

MCB121: The Microbes

Microbes will be examined through their connections to human society, from medicine and disease to applied technologies. This year's focus is to consider the intersection between microbiology and climate change.

Time: Tu/Th noon – 2:45 PM

Snacks +/- light lunch provided

Place: Biological Laboratories, room 1058 (Tuesdays)

Thursday class will meet either in the Biological Laboratories lecture hall or Northwest Building Lecture Hall. Experiments will be performed in Northwest Building, room B141.

Tuesdays = lecture + discussion + case studies

Thursdays = hands-on experiments + seminars

Faculty: **Prof. Karine A. Gibbs**

kagibbs at mcb.harvard.edu

TF: **Danai Montalvan**

dmontalvan at seas.harvard.edu

Office hours: TBD and by appointment

NO ADDITIONAL SECTIONS WILL BE HELD.

Notes: Yes, this class is longer than most electives. Yes, this class might take more time than usual for an elective. Yes, this class will provide you with the foundational skills to navigate future intersections with the microbial world. Yes, this course fulfills the pre-vet requirements.

The course will have three main units: disease, environment, and applications. During each class, we will consider intersections with climate change.

Learning goals:

- 1. To acquire a broad understanding of what microbiologists study**
- 2. To develop basal knowledge about the effects of microbes on the environment, on human health and development, and on society**
- 3. To have one or more dinner party anecdotes about the impact on microbes on one's life**

Assignments:

- Weekly assignments will include maximum 3 primary texts and/or reviews. Be prepared to discuss all in class.
 - Textbook chapters are optional background reading. Additional optional materials to prepare for the hands-on experiments will be provided.
- 6 Problem sets, due on September 12 (5Q), 19; October 10 (5Q), 24; November 7 (5Q), 14
 - Problem sets will vary; the shortest is 5 questions and the longest is 10 questions.
- 3 Research reports (4 pages maximum)
 - Each is due at noon on October 3, October 31, or December 3.
- 1 Final paper, due December 18, 2019 at 11:59 PM (15 pages maximum)
 - A mandatory rough draft (5 pages minimum), due on Thursday, November 21 at noon.
- There will be no midterm and final examinations.

Reading materials:

Papers will be available on the course website generally two weeks before the assignment is due. As part of the course, you will also identify articles through literature searches.

The optional textbook is “Microbiology: An Evolving Science”, 2nd or 4th editions. Joan L. Slonczewski and John W. Foster. (Publisher: W.W. Norton)

Versions of this textbook are on reserve at the Harvard Libraries. We will also have one copy for in-building borrowing available. The COOP currently is selling the textbook.

Hands-on experiments:

The course will have three main experimental units:

1. **Identifying gene functions and/or novel genes using comparative analysis of genomes**
2. **Isolate, identify, and culture bacteria from an environmental community**
3. **Design and build a better enzyme based on forward and/or reverse genetics**

Each week, lab notebooks should be maintained. Lab notebooks are due at the end of each project, not weekly. Each week's write-up is worth 5 points total. (Notebooks can be checked earlier if you would like TF or Prof input on improving them.)

At the end of each unit, a short report/communications incorporating manuscripts/discussions from the class will be considered the "lab assessment". This document should be 4 pages maximum.

Criteria for grading will be provided during the first unit along with a sample outline.

The major goal of the hands-on experiments is to provide the tools and exposure needed to do research in a microbiology laboratory. This project-based learning interconnects with materials in lecture/discussion/case studies to better contextualize what is being taught.

Learning assessments:

Students are responsible for completing all course readings. The in-class lectures will incorporate elements **not** found in the text. I also will not cover every item from the course reading during lecture. The assessments will incorporate knowledge covered in lecture, in the textbook, in the weekly section, and in handouts.

Problem sets will be due on Thursdays at noon Eastern time. Please bring to class, submit on the course website, or email Danai. One late submission will be forgiven; otherwise, late submissions might be penalized in the grades. Come speak to Professor Gibbs or Danai if you have questions about the assignments.

Participation grades consist entirely of attendance and communication during class and section. Attendance on Tuesdays and Thursdays is expected. Please contact me directly if you will be absent. Class handouts will be made available on the course website. Contact Professor Gibbs if you would like mid-term grades.

The final grade is calculated as follows:

Participation	20%
Problem sets	25%
Research reports	21%
Rough draft of final assignment	9%
Final assignment	25%

Course ethics policy:

Discussion of problem sets and take-home assignments, including the final assignment, with other class members is permitted. However, answers must be written **separately** and **clearly represent your** (the individual student's) own voice, words, and analysis. It is not appropriate to copy verbatim from any source, whether text, vocal, or video.

Properly cite your work; this includes all media and lectures, and even "just a discussion with Professor X". List the names of colleagues with whom you discussed or collaborated on any submitted assignments. If it is not your own original idea or words, then cite whose it is. If you are ever unsure, use a citation. It does not hurt to cite others. See below for guides on citation [1]. Your assignments, however, should not consist of only citations. Submitting work that is not written by you and/or in your own words constitutes plagiarism.

Finally, civility and professional respect towards each other and the teaching staff is expected. We will follow Harvard University policies in handling any cases of suspected academic misconduct, including but not limited to plagiarism, and will refer cases to the Harvard College Administrative Board as needed.

Please see Professor Gibbs if you have any questions about this course policy.

[1] Citation resources (can be found as links on the course website):

A short guide on appropriately using citations in written works:

<http://isites.harvard.edu/fs/docs/icb.topic839457.files/Guide_to_Citing_in_the_Life_Sciences.pdf>

Student's Guide to Writing in the Life Sciences

<http://isites.harvard.edu/fs/docs/icb.topic235750.files/Life_Sciences.pdf>

Disclaimer:

It is my (Professor Gibbs') intention to provide material that is as accurate as possible, according to current scientific knowledge.

Please consult the course website for helpful links and resources during the term.

Unit topic	Date	Topic	Assignment due
Unit 1, Disease pt 1	September 3	Introduction, define microbiology, history	
Unit 1, Disease pt 2	September 5	Define microbes. Cell biology, part 1. Epidemiology, part 1. Germ Theory, Koch's theory.	Readings for class discussion
Unit 1, Disease pt 3	September 10	Cell biology, part 2. Epidemiology, part 2. Genomics, outbreaks.	Readings for class discussion
MCB121 Hands-on Unit 1, week 1	September 12	Noon - 2:45 PM In silico experiments in BioLabs 1058	PS 1 (5Q)
Unit 1, Disease pt 4	September 17	Pathogenesis, molecular biology pt 1	Readings for class discussion
MCB121 Hands-on Unit 1, week 2	September 19	Noon - 1:15 PM, Seminar in BioLabs lecture hall (Dr. Emonet, Yale); 1:20 - 2:45 PM, In silico experiments in BioLabs 1058	PS 2 (5Q)
Unit 1, Disease pt 5	September 24	Molecular biology pt 2. Gene transfer, evolution, role of viruses, etc. Place in the context of microbial communities.	Readings for class discussion
MCB121 Hands-on Unit 1, week 3	September 26	Noon - 2:45 PM, In silico experiments in BioLabs 1058	Readings for class discussion
Unit 1, Disease pt 6	October 1	Signaling pathways & two-component systems (Molecular biology pt 3) Recap of Unit 1 and catch-up day.	Readings for class discussion
MCB121 Hands-on Unit 2, week 1	October 3	Noon - 2:45 PM, Experiments in NW B141	Research report, Hands-on unit 1
Unit 2, Environment pt 1	October 8	Transition to microbial communities, starting with human-based and stable communities in foods, etc. Microbe communities; interactions/intersections (related to microbiomes)	Readings for class discussion

Unit topic	Date	Topic	Assignment due
MCB121 Hands-on Unit 2, week 2	October 10	Noon - 1:15 PM, Seminar in BioLabs lecture hall (Dr. Amon, MIT); 1:20 - 2:45 PM, Experiments in NW B141	PS 3 (5Q)
Unit 2, Environment pt 2	October 15	Centrality of microbes to earth: great oxidation event; periods of earth history; intro to Anthropocene; C, N, H, phosphate cycles	Readings for class discussion
MCB121 Hands-on Unit 2, week 3	October 17	Noon - 1:15 PM, Seminar in BioLabs lecture hall (faculty search); 1:20 - 2:45 PM, Experiments in NW B141	Readings for class discussion
Unit 2, Environment pt 3	October 22	Centrality of microbes to earth, part 2; Metabolic processes across environment and within the host; types of communities formed/balanced. Begin to consider the role of the immune system	Readings for class discussion
MCB121 Hands-on Unit 2, week 4	October 24	MCB121 Hands-on Unit 2, week 4. Noon - 1:15 PM, Seminar in NW lecture hall (Prof. Gibbs, Harvard); 1:20 - 2:45 PM, Experiments in NW B141	PS 4
Unit 2, Environment pt 4	October 29	Microbes and agriculture. Contributions of microbes to food security? How does this intersect with disease/disease risks. We will consider pesticides/nitrogen run-off and circle back to nutrient cycles.	Readings for class discussion
MCB121 Hands-on Unit 3, week 1	October 31	Noon - 2:45 PM, Experiments in NW B141	Research reports, unit 2
Unit 2, Environment pt 5	November 5	Recap of Unit 2 and catch-up day. Integrate with Unit 1. Transition to considering applications across industries.	Readings for class discussion
MCB121 Hands-on Unit 3, week 2	November 7	Noon - 1:15 PM, Seminar in BioLabs lecture hall (Dr. Martindale, University of Florida); 1:20 - 2:45 PM, Experiments in NW B141	PS 5 (5Q)

Unit topic	Date	Topic	Assignment due
Unit 3, Applications pt 1	November 12	Consider some broad microbial applications: plant-engineering/RoundUp; Wolbachia; H ₂ -power cells; bacillus spores for energy generation, etc. Class brainstorm: what are the critical questions for how microbes can impact/help/hurt with climate change? Can technologies used?	Readings for class discussion
MCB121 Hands-on Unit 3, week 3	November 14	Noon - 2:45 PM, Experiments in NW B141	PS 6
Unit 3, Applications pt 2	November 19	Bio-inspired materials? (or swap with Thursday experiments)?	Readings for class discussion
MCB121 Hands-on Unit 3, week 4	November 21	Noon - 2:45 PM, Experiments in NW B141	Rough draft of Final Paper
Unit 3, Applications pt 3	November 26	Historical choices & emerging threats, natural and man-made (epidemics, bioterrorism)	Readings for class discussion
Unit 3, Applications pt 4	December 3	Where do we go from here? Recap Unit 3 and catch-up day. Tie back into units 1, 2, and 3.	Research report, unit 3
FINAL PAPER	December 18, 2019 at 11:59 PM		