

BIOLOGY 438 A01 (CRN 10442)
NUTRIENT CYCLING AND PROKARYOTES
September 7– December 5 2022
COURSE OUTLINE

PROFESSOR:

RÉAL ROY, Ph.D.

Office: Cunningham 048a

email realroy@uvic.ca

LECTURES

Monday, Thursday 8:30-9:50

CUN 146

OFFICE HOURS:

Monday, 10:00 am to 12:00 am

CUN 048 or

Zoom Meeting Room (send email request)

<https://uvic.zoom.us/j/4695576594?pwd=Z0VxbTk4WmF1TEFyZHJiWHlzYnRzUT09>

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: 30%
2. Midterm 2: 30%
3. Final: 40% (December in exam period)

Examination will be on-line on Brightspace but in a designated room at UVic.

Facultative

4. Bonus Assignments (to prepare midterms and final exams and up to 3% of final marks)
 1. Reading of articles like: Herschberger, K. L., S.M. Barns, A.-L. Reysenbach, S.C. Dawson, N.R. Pace. 1996. Wide Diversity of Crenarchaeota. *Nature* 384: 420.
Answer questions.
 2. Critical presentation of a scientific article.
 - 1) 2 page summary and critique of a published article.
 - 2) Powerpoint presentation (5 minutes, 5 slides maximum)
 3. Mount Douglas Park Microbial Communities and Nutrient cycling.
 - 1) Powerpoint presentation 10 slides: 5 different communities

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: any delays in submitting assignments will be penalized (10% per day).

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)

NO CLASSES ON THANKSGIVING AND READING BREAK.

THE DEPARTMENT OF BIOLOGY DOES NOT OFFER SUPPLEMENTAL FINAL EXAMS.

ABSENCE TO THE EXAMS FOR HEALTH PROBLEM WILL BE GRANTED ONLY WITH THE SUBMISSION OF A DOCTOR'S NOTE.

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'wəŋən peoples on whose traditional territory the university stands and the Songhees, Esquimalt and WSÁNEĆ 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

All course content and materials are made available by instructors for educational purposes and for the exclusive use of students registered in their class [\[1\]](#). 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 \(AC1300\)](#).

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. 8	Introduction
M Sept. 12	1. Ecosystem Energetics
Th Sept. 15	
M Sept. 19	2. Decomposition and Nutrient Cycling
Th Sept. 22	
M Sept. 26	3. Hubbard Brook: A Model Ecosystem
Th Sept.29	
M Oct. 3	4. Biogeochemical Cycles
Th Oct. 6	5. Microbial Systematics and Methods
M Oct. 10	Thanksgiving: no class
Th Oct. 13	MID-TERM 1 (30%)
M Oct. 17	6. Carbon Cycle: Photosynthesis
Th Oct. 20	7. Carbon Cycle: Respiration (bioremediation)
M Oct. 24	8. Carbon Cycle: Fermentation
Th Oct. 27	9. Carbon Cycle: Methanogenesis
M Oct. 31	10. Carbon Cycle: Methane Oxidation
Th Nov. 3	12. Nitrogen Cycle: Nitrogen fixation
M Nov. 7	11. Nitrogen Cycle: Nitrification
Th Nov.10	Remembrance Day & Reading Break: No class
M Nov. 14	Midterm Exam 2 (30%)
Th Nov. 17	13. Nitrogen Cycle: Denitrification
M Nov. 21	14. Localization of Prokaryotes: Soil & Sediment
Th Nov. 24	15. Localization of Prokaryotes: Aquatic Systems
M Nov. 28	16. Localization of Prokaryotes: Extreme Systems
Th Dec. 1	17. Biogeochemical Cycles and the Origin of Life
M Dec. 5	LAST CLASS
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.

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.

Other references

General textbooks

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.

This copy was made pursuant to the [Fair Dealing Guidelines](#) of the University, library database licenses, and other university licenses and policies. The copy may only be used for the purpose of research, private study, criticism, review, news reporting, education, satire or parody. If the copy is used for the purpose of review, criticism or news reporting, the source and the name of the author must be mentioned. The use of this copy for any other purpose may require the permission of the copyright owner.