

# Syllabus: ESM219 Microbial Processes in the Environment

Fall, 2023 Lecture: Bren Hall 1424: T/R, 12:30 – 1:45 Lab: Bren Hall 2015: R, 2 – 4:50

## Instructors:

Patricia (Trish) Holden (Professor) / Liviu Iancu (TA)

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## Office Hours:

Trish Holden, Bren Hall 3508: Tuesdays 3 – 5, or Zoom <https://ucsb.zoom.us/j/3067575343>

Liviu Iancu, Bren 2027

## Course Description

Microbes are the most abundant organisms on Earth and control most biogeochemistry. Some are disease-causing. Who, and where, are they? What do they do, and how? This course provides a foundation applicable to environmental and natural resource management. The learning is experiential, through integrated lecture (twice weekly) and lab (once per week) meetings.

Deliverables include lab reports with related exercises, a short paper, and an oral presentation of the paper. There is no required textbook, but “Brock Biology of Microorganisms” is a good resource. Other papers and materials uploaded to Canvas are for additional advanced reading / discussion.

## Student Learning Outcomes and Assessments

1. Explain concepts in environmental microbiology and microbial ecology, with application to natural resource and pollution management
  - a. *In class discussion, final presentation and paper*
2. Use in relationship to environmental problems including climate change, energy, pollution, and public health
  - a. *Invocation of core concepts via laboratory exercises, final paper, and presentation*
3. Discover how to find information and resources, for this course and the future.
  - a. *Selection of topic for paper and presentation*
  - b. *Sourcing information for use in lab reports*
4. Communicate the material; write, and present, using your knowledge gained in this course
  - a. *Quality of written and oral assignment, based on the rubric*

## A few suggested Resources

- **Textbook:** Brock Biology of Microorganisms 16<sup>th</sup> ed. Is the latest Madigan, Michael T. et al. It can be “rented” for a reasonable price: <https://www.pearson.com/en-us/subject-catalog/p/brock-biology-of-microorganisms/P200000006867/9780135860717>. Earlier editions are available. Copies are in the Bren Reading Room. Purchasing is not required.
- **Other reading:** Consult Canvas
- **Other references:**
- Environmental Microbiology by Raina M. Maier, Ian L. Pepper and Charles P. Gerba. 2000. Academic Press.

- General Microbiology by Hans Schlegel
- Microbial Ecology by Atlas & Bartha
- Soil Microbiology and Biochemistry by Paul & Clark
- Manual of Environmental Microbiology by ASM Press
- Some websites:
  - Microscopy (Microbe Zoo): <http://commtechlab.msu.edu/sites/dlc-me/zoo/index.html>
  - Biocatalysis / Biodegradation Database <http://eawag-bbd.ethz.ch/>
  - American Society for Microbiology <http://www.asm.org/>
  - National Center for Biotechnology Information (NCBI) <http://www.ncbi.nlm.nih.gov/>

## How to approach the course

Attend lectures and labs, read, note your questions and bring to class. Read the papers provided on Canvas. Search for other papers and information sources to augment your learning and peak your interests. Participate in discussions; ask for help with concepts. Make use of office hours or email for other options. Keep up with lab reports. Start early in the course with picking your paper topic, and work with the professor in making your choice.

## Grading Criteria

Lab reports / exercises: 60%; Written paper & presentation: 30%; Class participation: 10%

## Course assignments

Lab reports w/ related exercises, a short paper, and an oral presentation of the paper. Guidance on the paper and presentation, and some topic ideas, are posted to Canvas. Consult instructor in selecting your topic. Submit outline with title on Due Date. Guidance for lab reports is provided on Canvas, plus explained by the TA. Focus on completeness, quality, and relevance to the course.

## Calendar Course Outline (approximate): See Canvas for updates

| Wk                  | Lecture Topic                                  | Lab Exercise  | Due |
|---------------------|--|---|-----|
| 1<br>9/28           | Introduction                                   | E0: Introduction to the Lab (safety, and review of experiments) |     |
| 2<br>10/3<br>10/5   | Environmental compartments, habitats, function | E1: Culture microbes (part a)                                   |     |
| 3<br>10/10<br>10/12 | Diversity: discovery, quantification           | E1: Describe, count, subculture (part b);                       |     |

|  |  |  |                            |
|--|--|--|----------------------------|
| <b>4</b><br>10/17<br>10/19   | Energetics, growth, metabolism   | E1: Characterize cultures (part c);  |                            |
| <b>5</b><br>10/24<br>10/26   | Carbon cycle: greenhouse gases / climate                               | E2: C mineralization setup   | E1                         |
| <b>6</b><br>10/31<br>11/2  | Biotransformation organic pollutants                                   | E2: Final measurements (TA)<br>E3: Toluene biodegradation, biostimulation, and bioaugmentation |                            |
| <b>7</b><br>11/7<br>11/9   | Nitrogen cycle: N <sub>2</sub> fixation, ammonification; Nitrification | E4: N <sub>2</sub> fixation study  | paper title /outline<br>E2 |
| <b>8</b><br>11/14<br>11/16   | Nitrogen cycle: Denitrification<br>Microbiological water quality       | E5: Culture-based & molecular analysis of water quality (IDEXX / qPCR)                         | E3                         |
| <b>9</b><br>11/21<br>11/23   | HABs; Antibiotic Resistance<br><i>No class (holiday)</i>               | <i>No lab (holiday)</i>  | E4                         |
| <b>10</b><br>11/28<br>11/30  | Biotransformation metals<br>Biotechnology/ bioenergy                   | E6: DNA-based diversity (demo)   | E5                         |
| <b>11</b><br>12/5<br>12/7  | Review<br>Final presentations (students)                               | Final presentations (cont.)  | Final presentation         |
| <b>Final Student Presentations: Thursday Dec. 7<sup>th</sup>, (12:30 – 5 pm; Bren Hall 1424)</b><br><b>***NOTE: Final presentations are by students in lecture / lab time periods on last day of class. Papers are due Thursday, 12/14 no exceptions</b> |  |  | Paper due 12/14            |

## Student Resources

- Information and [links for applicable student resources](#).
- Links to [wellbeing and mental health](#) resources
- Library resources: [UCSB Library](#)