in the Learning Environment. *The Canadian Journal for the Scholarship of Teaching and Learning* **3**, 1 – 13 (2012). Doi:10.5206/cjsotl-rcacea.2012.2.7) Humans are very, very bad at trying to do multiple things at the same time. Technology provides distractions that deeply interfere with paying attention in class, even when we don't notice them doing so. Second, research has shown that taking written notes leads to much better retention and comprehension than typed ones. (See: Mueller, P.A. & Oppenheimer, D.M. The pen is mightier than the keyboard: advantages of longhand over laptop note taking. *Psychological Science* **25**, 1159–1168 (2014). Doi:10.1177/0956797614524581) This is in part because handwritten notes force you to think about what you are taking notes on, and I want you to understand this stuff! Third, much of the grade for the class is based on class participation, which means you'll need to be interacting with me and with your fellow students. Technology tends to get in the way of that.

Civility and Personal Conduct

Discussion will be a key part of this course. Let us be paragons of civil exchange of ideas! To facilitate discussion and an open, honest exchange of ideas, all students must be respectful and civil to each other at all times, including obeying the following guidelines:

- Be polite in discussion and be willing to disagree without being disagreeable.
- Allow others to finish speaking before beginning to speak yourself.
- Assume good faith and be charitable in interpreting what others say, even when you disagree strongly.

Please note the statement on Sexual Misconduct and Harassment below. Any student who engages in harassment of any sort, makes another student or the instructor feel unsafe, or otherwise fails to respect the inherent worth and dignity to which all are entitled by virtue of their humanity will be expelled from class. If necessary, such behavior will be reported to Kenyon's Title IX coordinator.

Accommodation Policy

Every effort will be made to accommodate students with disabilities. If you have a physical, psychological, medical, or learning disability that requires accommodation, please contact the Office of Disability Services at 740-427-5453. Erin Salva (salvae@kenyon.edu), the coordinator of Disability Services, will work with you to determine what accommodations are needed. If you have done this previously, please make sure that Ms. Salva notifies me. I cannot make accommodations without notification from the Disability Services Coordinator. All information and documentation of your disability is confidential.

Academic Integrity

Kenyon students are all expected to uphold the highest standards of academic integrity. Lying, cheating, unauthorized assistance, or plagiarism are absolutely unacceptable. All students are expected to know and abide by the college's rules on academic honesty. Please see the Academic Honesty and Questions of Plagiarism section in the Course Catalog. You will be held responsible for learning how to properly document, cite, and acknowledge all sources you draw upon in preparing your research project. Ignorance and carelessness are not excuses for failure to follow academic integrity policies. If you are ever unclear, please seek clarification. I cannot stress how important this is. A violation of academic honesty is one of the most serious wrongs a scholar can commit, and I am required to report potential violations. Always be sure to give yourself plenty of time to complete assignments and study for exams so that you don't put yourself in a situation in which you are tempted to do the wrong thing!

Severe Weather

Should severe weather, cataclysm, or apocalypse require the college to close or cancel classes, it will be announced via campus email or emergency broadcast. Nonetheless, if this occurs on a day when an assignment is due, the assignment should be sent to me electronically. If this occurs when an exam is scheduled, then the exam will be given in the next class. You are responsible for all assigned reading, regardless of any class cancellations. This policy may be reconsidered if the planet is destroyed.

Sexual Misconduct and Harassment

Kenyon College seeks to provide an environment that is free of gender bias, discrimination, and harassment. If you have experienced sexual harassment, misconduct, or assault, interpersonal violence, or stalking, we encourage you to report it. If you report the incident to me, I am obligated by law to notify Kenyon's Title IX coordinator of any information about the incident you provide. Kenyon College's Title IX and Intimate Partner Violence Policy is available at: <http://www.kenyon.edu/directories/offices-services/title-ix/policy/>. If you have any questions about these policies, please contact the Title IX Coordinator, Samantha Hughes, either by email (hughess@kenyon.edu) or call her at 740-427-5820. As this course's instructor, I am pledged to create and maintain a safe environment that facilitates learning.

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Tentative Schedule

This schedule is aspirational and will be adjusted based on pace and the need to catch up. This is especially true of the second half of the semester, the structure of which will depend on how the first half goes and what you might request for later topics.

Week	Day	Topic	Reading	Assignments
1	1/15 Tuesday	Orientation, Overview, and Introduction		
	1/17 Thursday	The Microbiology of History and the History of Microbiology	Chapter 1	
2	1/22 Tuesday	How We Study Microbes	Chapter 2 Chapter 4.3,4	
	1/24 Thursday	Basic Prokaryotic Cell Biology I: Cell Structure	Chapter 3 Chapter 19.1, 736 - Purcell, <i>Life at Low Reynolds Number</i>	
3	1/29 Tuesday	Basic Prokaryotic Cell Biology II: Growth	Chapter 4.1, 2, 5, 6 Blount, <i>The Unexhausted Potential of E. coli</i>	
	1/31 Thursday	Environmental Limits and Parameters	Chapter 5.1 - 6	Exam I
4	2/05 Tuesday	Origin of Life Genomes and Genetics I	Chapter 17.1 Chapter 7.1, 2, 4, 5	
	2/07 Thursday	Genomes and Genetics II Change and Plug and Play	Chapter 7.3 Chapter 9	Paper Topics Exam I Due
5	2/12 Tuesday	Microbial Evolution Experiments	Chapter 17.4 Lenski 2017, Fox and Lenski 2015	
	2/14 Thursday	Microbial Evolution and Speciation	Chapter 17.3, 5	
6	2/19 Tuesday	Gene Expression	Chapter 8	
	2/21 Thursday	Gene Regulation	Chapter 10	Paper Outlines Exam II
7	2/26 Tuesday	Bacterial Diversity	Chapter 18	
	2/28 Thursday	Archaeal Diversity	Chapter 19	Exam II Due
8	4/05 Tuesday	Spring Break		
	4/07 Thursday	Don't come to class. Please. (I won't be there.) Go home. Sleep. Frolic amongst the flowers of spring. Talk to your family.		
9	4/12 Tuesday	Make sure you get some rest!		
	4/14 Thursday			

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Week	Day	Topic	Reading	Assignments
10	3/19 Tuesday	Metabolism and Evolution I: Overview of Metabolism Early Metabolism		
	3/21 Thursday	Metabolism and Evolution II		
11	3/26 Tuesday	Metabolism II and Evolution III		
	3/28 Thursday	Microbial Ecology		First Drafts Exam III
12	4/02 Tuesday	Symbiosis and Endosymbiosis		
	4/04 Thursday	The Microbiome		Exam III Due
13	4/09 Tuesday	Viruses	Chapter 6	
	4/11 Thursday	Viruses	Chapter 6	
14	4/16 Tuesday	Eukaryotic Microbes		Exam IV
	4/18 Thursday	Medical Microbiology and Immunology		
15	4/23 Tuesday	Medical Microbiology and Immunology		Exam IV Due
	4/25 Thursday	Antibiotics and Antibiotic Resistance		Final Drafts
16	4/30 Tuesday	?????		
	5/02 Thursday	?????		Exam V
Finals	5/09 Thursday			Exam V due by 1:30 pm