Prerequisites: One year of college-level biology, chemistry, and mathematics, and an ecology course (can be met via BIOE342 Field Ecology at FLBS) or equivalents; or consent of instructor.

Course Description:
Stream Ecology (BIOE 439) is the study of the physical, chemical and biological processes in streams. F.-A. Forel coined limnology as the “oceanography of lakes”. Here we will do the same for streams and rivers by studying the ecology of streams rather than simply ecology in streams. This goal requires student integrating across scientific disciplines to learn principles, concepts and methods of stream ecology in a field, lecture, laboratory, and discussion settings. Daily participation, examinations, and written and oral reports of independent or group studies as directed by the professor are required.

After a year indoors, I have changed this course to include a larger and more immersive field experience, a 3-night float trip on the Middle Fork Flathead River. Much of the initial lectures and discussions will occur on the river, probably associated with early morning and evenings leaving the day free for travel and fieldwork. We will use this trip to examine composite productivity of a larger river network by sampling 1-2 tributaries, the main river in 2 spots corresponding to upwelling and downwelling zones, and a floodplain springbrook.

Text: None, but lots of required readings on Dropbox.

Student Learning Outcomes:
Course Learning Objectives
1) Engage students in stream ecology concepts such as the interactions of physical, chemical, and biological processes through lectures, discussions, readings, and field investigations.
2) Students collect and analyze data and present written findings from field research, working both independently and as a team.

Expected Learning Outcomes
After completing this course, students will be able to:
1) Identify and explain ecological relationships pertaining to a variety of stream organisms and environments. Students accomplish this task using terms, concepts, and models familiar to professional stream ecologists.
2) Evaluate and communicate ideas from stream ecology literature.
3) Conduct a quantitative and repeatable study design that addresses a research question of relevance in stream ecology.

Graduate Increment:
Students taking this class for graduate credit will take the lead in data analysis and modeling for jointly led
class project. They will present to the class methods and models for leaf litter breakdown and ecosystem metabolism.

**Evaluation and Grading:**

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
<th>Grade Range</th>
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<tbody>
<tr>
<td>Participation (daily)</td>
<td>24%</td>
<td>A ≥94% A- 90–93%</td>
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<tr>
<td>Short papers (4)</td>
<td>16%</td>
<td>B+ 87–89% B 84–86% B- 80–83%</td>
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<tr>
<td>Research paper (1)</td>
<td>30%</td>
<td>C+ 77–79% C 74–76% C- 70–73%</td>
</tr>
<tr>
<td>Final exam (1)</td>
<td>30%</td>
<td>D+ 67–69% D 64–66% D- 60-63%</td>
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<td>F &lt;60%</td>
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Participation is based on discussions, attendance and short exercises that you will do, we will discuss, but won’t become a full blown paper. Short papers are 1 pagers turned in on new papers in the field. Description for these is on Dropbox. Final paper is a group research report that you will write about the field data that we collect in the course.

**Course and Field Supplies/Equipment:** (*Available for purchase at the FLBS Bookstore*)

- Rite in the Rain field notebook*
- Pencils*
- Hot/cold mug (or else you use the Bowl of Shame!)*
- Water bottle*
- Lunch pack-up container (re-sealable)*
- Bear spray*
- bug spray
- Wading shoes or sandals
- Flashlight (headlamp) and batteries
- Laptop computer with MS Excel or RStudio
- Personal first aid kit
- Mess kit (bowl, fork, plate)
- sunscreen / sun protection.
- tent, groundcloth, pad, sleeping bag

- **Required Overnight Field Gear and Other Items to Bring Checklists:** [http://flbs.umt.edu/urls/lists](http://flbs.umt.edu/urls/lists)

**Computers:** We will do lots of data analysis and writing in this course. You are free to use the software of your choice. I use R (via RStudio) for data and graphing, LaTeX for difficult writing (papers), and MS Word for easy writing (this syllabus), and Excel for arranging data. You are welcome to use Excel, any other spreadsheet program, R, Matlab, MS Word, open office, R Markdown, etc. For those who don’t like paying money, RStudio and LaTeX are free and have cloud options (RStudio Cloud, Overleaf). You will use Overleaf for your paper because it allows for easy collaboration. I will set up the format so that all you have to do is type in the words. One of the exercises (stream metabolism) requires R, but we can use my computer. Please hand in the 1 page papers as an actual piece of paper (note use of singular. 1 page, not 2. The final paper should be as .pdf and I will mark it up electronically so each person in the group has access.

**Course Policies:**

Students are expected to review and adhere to the University of Montana Student Code of Conduct at this link: [https://www.umt.edu/student-affairs/community-standards/um_student_code_of_conduct_2021-2020.pdf](https://www.umt.edu/student-affairs/community-standards/um_student_code_of_conduct_2021-2020.pdf) and adhere to the Flathead Lake Biological Station Code of Conduct form signed during student registration. Students must also abide by the FLBS Rules and Regulations and the Safety Orientation Checklist. Students who have not already completed the University of Montana online Prevention Education Programs: AlcoholEdu and Sexual Assault Prevention for Adult Learners must complete these programs at this link: [https://www.umt.edu/student-affairs/programs/](https://www.umt.edu/student-affairs/programs/) (NetID and password required).
**Schedule:** The schedule may change 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!

<table>
<thead>
<tr>
<th>Date</th>
<th>Lectures – Labs – Field Work</th>
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</table>
| 18-Jul-2022 (M) | 08:00 Lecture: Intro to geomorphology & hydrology  
10:00 – Data and donuts  
11:00 Lecture: Carbon Cycling, metabolism, detritus, C budgets  
12:00 Lunch  
13:00 Lecture: Bugs/Algae  
14:00 Trip prep  
17:30 Dinner |
| 19-Jul-2022 (T) | 08:30 Load trucks and boats  
10:00 leave for Essex  
12:00 Lunch and launch  
17:00 Arrive at Nyack  
18:30 Dinner  
19:30 Boix Canadell paper Discussion |
| 20-Jul-2022 (W) | 06:45 reveille  
09:00 launch  
12:00 Lunch  
13:00 Sample constrained reach somewhere along way  
17:00 camp  
19:00 Dinner |
| 21-Jul-2022 (Th) | 06:45 reveille  
08:00 Lecture: Nutrient Cycling  
10:00 Hike to Movie Road for downwelling river samples  
12:00 lunch  
13:30 Hike to Beaver Brook for floodplain spring stream samples and so set up river reach for Monday experiment  
16:00 Maybe RCC lecture  
19:00 dinner |
| 22-Jul-2022 (F) | 06:45 reveille  
09:00 Break camp, launch  
10:00 Sample upwelling reach somewhere along way  
12:00 Lunch  
13:00 enter canyon  
13:30 watch kayakers swim Bonecrusher?  
16:00 take out  
17:00 Burritos  
19:00 return to FLBS |
<table>
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<tr>
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| 25-Jul-2022 (M) | 08:30am Pack for nutrient experiment  
10:30am Return to Nyack, NO3 addition experiment  
16:00 Maybe chemistry if NH4 works, enter and go over salt data and nitrate data  
17:30pm Dinner |
| 26-Jul-2022 (T) | 08:30 Lecture RCC and Stream Food webs  
11:00 Wallace discussion  
12:00 Lunch  
13:00 Data and sample analysis  
17:30 Dinner |
| 27-Jul-2022 (W) | 08:30 Giersch discussion  
09:00 Samples and data  
12:00 Lunch  
13:00 Data and writing  
17:30 Dinner |
| 28-Jul-2022 (Th) | 08:30 Metabolism analysis  
11:00 Lecture: Bioassessment  
12:00 Lunch  
13:00 Data and writing  
17:30 Dinner |
| 29-Jul-2022 (F) | 08:30 Lecture: Dams  
09:30 Kennedy Discussion  
10:30 Finish and submit paper by 12:00  
12:00 Lunch  
13:00 Chill  
15:00 Final exam |

Students with disabilities may request reasonable modifications by contacting the instructor. The University of Montana assures equal access to instruction for students with disabilities in collaboration with instructors and the Office for Disability Equity. The University does not permit fundamental alterations of academic standards or retroactive modifications. If you have a disability that adversely affects your academic activities, please let us know at summersession@flbs.umt.edu so we can discuss an accommodation.