

**Microbial Ecology**  
**(BIOL 421)**  
**Spring 2018**  
Tue. & Thu. 10:50-12:05, EHFA 256.

**Instructor:** Dr. Vlad Gulis

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**Office Hours:** Tue. & Thu. 4:00-5:30, Wed. 10:00-1:00 or contact me for an appointment (you may expect a reply within 24 hours during the normal working hours).

**Textbook:** Atlas R.M. and Bartha R. 1998. Microbial Ecology: Fundamentals and Applications, 4th ed. Benjamin/ Cummings Science Publishing (recommended but not required; see also other reference materials on p. 2).

**Moodle:** Moodle will be used for this class. A copy of the syllabus, lecture notes, some journal articles/readings, points/grades and other pertinent information will be posted. Check it regularly.

**Course description:** This course is designed to introduce students to the vital roles that microorganisms play in various environments and in sustaining life on Earth. Some topics that will be covered include: microbial metabolic diversity; the role of microorganisms in biogeochemical cycles; microbial diversity, activity and importance in the functioning of aquatic and terrestrial ecosystems; microbial bioremediation.

**Course objectives:** To ensure that students:

- understand major topics and principles in microbial ecology
- understand and explain the critical importance of microorganisms in sustaining life on Earth
- have sufficient background in microbial ecology to take more advanced courses, either as an undergraduate or graduate student.

**Student learning outcomes:** By the end of the semester, the student will be able to:

- demonstrate a general understanding of major methodological approaches to analyses of microbial communities
- describe and differentiate symbiotic relationships among microorganism and their interactions with plants and animals along the continuum from parasitism to mutualism
- discuss the metabolic adaptations and ecological importance of chemolithotrophs and microorganisms capable of anaerobic respiration in aquatic and subsurface environments
- describe the role of microorganisms in biogeochemical cycles of carbon, nitrogen and sulfur
- explain the crucial role of microorganisms in the functioning of aquatic and terrestrial ecosystems
- describe the processes involved in microbial degradation of solid waste, wastewater treatment and some aspects of bioremediation.

**Assessment and grading:** The student's performance in this course will be assessed *via* a series of quizzes, three exams during the semester as well as a cumulative final exam. Quizzes will be given, unannounced, every few classes, usually at the beginning of a class. Exams may include multiple choice, short answer and discussion type questions. Grades will be assigned on the basis of the percentage of 550 points as follows:

Point distribution

| Assignment   | Points     |
|--------------|------------|
| Exam 1       | 100        |
| Exam 2       | 100        |
| Exam 3       | 100        |
| Final exam   | 150        |
| Quizzes (4)  | 100        |
| <b>Total</b> | <b>550</b> |

Grading scale

| Grade | %      |
|-------|--------|
| A     | 90-100 |
| B+    | 85-90  |
| B     | 80-85  |
| C+    | 75-80  |
| C     | 70-75  |
| D+    | 65-70  |
| D     | 60-65  |
| F     | 0-60   |

Confirmed cheating or plagiarism on an exam or assignment will result in a grade of "F" for that assignment, the entire course and/or reporting to the university. In general, academic misconduct will not be tolerated. See CCU Student Code of Conduct for details.

**Attendance:** Attendance is expected and will be monitored *via* a sign-off sheet, which will be passed around at the beginning of each lecture. I will follow the CCU catalog policy that "An instructor is permitted to impose a penalty, including assigning the grade of F, for unexcused absences in excess of 25% of the regularly scheduled class meetings". If you are absent or late, you may miss unannounced quizzes that would affect your grade. Make-up exams are only given for university-excused absences. See current CCU catalog for details.

**Cell phones:** Use of cell phones during the class is both disruptive and disrespectful to your colleagues. You will be asked to leave the class after the second offense.

**Disabilities:** Students with disabilities should see me at the beginning of semester so special arrangements can be made, if necessary. Also, please contact Office of Disability Services.

**Other reference materials:** The text recommended for this class is one of the few available in microbial ecology. Unfortunately, it is outdated. As you can see from the course outline, I will not follow the organization of the text during the semester. Therefore, I will be somewhat selective as to the topics covered. For some areas, the text gives good coverage, in other areas, I have found better coverage from other sources. Consequently, I have indicated some of these sources under the appropriate topic. Copies of some material (not necessarily listed below, e.g. journal papers) may be made available in electronic form through Moodle and will be mentioned in class. Commonly used sources include:

Madigan M.T. et al. 2015. Brock Biology of Microorganisms, 14th Edition, Pearson. (Earlier editions, e.g. 13th and 12th are useful as well).

- Kirchman D.L. 2012. Processes in Microbial Ecology. Oxford University Press.
- Hurst C.J. et al. (Eds.) 2007. Manual of Environmental Microbiology, 3rd ed. ASM Press.
- Kemp P.F., Cole J.J., Sherr B.F., Sherr E.B. 1993. Handbook of Methods in Aquatic Microbial Ecology. Lewis Publishers.
- Kirchman D.L. (Ed.). 2000. Microbial Ecology of the Oceans. Wiley-Liss.
- Staley J.T. and Reysenbach A.L. 2002. Biodiversity of Microbial Life: Foundation of Earth's Biosphere. Wiley-Liss.
- Ford T.E. (Ed.). 1993. Aquatic Microbiology: An Ecological Approach. Blackwell Science.

**Some useful web resources:**

International Society for Microbial Ecology - <https://www.isme-microbes.org/>  
 The Center for Microbial Ecology (Michigan State U) - <http://www.cme.msu.edu>  
 The Microbial Zoo - <http://commtechlab.msu.edu/sites/dlc-me/index.html>

**TENTATIVE SCHEDULE**

| <b>Date</b>                  | <b>Week</b> | <b>Lecture Topic and Assigned Readings*</b>   |
|------------------------------|-------------|---|
| Tue, Jan. 9<br>Thu, Jan. 11  | 1           | Introduction and overview of microorganisms. Roles and significance of microorganisms in ecosystem level processes. Text: Chapter 1 & 2, Madigan et al.: Chapter 1 & 2. |
| Tue, Jan. 16<br>Thu, Jan. 18 | 2           | Methods for examining microorganisms in the environment. Text: Chapter 7, Madigan et al.: Chapter 18.   |
| Tue, Jan. 23<br>Thu, Jan. 25 | 3           | Methods in microbial ecology, continued.  |
| Tue, Jan. 30<br>Thu, Feb. 1  | 4           | <b>Exam 1</b><br>Interactions among microorganisms. Microbial loop. Biofilms. Lichens. Text: Chapter 3.   |
| Tue, Feb. 6<br>Thu, Feb. 8   | 5           | Interactions among microorganisms, continued.   |
| Tue, Feb. 13<br>Thu, Feb. 15 | 6           | Interactions between microorganisms and animals. Nutrition, gut flora, rumen, mycophagy. Text: Chapter 5; Madigan et al.: Chapter 22.6-22.14.                           |
| Tue, Feb. 20<br>Thu, Feb. 22 | 7           | Interactions between microorganisms and plants. Rhizosphere, mycorrhizae, symbiotic nitrogen fixation. Text: Chapter 4, Madigan et al.: Chapter 22.3-22.5.              |
| Tue, Feb. 27<br>Thu, Mar. 1  | 8           | <b>Exam 2</b><br>Microbial metabolic diversity, Madigan et al.: Chapter 13, also Chapters 3 and 14, in part.  |

|                              |    |   |
|------------------------------|----|---|
| Tue, Mar. 6<br>Thu, Mar. 8   | 9  | <b>Spring Break</b>   |
| Tue, Mar. 13<br>Thu, Mar. 15 | 10 | Microbial metabolic diversity, continued.   |
| Tue, Mar. 20<br>Thu, Mar. 22 | 11 | Biogeochemical cycles. Carbon cycle. Text: Chapter 10; Madigan et al.: Chapter 20.1, 20.2.<br><b>Mar. 21 is the last day to drop with a “W”.</b>  |
| Tue, Mar. 27<br>Thu, Mar. 29 | 12 | Nitrogen cycle. Text: Chapter 11; Madigan et al.: Chapter 20.3.<br>Graduate student presentations   |
| Tue, Apr. 3<br>Thu, Apr. 5   | 13 | Phosphorus cycle. Sulfur cycle. Text: Chapter 11; Madigan et al.: Chapter 20.4, 20.6.<br><b>Exam 3</b>  |
| Tue, Apr. 10<br>Thu, Apr. 12 | 14 | Aquatic microbiology. Freshwater, estuarine, marine environments. Hydrothermal vents. Text: Chapter 9; Madigan et al.: Chapter 19.4, 19.5, 19.8-19.13.                                      |
| Tue, Apr. 17<br>Thu, Apr. 19 | 15 | Soil microbiology. Atmospheric microbiology. Text: Chapter 9; Madigan et al.: Chapter 19.6, 19.7.<br>Bioremediation. Wastewater treatment. Text: Chapter 12-14. Madigan et al.: Chapter 21. |
| Tue, Apr. 24                 | 16 | Bioremediation, continued.  |
| Thu, May 3                   |    | <b>Final Exam (11 am)</b>   |

\*The schedule is tentative and subject to change at the discretion of the instructor