

BIOLOGY 438 A01 (CRN 10399)
NUTRIENT CYCLING AND PROKARYOTES
September 4– December 4 2024
COURSE OUTLINE

PROFESSOR:

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Office: Cunningham 048a

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LECTURES

Monday, Thursday 8:30-9:50

ECS 124

OFFICE HOURS:

Monday, 10:00 am to 12:00 am

CUN 048

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.

EVALUATION

Required

1. Midterm 1: October 7th 8:30-9:30 am CLE A102 (30%)
2. Midterm 2: November 4th 8:30-9:30 am CLE A102 (30%)
3. Final: (in December during exam period): TBA (40%)

All examinations will be conducted on-line using Brightspace in a designated room at UVic.

Students missing the midterm for illness need to notify me by email prior to the examination. If possible, a remedial examination will be scheduled as soon as possible after the midterm.

Facultative

4. Bonus Assignments (to prepare midterms and final exams and up to 4% of final marks):
Some example:

1. 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)
 - 3) Wide diversity of Crenarchaeota (Herschberger, K. L., et al. 1996. *Nature* 384: 420. 4)
 - 4) Silent MGC in a soil anoxygenic phototrophic bacterium (Dziuba, M.V. 2023. *ISME Journal* 17: 326–339.)

Assignments are facultative but intended to prepare for the midterm and final examinations. Examinations may even include some questions from the assignments. Students are therefore encouraged to do the assignments. Bonus points may also be given after the final examination for completion of the assignments.

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)

ATTENDANCE

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 ON THANKSGIVING AND READING BREAK.

THE DEPARTMENT OF BIOLOGY DOES NOT OFFER SUPPLEMENTAL FINAL EXAMS.

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 lək'wəḡən 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** for the Fall 2021 term (approved by Senate). **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.

Class recording (Echo360)

Be aware that sessions in this course may be recorded to allow students who are not able to attend to watch later. The recording will be posted in Brightspace. Students who have privacy concerns can contact me and will have the option to limit their personal information shared in the recording. If you have other questions or concerns regarding class recording and privacy please contact privacyinfo@uvic.ca.

Transcription & Captioning

Auto-generated transcription and captioning is enabled in this course. Please be aware that automated transcription and captioning is at best 70-90% accurate and by nature will include error. This depends on the subject matter, speaker, audio quality etc. Words prone to error include specialized terminology and proper names. Students are asked to refer to the audio feed for clarification of any errors. If you find transcription or captioning **that is offensive**, please contact your instructor and/or teaching assistant so that they are aware. If you require captions as part of an academic accomodation, please contact [CAL](#).

Copyright

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Online 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, by 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

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. The source of symptoms might be related to your course work; if so, please speak with me. However, problems with other parts of your life can also contribute to decreased academic performance. [The UVic Student Wellness Centre](#) provides cost-free and confidential mental health services to help you manage personal challenges that impact your emotional or academic well-being.

LECTURE TOPICS (Tentative: Not all topics may be covered depending on the time available)

Date	Topics
Th Sept. 5	Introduction/ <i>Assignment 1: article Circle of Life</i>
M Sept. 9	<i>Assignment 2: SAR11 in Sargasso Sea</i>
Th Sept. 12	1. Ecosystem Energetics
M Sept. 16	<i>Discuss Assignment 2: SAR11 in Sargasso Sea</i>
Th Sept. 19	2. Decomposition and Nutrient Cycling
M Sept. 23	3. Hubbard Brook: A Model Ecosystem
Th Sept. 26	<i>Assignment 3: Wide Diversity of Crenarchaeota</i>
M Sept. 30	Day for Truth and Reconciliation: No class
Th Oct. 3	4. Biogeochemical Cycle/ <i>Discuss Assignment 3: Wide Diversity of Crenarchaeota</i>
M Oct. 7	MID-TERM EXAM 1 (30%) 8:15-9:30 am CLE A102 (30%)
Th Oct. 10	5. Microbial Systematics and Methods
M Oct. 14	Thanksgiving
Th Oct. 17	6. Carbon Cycle: Photosynthesis
M Oct. 21	<i>Assignment 4: Silent MGC</i>
Th Oct. 24	7. Carbon Cycle: Respiration (bioremediation)
M Oct. 28	8. Carbon Cycle: Fermentation
Th Oct. 31	9. Carbon Cycle: Methanogenesis/ <i>Discuss Assignment 4: Silent MGC</i>
M Nov. 4	MID-TERM EXAM 2 (30%) 8:15-9:30 am CLE A102 (30%)
Th Nov. 7	
M Nov. 11	Remembrance Day & Reading Break: No class
Th Nov. 14	10. Carbon Cycle: Methane Oxidation
M Nov. 18	11. Nitrogen Cycle: Nitrogen fixation
Th Nov. 21	
M Nov. 25	12. Nitrogen Cycle: Nitrification
Th Nov. 28	13. Nitrogen Cycle: Denitrification
M Dec. 2	
Dec.	FINAL EXAMINATION (40%)

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. and . 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.

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