

**BIOLOGY 438 A01 (CRN20378)**  
**NUTRIENT CYCLING AND PROKARYOTES**  
**September 09- December 07, 2026**

**COURSE OUTLINE**

**INSTRUCTOR Name:** Farnoosh Farhoomand, Ph.D.

**Office:** -                      **email:** [Farhooma@uvic.ca](mailto:Farhooma@uvic.ca)

**LECTURES**

Day and Time: Monday, Thursday- 5:30-6:50 pm

Building and room: Elliott 062

Delivery Mode

Face to face, PowerPoint, Brightspace

**OFFICE HOURS:**

Day and Time: Wednesday 10:00 am- 12:00 pm

Building and room: Virtual with appointment

**COURSE DESCRIPTION**

An introduction to prokaryotes (bacteria and archaea) and their role in nutrient cycling in forests, lakes and oceans. Diversity and evolution of populations and communities of prokaryotes and their role in the major biogeochemical cycles: carbon, nitrogen, sulfur. Genetic, biochemical, physiological and ecological aspects of processes such as nitrogen fixation and methanogenesis; design of experimental approaches to assess cycling of elements in forests, lakes and oceans by prokaryotes.

**LEARNING OUTCOMES**

At the end of this course, you will be able to:

1. Define, explain and analyze populations of prokaryotes in various natural systems.
2. Define, explain and analyze the contribution of prokaryotes to various communities.
3. Explain how prokaryotes contribute to the functioning of ecosystems by analyzing the contribution of prokaryotes in
  - a) the cycling of carbon
  - b) the cycling of nitrogen.
4. Design observational and experimental approaches to study prokaryotes in various ecosystems:
  - a) Soil and sediment
  - b) Freshwater and marine systems
  - c) Extreme environments.

5. Understand connection between the diversity of prokaryotes and their fundamental contributions to energy transfer and material cycling in natural ecosystems.
6. Evaluate critically primary literature published in the area of microbial ecology.

## Tentative LECTURE TOPICS

Tentative: Not all topics may be covered depending on the time available

| Date        | Topics                                                                                       |
|-------------|----------------------------------------------------------------------------------------------|
| Th Sept. 10 | Introduction to the course                                                                   |
| M Sept. 14  | Bacteria and Archaea: A Review                                                               |
| Th Sept. 17 | Ecosystem Energetics/ <b>Assignment 1: article Circle of Life</b>                            |
| M Sept. 21  | Ecosystem Energetics                                                                         |
| Th Sept. 24 | Decomposition and Nutrient Cycling// <b>Quiz 1 assignment 2: SAR 11 in Sargasso Sea (5%)</b> |
| M Sept. 28  | Decomposition and Nutrient Cycling                                                           |
| Th Oct. 1   | Biogeochemical Cycle                                                                         |
| M Oct. 5    | Biogeochemical Cycle                                                                         |
| Th Oct. 08  | Microbial Systematics and Methods                                                            |
| M Oct. 12   | <b>NO CLASS- Thanksgiving Day</b>                                                            |
| Th Oct. 15  | <b>Quiz 2 Assignment 3: Diversity of Crenarchaeota (5%)</b>                                  |
| M Oct. 19   | Microbial Systematics and Methods                                                            |
| Th Oct. 22  | <b><u>MID-TERM EXAM 1 (30%)</u></b>                                                          |
| M Oct. 26   | Carbon Cycle: Photosynthesis/                                                                |
| Th Oct. 29  | Carbon Cycle: Respiration (bioremediation)                                                   |
| M Nov. 02   | Carbon Cycle: Fermentation                                                                   |
| Th Nov. 05  | Carbon Cycle: Methanogenesis                                                                 |
| M Nov. 09   | <b>No CLASS- Reading Break</b>                                                               |
| Th Nov. 12  | Carbon Cycle: Methane Oxidation                                                              |
| M Nov. 16   | <b><u>MID-TERM EXAM 2 (30%)</u></b>                                                          |
| Th Nov. 19  | Nitrogen Cycle: Nitrogen fixation                                                            |
| M Nov. 23   | <b>Quiz 3 Assignment 4: Silent MGC (5%)</b>                                                  |
| Th Nov. 26  | Nitrogen Cycle: Nitrification                                                                |
| M Nov. 30   | Nitrogen Cycle: Denitrification                                                              |
| Th Dec 03   | Review                                                                                       |
| M Dec 07    | <b><u>FINAL EXAMINATION (25%)</u></b>                                                        |

## **RECOMMENDED TEXTBOOK AND REFERENCES**

### **Recommended textbook**

- Madigan, M., J.M. Martinko, P.V. Dunlap, D.P. Clark. 2012. Brock Biology of Microorganisms. 13th ed. Pearson-Benjamin Cummings, San Francisco, CA, USA

### **Other references**

#### **General textbooks**

- Hunter, M. D. 2016. The Phytochemical Landscape. Linking Trophic Interactions and Nutrient Dynamics. Monographs in Population Biology. S.A. Levin and H.S. Horn Eds. Princeton University Press. Princeton, NJ, USA. 360 p.
- Krebs, Charles J. 2016. Why Ecology Matters. The University of Chicago Press. 193 p.
- Smith, T.M. and R.L. Smith. 2015. Elements of Ecology. 9th Ed. Pearson, Boston, MASS, USA.
- Hubbard Brook Ecosystem Study
  - Likens, G. E. 2013. Biogeochemistry of a Forested Ecosystem. 3rd Ed. Springer, New York, NY, USA.
  - Bormann, F.H. and G. E. Likens. 1979. Pattern and Process in a Forested Ecosystem. Springer, New York, NY, USA.
  - Likens, G.E. (Ed.). 1985. An Ecosystem Approach to Aquatic Ecology. Springer, New York, NY, USA.

#### **Other textbooks**

- Atlas, R.M., and R. Bartha. 1998. Microbial Ecology. 4th ed. Benjamin Cummings, Menlo Park, CA.
- Schlegel, H.G. 1997. General Microbiology. 7th Ed. Cambridge University Press, Cambridge, UK. Stolp, H. 1988.
- Microbial Ecology: Organisms, Habitats, Activities. Cambridge Studies in Ecology. Cambridge University Press. Cambridge, UK.

#### **Taxonomy**

- Garrity, G.M. 2001-2009. Bergey's Manual of Systematic Bacteriology. Second Edition. Vol. 1 (Archaea), Vol 2 (Parts A, B, C) (Proteobacteria), Vol. 3 (Firmicutes), Vol. 4 (Miscellaneous Phyla). Springer, NY, USA.

#### **Genetic diversity**

- Hopwood, D. A., and K.F. Chater (eds.). 1989. Genetics of Bacterial Diversity. Academic Press, London, UK.

#### **Biogeochemical cycling**

- Fenchel, T., G. King, and T.H. Blackburn. 1998. Bacterial Biogeochemistry. The Ecophysiology of Mineral Cycling. Academic Press, London, UK.

### **Nitrogen cycle**

- Sprent, J. 1987. The Ecology of the Nitrogen Cycle. Cambridge Studies in Ecology. Cambridge University Press, Cambridge, UK.
- Postgate, J. R. 1998. Nitrogen Fixation. Cambridge University Press, Cambridge, Cambridge, UK.
- Payne, J.W. 1982. Denitrification. John Wiley & Sons, New York, NY.

### **Soil Microbiology**

- Paul, E.A. 1998. Soil Microbiology and Biochemistry. Academic Press, San Diego, CA.
- Sylvia, D.M., J.J. Fuhrman, P.G. Hartel, D.A. Zuberer (Eds.). 1999. Principles and Applications of Soil Microbiology. Prentice Hall, Upper Saddle River, NJ.

### **Aquatic Microbiology**

- Kirchman, D.L. (Ed.). 2008. Microbial Ecology of the Oceans. 2nd Ed. Wiley-Blackwell, Hoboken, NJ, USA.
- Rheinheimer, G. 1980. Aquatic Microbiology. 2nd ed. John Wiley & Sons, London, UK.
- Paul, J.H. (Ed.). 2001. Marine Microbiology. Academic Press, San Diego, CA.

### **Fermented Food**

- Hutkins, R.W. 2006. Microbiology and Technology of Fermented Foods. IFT Press-Blackwell Publishing, Ames, Iowa, USA.

## **EVALUATION**

### **Required**

1. **Midterm 1:** October 22 (30%)
2. **Midterm 2:** November 16 (30%)
3. **Final:** December 07 (25%)
4. **Quizzes** are multiple choice questions and are based on assigned research articles: 3 x 5% each for 15% of final mark

**NOTE:** All exams and quizzes are conducted in person using paper-based formats.

Students **missing a midterm** for illness need to notify me by email ([Farhooma@uvic.ca](mailto:Farhooma@uvic.ca)) prior to the examination. If possible, a remedial examination will be scheduled as soon as possible after the midterm.

There is no additional make-up for **missed quizzes and Final exam.**

### **Facultative**

**4. Assignments:** Four research articles with guiding questions form the assignments. Submission of written answers to the guiding questions is facultative but will be counted as

bonus points (0.5% to 1.0 % per assignment) after the final examination and added to the term mark.

### **Reading of articles**

1. Nitrogen cycle (THE WIBBLY-WOBBLY CIRCLE OF LIFE)
2. SAR 11 in Sargasso Sea (Giovannoni, S.J. et al. 1990. Nature 345: 60-63; Rappe, M.S. et al. 2002. Nature 418: 630-633) (**QUIZ 1**)
3. Wide diversity of Crenarchaeota (Herschberger, K. L., et al. 1996. Nature 384: 420. 4) (**QUIZ 2**)
4. Silent MGC in a soil anoxygenic phototrophic bacterium (Dziuba, M.V. 2023. ISME Journal 17: 326–339.) (**QUIZ 3**)

Assignments are facultative but intended to prepare for the midterms and final examinations. Examinations may even include some questions from the assignments. Students are therefore encouraged to do the assignments.

**Bonus points** (0.5% to 1.0 % per assignment submitted) will be given after the final examination for completion and submission of assignments to Brightspace before the due date and time.

**IMPORTANT:** assignments must be submitted at the time specified to be counted as bonus marks.

**Grading scheme:** A+ (90-100%), A (85-89.5%), A- (80-84.5%), B+ (77-79.5%), B (73-76.5%), B- (70-72.5%), C+ (65-69.5%), C (60-64.5%), D (50-59.5%), F (<50%, after final)

### **N grades:**

To pass the course, students must complete the midterms and final exams. Students who do not complete both exams will automatically fail the course and receive a grade of "N" on their transcript.

### **ATTENDANCE (this is an optional section that you may not require)**

Attendance to lecture is expected (attendance sheet will be circulated from time to time to record a sample of attendance).

Attendance to evaluations (midterms and final examination) is also recorded and required for marking of evaluation.

### **LECTURES**

This course is delivered in a face-to-face format. Zoom lectures may be done if for some reason (illness) I cannot come to campus to give the lecture. Lectures are PowerPoint presentations available on Brightspace if students are missing a lecture for sickness.

**NO CLASSES DURING READING BREAK.**

**THE DEPARTMENT OF BIOLOGY DOES NOT OFFER SUPPLEMENTAL FINAL EXAMS.**

## ADDITIONAL MATERIAL

***UVic is committed to promoting, providing and protecting a supportive and safe learning and working environment for all its members.***

### **Territorial Acknowledgement**

*We acknowledge and respect the ləkʷəŋən peoples on whose traditional territory the university stands and the Songhees, Esquimalt and W̱SÁNEĆ peoples whose historical relationships with the land continue to this day.*

### **Attendance and absences**

*Medical documentation for short-term absences is **not required**. [Attendance is important](#). Students who can not attend due to illness are asked to notify their instructors immediately. If illness, accident, or family affliction causes a student to miss the final exam or to fail to complete any assignment by the end of the term students are required to submit a request for academic concession.*

- *Policies regarding undergraduate student academic concessions and deferrals are also detailed on the [Undergraduate Records](#). Students must submit a [Request for Academic Concession](#).*

### **Academic Integrity**

*Students are required to abide by all academic regulations set as set out in the University calendar, including standards of academic integrity. Violations of academic integrity (e.g. cheating and plagiarism) are considered serious and may result in significant penalties.*

*<https://www.uvic.ca/students/academics/academic-integrity/index.php>*

### **Class recording (Echo360)**

*There will be no class recording of the lectures*

### **Transcription & Captioning**

*If you are using transcriptions, state that in the syllabus eg: *If you require captions as part of an academic accomodation, please contact [CAL](#).**

### **Copyright**

*All course content and materials are made available by instructors for educational purposes and for the exclusive use of students registered in their class<sup>[1]</sup>. The material is protected under copyright law, even if not marked with a ©. Any further use or distribution of materials to others requires the written permission of the instructor, except under fair dealing or another exception in the Copyright Act. Violations may result in disciplinary action under the [Resolution of Non-Academic Misconduct Allegations policy \(AC1300\)](#).*

### **Student conduct**

*The University of Victoria is committed to promoting critical academic discourse while providing a respectful and supportive learning environment. All members of the university community have the right to this experience and the responsibility to help create such an environment. The University will not tolerate racism, sexualized violence, or any form of discrimination, bullying or harassment. Please be advised that this includes logging into UVic's learning systems or interacting with online resources, and course-related communication platforms, you are engaging in a university activity. All interactions within this environment are subject to the university expectations and policies. Any concerns about student conduct may be reviewed and responded to in accordance with the appropriate university policy.*

*To report concerns about online student conduct: [onlineconduct@uvic.ca](mailto:onlineconduct@uvic.ca)*

*Concerns about conduct in lectures and labs should be brought to your instructor.*

### **Mental Health**

*A note to remind you to take care of yourself. Diminished mental health can interfere with optimal academic performance. Do your best to engage in self-care and maintain a healthy lifestyle this semester. This will help you achieve your goals and cope with stress. All of us benefit from support during times of struggle. You are not alone. Support services at UVic can be found through [The UVic Student Wellness Centre](#) which provides cost-free and confidential mental health services to help you manage personal challenges that impact your emotional or academic well-being.*

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