

**BIOLOGY 438 (CRN 10432)**  
**NUTRIENT CYCLING AND PROKARYOTES**  
**September – December 2020**  
**COURSE OUTLINE**

**PROFESSOR:**

RÉAL ROY, Ph.D.

Office: Cunningham 048a

ph: 472-5071

email [realroy@uvic.ca](mailto:realroy@uvic.ca)

**TEACHING ASSISTANT:**

BRETT JAMESON

email: [bjameson@uvic.ca](mailto:bjameson@uvic.ca)

**LECTURES**

Room: on-line (ZOOM)

Join Zoom Meeting

<https://uvic.zoom.us/j/99905581172?pwd=cnp0UEw4WkMvUExaTHRUdkRMNEJ3Zz09>

Monday, Thursday 8:30-9:50

**OFFICE HOURS: (Zoom)**

Join Zoom Meeting

<https://uvic.zoom.us/j/4695576594?pwd=Z0VxbTk4WmF1TEFyZlZlYnRzUT09>

Meeting ID: 469 557 6594

Password: 105221

## 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

1. Midterm 1: 30% (October 4)
2. Midterm 2: 30% (November 4)
3. Final: 40% (December in exam period)
4. Bonus Assignments: (1-3% of final marks)
  1. Reading of 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 (85-89.9%), A- (80-84.9%), B+ (77-79.9%), B (73-76.9%), B- (70-72.9%), C+ (65-69.9%), C (60-64.9%), D (50-59.9%), F (<50%, after final)

**NO CLASSES ON OCTOBER 14 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.*

**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	
Th Sept. 30		
M Oct. 4	4. Biogeochemical Cycles	
<b>Th Oct. 7</b>	<b><u>MID-TERM 1 (30%)</u></b>	6-7
<b>M Oct. 11</b>	<b><u>Thanksgiving: no class</u></b>	8, 11
Th Oct. 14	5. Microbial Systematics and Methods	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
<u>Th Oct. 28</u>	9. Carbon Cycle: Methanogenesis	9-10
M Nov. 1	10. Carbon Cycle: Methane Oxidation	9-10
Th Nov. 4	<u>MID-TERM 2 (30%)</u>	9-10
M Nov. 9	11. Nitrogen Cycle: Nitrogen fixation	9-10
<b>Th Nov. 11</b>	<b><u>Remembrance Day &amp; Reading Break: No class</u></b>	
M Nov. 16	12. Nitrogen Cycle: Nitrification	
Th Nov. 19	13. Nitrogen Cycle: Denitrification	12
M Nov. 23	14. Localization of Prokaryotes: Soil & Sediment	12
Th Nov. 26	15. Localization of Prokaryotes: Aquatic Systems	12
M Nov. 30	16. Localization of Prokaryotes: Extreme Systems	13
Th Dec. 3	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**

Pearson Custom Library. Symbiosis. BIOL 438 Nutrient Cycling and Prokaryotes, University of Victoria. (available at UVic Bookstore)

Krebs, Charles J. 2016. *Why Ecology Matters*. The University of Chicago Press. 193 p.

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**

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.

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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