Summer Session 2024

Ecology of Mountain Ice and Snow (BIOB 491) Syllabus

Course dates: July 29 – August 9, 2024
3 Credits; Field & Lab Work, Online Lectures

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Note: This syllabus and schedule are subject to change.

Instructors
Lead: Trinity Hamilton, Ph.D., trinityh@umn.edu, University of Minnesota

- You can call me: Dr. Hamilton, Dr. Ham, or Trinity (pronouns: she/her/hers)
- Lab website: The-Fringe-Lab.com
- My area of scientific expertise: Microbial Ecology, Geobiology, Microbial Physiology

Course Description
The cryosphere includes glaciers, snow, permafrost, sea ice, and other frozen environments. These environments host a number of unique ecosystems and highly adapted organisms but the cryosphere, particularly mountain ice and snow, is rapidly changing with climate change.

In this course, we will explore mountain ice and snow ecosystems. We will investigate the physiology and ecology of several key mountain ice and snow organisms, discuss ecosystem-level processes in mountain ice and snow, and consider how these may change with a changing climate. We will also perform lab and field experiments in snow and ice ecosystems and then analyze and present data from these experiments.

Prerequisites — At least one course of ecology, biology, or chemistry or with consent or instructor.

Learning Goals
1. demonstrate familiarity with mountain ice and snow ecosystems, including abiotic characteristics and the physiology of organisms in each these environments
2. understand how different mountain ice and snow environments form
3. critique and analyze current mountain ice and snow ecology literature
4. explain how climate change will impact the ecology of mountain ice and snow environments
5. design an experiment to examine a key organism of mountain ice or snow
6. engage in hands-on laboratory/field work using scientific equipment
7. apply critical thinking and analytical skills to interpret the results of scientific study

Textbook – We will read selected chapters from *The Ecology of Snow and Ice Environments* (Laybourn-Parry, Tranter, Hodson). Additional assigned readings will be available via the course website. See **page 4** for the course schedule.

Physical Demands – Course will involve physical activity including hiking over varied terrain for up to 10 miles some days. Ability to wear Personal Protective Equipment is required for lab work. Course work will be performed indoors and outdoors, in a variety of weather conditions. Course work may require evening and weekend hours and at least one overnight camping trip.

Evaluation and Grading for Undergraduate Credit – Grades will be earned based on three criteria:

1) Regular attendance and participation in course activities
2) Lab and field reports
3) Project presentation

Evaluation and Grading for Graduate Credit – Students seeking graduate-level credits will develop a proposal outlining a research project to test one or more hypotheses about snow or ice microbes. Throughout the course, students can use data collection during field trips or data from analyses to support their proposal idea. Students will a 2-page proposal which will be due at the end of the class.

1) Regular attendance and participation in course activities
2) Lab and field reports
3) Project report
4) Project presentation

Undergraduate Course Grades will be determined by cumulative point total, based on a maximum of 250 points to be distributed as follows:

Grade category	*Number*	*Pts. Per*	*Total*	*Percent*
Attendance	10	5	50	20
Lab and field reports	4	25	100	40
Project presentation	1	100	100	40
		Total	**250**	**100%**

Graduate Course Grades will be determined by cumulative point total, based on a maximum of 300 points to be distributed as follows:

Grade category	*Number*	*Pts. Per*	*Total*	*Percent*
Attendance	10	5	50	16.7
Lab and field reports	4	25	100	33.3
Project presentation	1	100	100	33.3
Project proposal	1	50	50	16.7
		Total	**300**	**100%**

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

Lab and field reports — Each student will prepare two lab and two field reports. These are short (1-2 pages) summaries with 4 sections: 1) purpose of a lab experiment or field sampling trip, 2) methods with enough details so that someone else can understand and replicate what you did including the variables being tested, and controls in your experiments, 3) results and data including field or lab observations and figures, 4) and a discussion or conclusion. Lab and field reports are meant to be written in full sentences, should be grammatically correct, free of spelling errors, and include appropriate citations when needed. See rubric on **page 4**.

Project presentation — Each students will deliver a 15-minute oral presentation. The presentation will explore a concept or topic related to mountain ice and snow ecology and will present datasets collected at part of the course. Developing the presentation will likely require reading a few scientific articles. You should discuss your selected topics with the instructor. Groups can work on presentations and topics together but each student must present. The presentations do not have to be in a specific format and can include slides, videos, animations, etc.. See rubric on **page 5**.

Proposal (for graduate credit only) — In this assignment, students seeking graduate level course credits will choose a topic, identify an outstanding or unknown question (or questions but no more than 2) about mountain ice and/or snow ecology and write a short research proposal to examine this question. The proposal will be no more than 2-pages (single space, typed, 11 or 12-point font, not including references). At least one figure should be included in the proposal (within the 2-page limit). The proposal should be based on peer-reviewed literature and references must be cited appropriately in the text and a full reference list must be provided. See rubric on **page 5**.

Course and Field Supplies/Equipment (*available for purchase at the FLBS Bookstore)
Waterproof field notebook (Rite in the Rain 8.5" by 11")*
Pencils*
Laptop computer
Plastic, resealable containers for lunch pack-up*
Warm jacket
Rain gear
Hiking boots
Backpack (for hiking)
Water bottle* or water bladder/hydration reservoirs (for hiking)
Clothes that can get muddy and wet
Bug spray
Sun screen
Camping gear — flashlight or headlamp with batteries, sleeping bag, pillow, mess kit, travel mug

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.

Course Schedule
Note: Make sure you pack your brown bag lunch each day at breakfast.

Week 1: Snow as an ecosystem

Major environments and life of mountain snowfields
- examine global distribution of the mountain snow
- discuss impacts of a changing climate on snow as an ecosystem
- design experiments to assess the ecology of snow organisms

Snow and snow associated ecosystems
- major microbial groups + other life that interacts with snow ecosystems including biogeochemical transformations
- snow algae and albedo

Visit (hike to) snow ecosystems
- measure in situ parameters, collect samples for experiment and DNA sequencing

Begin experiment, DNA extractions, Nanopore DNA sequencing

Week 2: Mountain ice ecosystems

Glaciers
- glacier formation, major microbial groups and biogeochemical transformations
- glacier hydrology, glacier landscapes, rock vs. surface glaciers
- life on, in and beneath glaciers
- major microbial groups and biogeochemical transformations in proglacial streams

Visit (hike to) glaciers and glacier-influenced systems
- Grinnell glacier, Upper Grinnell Lake, and outflow stream

End snow algae experiment
- analyze and interpret data, present results

	Category	**Details - lab/field reports**	**Points possible**
Lab/Field Reports (25 points total)	Introduction/ Background	Establish the purpose of your experiment (what principles you are examining) and your hypothesis (what you expect to see and why), if applicable	**5**
	Methods	Enough details should be included so that someone else can understand and replicate what you did. Explain the variables being tested and controls in your experiments, if applicable.	**5**
	Resutls	Data presented in graphs or tables (whatever is appropriate) along with appropriate legends and descriptions. This section should also include any observations.	**7.5**
	Discussion/ Conclusion	Analysis of results, relates data back to hypothesis or goal. Report whether the results you obtained matched what was expected and the conclusions that can be drawn from this.	**7.5**
		Total	**25**

	Category	Details - 15 minute project presentation	Points possible
Project presentation (100 points total)	Concept	Identify and present concept or topic of interest in mountain snow and/or ice ecology	**25**
	Methods	Methods used in the course or otherwise to examine the concept of interest	**15**
	Dataset(s)		**15**
	Data Interpretation	Interpret data collected in the class (or discuss data interpretation needed for potential data)	**25**
	Conclusions	Provides a succinct summary of concepts and data	**10**
	Presentation	Engaging presentation, high quality graphics, imagery, etc., includes proper citations. Is the appropriate length (15 minutes).	**10**
		Total	**100**

	Category	Details - proposal (for graduate credit)	Points possible
Proposal (50 points total)	Outstanding Question(s)	Provides clear and compelling argument that the question(s) to be addressed are unknown but necessary to study. Includes reference to relevant literature.	**10**
	Specific Aims	Logical and reasonable aims for addressing outstanding question.	**10**
	Methods	Approach is feasible, methods appropriate for Aims and resulting outcomes clearly address the outstanding question(s).	**10**
	Figure(s)	High resolution, integrated with the rest of the proposal, appropriately cited, with an informative legend.	**5**
	Presentation	Writing is clear, logical, free of grammatical errors.	**10**
	References	References are cited in the text as well as provided in a reference cited list.	**5**
		Total	**50**