Summer Session 2024

BIOE 400 Aquatic Microbial Ecology
Syllabus

3 credits: Lectures, Labs, Field Work
Course dates: June 17-June 28, 2024
Instructor: Matthew Church
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Prerequisites: BIOB 170N (Principles Biological Diversity), CHMY 121N (Introduction to General Chemistry), One-year college math, or consent of instructor.

Level: U/G

Course Description:
Aquatic Microbial Ecology (BIOE 400) is an immersive (2 week) summer course offered to undergraduate and graduate students with interests in microbiology and aquatic ecology. The course includes lectures, laboratories, and several field-based sampling trips. The course provides a conceptual foundation and hands-on field and laboratory training in modern methods in aquatic microbial ecology. Lectures, laboratories, field trips, and in-class discussions will be used to explore topics such as physiology and metabolism of aquatic microbes; methods and tools for assessing microbial diversity, biomass, and growth; and the role of microbes in bioelemental cycles. Students will gain hands-on experience with both cultivation-based approaches and cultivation-independent methods for studying environmental microorganisms. The heavy field-based emphasis of the course is intended to provide an experiential learning environment.

Using immersive field experiences, coupled with classroom and laboratory activities, students will:
1) Identify similarities and differences in the types and activities of microorganisms inhabiting diverse aquatic environments,
2) Gain understanding of how microorganisms are influenced by and influence these environments, and
3) Obtain hands-on experience with field sampling, experimental design, and laboratory methods utilized for assessing the role of aquatic microorganisms in ecosystem processes. Course includes field trips and experiments conducted in local aquatic habitats.

Student Learning Goals:
1) Characterize metabolic strategies used by microorganisms in aquatic environments.
2) Describe the microbial loop and methods for quantifying fluxes of material through the loop.
3) Define processes controlling microbial abundances, growth, and diversity in aquatic environments.
4) Be able to explain ways that microorganisms influence nutrient cycling in aquatic ecosystems.

Student Learning Outcomes:

1) Become familiar and proficient with techniques for field-based sampling of microorganisms and their habitats.
2) Quantify distributions and concentrations of microbial communities and their metabolic byproducts in aquatic environments.
3) Be able to describe and demonstrate proficiency in laboratory methods commonly used for measuring microbial biomass, productivity, and diversity.
4) Be able to graphically depict field and laboratory data related to concentrations and activities of microorganisms.
5) Present results of field and laboratory research to peers and colleagues.

Required Text: There are no required text books for the course; however, students will be assigned readings that include both primary literature and textbook chapters pertinent to the topics covered in class.

Course and Field Supplies/Equipment

(*available for purchase at the FLBS Bookstore)

- Waterproof field notebook (Rite in the Rain 8.5" by 11")* - Lab notebook*; binder or clipboard (optional)* - Pencils* - Laptop Computer - Plastic, resealable containers for lunch pack-up* - Warm jacket	- Rain gear - Water bottle* - Clothes that can get muddy and wet - Flashlight or headlamp with batteries - Bug spray -Shoes that can get wet

Evaluation and Grading for Undergraduate Credit:

Grades will be earned based on three criteria:

1) Regular attendance and participation in course activities.
2) Performance on an oral presentation summarizing individual or group projects (15 min total: 12-minute talk with 3 minutes for questions).
3) Completion and quality of final exam testing students' familiarity with concepts and methodologies covered during lectures, reading discussions, labs, and field sampling trips.

Students completing the course for undergraduate credit will be graded as follows:

1) Attendance and participation in field excursions, field and lab sample collection and processing, attendance and participation in lectures, discussions, and labs (30%),
2) Performance on oral presentation summarizing group projects (40%), and
3) Performance on final exam (30%)

Oral Presentations:

Students will deliver a 12-minute oral presentation that explores concepts, datasets, and methods developed as part of this field and lab class. These can be part of a group presentation or you can work independently; regardless, each student should give a presentation. My hope is that you will identify a topic of interest, ideally one deriving from our field/lab activities, and use the data we collect as part of the class as the basis for this presentation. You will need to rely on primary literature for background. Your presentation should poise a question or hypothesis, and then use any related measurements from our sampling and lab activities to try and answer the question or test the hypothesis. Please discuss the selected topic with the instructor sometime during the first week of the course. These presentations can be in many different forms; for example,

you might use a mix of a video and more traditional Powerpoint slides, or perhaps something more creative (an animation, a poem, a song, drawing/painting, etc.). Be creative! The important thing is to communicate the key findings in a way that is informative and educational.

Presentations will be evaluated based on the following metrics:

Excellent: • Engaging eye contact, proper enunciation of words, creativity of presentation (e.g., interactive elements and/or visual imagery). • Topic has a clear focus and contains at least two scholarly sources. Finishes precisely on time.	*Satisfactory*: • Decent eye contact, most words are properly enunciated. • Has basic requirements of a visual presentation. • Topic is mostly clear, and contains one scholarly source. Stays within reasonable time limit.	*Needs improvement*: • Lacking eye contact, many words were not properly enunciated. Presentation lacks visual flair, and may have errors. • Topic is not clear, and contains no scholarly sources. • Presentation time was either too long or too short.

Evaluation and Grading for Graduate Credit:

In addition to completing all requirements specified above, students seeking graduate-level credits for the course will be expected to develop a proposal outlining a research project to test one or more hypotheses specific to the biogeochemical and ecological role of aquatic microbes. Students can use data gathered as part of the class field trips to support their proposal idea. Students will write a 4–6 page research proposal to be submitted at the end of the class.

Grades for graduate credit will be earned based on student performance on the following four criteria:

1) Regular attendance and participation in course activities;
2) Performance on an oral (15 min total: 12-minute talk with 3 minutes for questions) presentation summarizing the group project/experiment;
3) Submission and quality of research proposal (5 pages) outlining methods and approaches to address specific questions and hypotheses related to the ecological and biogeochemical role of aquatic microbes.
4) Completion and quality of final exam testing students' familiarity with concepts and methodologies covered during lectures, reading discussions, labs, and field sampling trips.

Graduate student grades will be weighted as follows:

1) Attendance and participation in class lectures, discussions, and labs (30%),
2) Quality of oral presentation summarizing group project (30%)
3) Quality of written proposal (10%)
4) Performance on final exam (30%)

Grading of research proposal (for graduate credits only)

Graduate students will write a 5 page (excluding references) research proposal addressing a question whose answer might help us better understand the role of aquatic microorganisms in the various habitats studied as part of the class. Early in the class students and instructor will select a mutually agreeable research question; students should formulate a question and then develop a testable hypothesis to address the question. At the end of the class, students will submit a proposal outlining a research plan that addresses the question and tests the hypothesis. The research plan should build on field sampling approaches, laboratory methodologies, and data generated as part of the class. The research proposal should include:

1) Statement of the research question
2) Articulation of a testable hypothesis based on the research question
3) Experimental design and field sampling approach
4) Description of laboratory methodologies to be used as part of the research
5) Presentation of preliminary data to help justify the proposal hypothesis and research plan

Course Grading Criteria:
Letter grades for the course will be assigned based on earned percentage of points (out of **100 points** total):
A: 90–100%
B: 80–89%
C: 70–79%
D: 60–69%
F: <60 points

Absences: Students are expected to attend all classes and actively participate in discussions and ask questions. Unexcused absences will impact the grade you receive in the course.

Disabilities:
Any student who feels s/he may need an accommodation based on the impact of a disability is invited to contact the course instructor privately. The University of Montana assures equal access to instruction through collaboration between students with disabilities, instructors, and Disability Services for Students. If you have a disability that adversely affects your academic performance, and you have not already registered with Disability Services, please contact Disability Services in Lommasson Center 154 or 406.243.2243. The instructors will work with you and Disability Services to provide an appropriate modification.

Course Policies:
Students will adhere to University of Montana Student Conduct Code and Discrimination, Harassment, Sexual Misconduct, Stalking, and Retaliation Policy (UM policy website: http://www.umt.edu/safety/policies/).
Students must also adhere to the FLBS Code of Conduct and FLBS Rules and Regulations, as well as abide by the Safety Orientation Checklist.

FLBS students are required to complete University of Montana Prevention Education Program courses: AlcoholEdu and Sexual Assault Prevention for Adult Learners after coursework begins and prior to completion of coursework.

Class Schedule: See pages 5 and 6 for details.

Class Schedule 2024: The schedule may change subject prior to first day of class and while class is in session due to location availability and field conditions.
Note: Make sure you pack your brown bag lunch each day at breakfast!

Date (2024)	Time	Activity
17 June (Monday)	07:30-08:30	Breakfast (FLBS), pack lunch
	08:30-09:30	Welcome, orientation, introduction to aquatic microbial ecology (Church)
	10:00-11:00	Data and Donuts FLBS seminar
	11:00-15:30	**Field sampling: Echo Lake**
	Lunch (in the field)	
		Equipment and supplies needed for field sampling:
		Canoes (x5) and canoe trailer; Hydrolab; downwelling PAR meter; Van Dorn bottle, line, messenger; sample bottles and carboys (125 mL, 500 mL, 1 L, and 20 L carboy)
	15:30-17:30	Lab-based processing of samples
	17:30-18:30	Dinner (FLBS)
18 June (Tuesday)	07:30-08:00	Breakfast (FLBS), pack lunch
	08:30-09:30	**Lecture:** Bioenergetics and metabolism (Church)
	09:30-15:30	**Field sampling: Tally Lake** Lunch (in the field) Equipment and supplies needed for field sampling: Canoes (x5) and canoe trailer; Hydrolab; downwelling PAR meter; Van Dorn bottle, line, and messenger; sample bottles and carboys (125 mL, 500 mL, 1 L, and 20 L carboy)
	15:30-17:30	Laboratory processing of samples
	17:30-18:30	Dinner (FLBS)
19 June (Wednesday)	07:30-08:30	Breakfast (FLBS), pack lunch
	08:00-09:00	**Lecture:** Ecology of the alluvial flood plain on the Flathead River (Tom Bansak)
	09:00-15:30	**Field sampling: Nyack Flood Plain with Dr. Rachel Malison** Equipment and supplies needed for field sampling: Pneumatic pump (to clear wells), peristaltic pump and batteries, sample collection bottles, 50 mL syringes, syringe filter holder, filters
	16:30-17:30	Laboratory processing of samples at FLBS
	17:30-18:30	Dinner (FLBS)
20 June (Thursday)	07:30-08:30	Breakfast (FLBS), pack lunch
	08:30-09:30	**Lecture:** Microbial biomass (Church)
	09:30-15:30	Lunch (in the field) **Field sampling: Flathead Lake aboard the *Jessie B*** Equipment and supplies needed for field sampling: Canoes (x5) and canoe trailer; Hydrolab; downwelling PAR meter; VanDorn bottle, line, and messenger; sample bottles and carboys

		(125 mL, 500 mL, 1 L, and 20 L carboy)
	16:30-17:30	Laboratory processing of samples
	17:30-18:30	Dinner (FLBS)
21 June (Friday)	07:30-8:30	Breakfast (FLBS), pack lunch
	08:00-16:30	**Field sampling the Middle Fork of the Flathead River – rafting the flood plain to the canyon** Equipment and supplies needed for sampling: 2 rafts, 12 paddles, 12 helmets, 12 life jackets, sample bottles and carboys (125 mL, 500 mL, 1 L, and 20 L carboy)
	17:30-18:30	Dinner (FLBS)
Date (2024)	**Time**	**Activity**
24 June (Monday)	07:30-08:30	Breakfast (FLBS)
	08:30-10:00	**Lecture:** Photosynthesis and primary production (Church)
	10:00-11:00	Data and Donuts FLBS seminar
	11:00- 17:00	**Laboratory processing of samples** nutrient analyses: NH_4^+, TN/TP digests; microscopy, DNA extractions
	17:30-18:30	Dinner (FLBS)
25 June (Tuesday)	07:30-08:30	Breakfast (FLBS)
	08:30-09:30	**Lecture:** Microbial respiration (Church)
	10:00-11:00	Data and Donuts FLBS seminar
	11:00- 17:00	**Laboratory processing of samples** (nutrient analyses: NOx, SRP, TN/TP), microscopy, flow cytometry, PCR)
	17:30-18:30	Dinner (FLBS)
26 June (Wednesday)	07:30-08:30	Breakfast (FLBS), pack lunch
	08:30-09:30	**Lecture:** Microbial control of nutrient biogeochemistry (Church)
	09:30-12:00	**Laboratory processing of samples** (PCR and ddPCR)
	13:00-17:00	Tools for data visualizations (Logan Peoples)
	17:30-18:00	Dinner (FLBS)
27 June (Thursday)	07:30-08:30	Breakfast (FLBS), pack lunch
	08:30-09:30	**Lecture:** Application of molecular approaches to microbial ecology (Logan Peoples)
	09:30-13:00	Complete data analyses and visualizations
	13:00-17:00	Work on presentations
	17:30-18:30	Dinner
28 June (Friday)	07:30-08:30	Breakfast (FLBS), pack lunch
	08:30-10:30	Complete presentations
	10:30-12:00	**Student presentations**
	13:00-15:00	**Exam**
	15:00-15:30	Course evaluations
	15:30-16:30	Classroom cleanup
	17:30-18:30	Dinner (FLBS)