

**BIOLOGY 438 (CRN 10429)**  
**NUTRIENT CYCLING AND PROKARYOTES**  
**September – December 2021**  
**COURSE OUTLINE**

**PROFESSOR:**

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**LECTURES**

Monday, Thursday 8:30-9:50

COR A-121

**OFFICE HOURS:**

Monday, 10:00 am to 12:00 am

**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

### **Examination will be on Brightspace**

1. Midterm 1: 30%
2. Midterm 2: 30%
3. Final: 40% (December in exam period)
4. Bonus Assignments: (1-3% 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)

**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 OCTOBER 11 AND NOVEMBER 11 BECAUSE OF 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'wəḡən 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](mailto: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](mailto: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)

Date	Topics	Ref
Th Sept. 9	Introduction	1
M Sept. 13	1. Ecosystem Energetics	2
Th Sept. 16		
M Sept. 20	2. Decomposition and Nutrient Cycling	3, 4, 5
Th Sept. 23		
M Sept. 27	3. Hubbard Brook: A Model Ecosystem	
<b>Th Sept.30</b>	<b>No Lectures: Day of Commemoration</b>	
M Oct. 4	4. Biogeochemical Cycles	
Th Oct. 7	5. Microbial Systematics and Methods	6-7
<b>M Oct. 11</b>	<b>Thanksgiving: no class</b>	8, 11
<b>Th Oct. 14</b>	<b>MID-TERM 1 (30%)</b>	9-10
M Oct. 18	6. Carbon Cycle: Photosynthesis	
Th Oct. 21	7. Carbon Cycle: Respiration (bioremediation)	9-10
M Oct. 25	8. Carbon Cycle: Fermentation	9-10
Th Oct. 28	9. Carbon Cycle: Methanogenesis	9-10
M Nov. 1	10. Carbon Cycle: Methane Oxidation	9-10
Th Nov. 4	12. Nitrogen Cycle: Nitrogen fixation	9-10
M Nov. 8	11. Nitrogen Cycle: Nitrification	9-10
<b>Th Nov.11</b>	<b>Remembrance Day &amp; Reading Break: No class</b>	
<b>M Nov. 15</b>	<b>Midterm Exam 2 (30%)</b>	
Th Nov. 18	13. Nitrogen Cycle: Denitrification	
M Nov. 22	14. Localization of Prokaryotes: Soil & Sediment	12
Th Nov. 25	15. Localization of Prokaryotes: Aquatic Systems	12
M Nov. 29	16. Localization of Prokaryotes: Extreme Systems	13
Th Dec. 2	17. Biogeochemical Cycles and the Origin of Life	8
Dec.	FINAL EXAMINATION (40%)	

Ref numbers are chapters in the Pearson Customized Textbook

## RECOMMENDED TEXTBOOK AND REFERENCES

### Recommended textbook

Madigan, M., J.M. Martinko, P.V. Dunlap, D.P. Clark. 2012. Brock Biology of Microorganisms. 13<sup>th</sup> 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.

### **Coursepack available through on-line UVic Library**

#### **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. 9<sup>th</sup> Ed. Pearson, Boston, MASS, USA.

##### **Hubbard Brook Ecosystem Study**

Likens, G. E. 2013. Biogeochemistry of a Forested Ecosystem. 3<sup>rd</sup> 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. 4<sup>th</sup> ed. Benjamin Cummings, Menlo Park, CA.

Schlegel, H.G. 1997. General Microbiology. 7<sup>th</sup> 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. 2<sup>nd</sup> Ed. Wiley-Blackwell, Hoboken, NJ, USA.

Rheinheimer, G. 1980. Aquatic Microbiology. 2<sup>nd</sup> 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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