

## **ENVS 493: Earth System Field Science (The Juneau Icefield Research Program); 2014 Syllabus and Course Description**

### **Course description**

This is an upper-division Earth Systems Science, 8-week field course, with emphasis on the integration of Alaskan Alpine glacial geomorphology, field techniques, and concepts in basic glaciology. Students will conduct original research and learn to be safe in the extreme environment of the Juneau Icefield. Participants will also experience learning first-hand the relationships between key disciplines in the earth, atmospheric, and climate sciences. This course emphasizes field observations, student use of instruments for glacier data collection, student learning through relevant demonstrations and pertinent lectures by JIRP faculty at nunatak camps and research sites across the Juneau Icefield. Disciplinary academic areas include: Glaciology, Atmospheric Science, Geophysics, Climate Science, Geomorphology, Bedrock Geology, Alpine Ecology, Hydrology, and safety training in glacier surface travel, Field camp efficiency and safety, and extreme environment logistics.

Students will collect data related to long-term glacier monitoring studies of ice mass balance, ice velocity and ice thinning. They will also develop individual interdisciplinary research projects related to glaciology, mass balance, ice dynamics glacial geology, geomorphology, or hydrology. Students will develop a research plan and collect data with mentoring from faculty advisors, analyze, and interpret the data and present their preliminary results at an annual symposium held in the community of Atlin BC at the end of the field course. Within 6 weeks of the end of JIRP, students will electronically upload a written summary report to the course website; and complete and upload an open book final exam that encompasses all academic information presented during the course.

Selected research project may be suitable for use in Senior thesis. All student data collection and field analysis is completed during the standard 8-week program.

Students may enroll in 8 semester credit hours for their 8-week course.

**Academic prerequisites** – the most important and primary prerequisite is a demonstrated desire to broaden ones scope of academic interest in the sciences and achieve competence leading to an understanding of Earth Systems and dynamic equilibrium adjustment and thresholds.

## **General goals**

**Exploration:** Probe the physical parameters that define the alpine and glacial environment by looking beyond superficial appearance.

**Discovery:** Question the conditions that exist through conventional means and test alternatives to reveal the still unknown.

**Creativity:** Utilize a broad and firm frame of reference, look beyond the conventional for new approaches that reveal previously unknown information, parameters, and components of this environment.

## **JIRP academic objectives**

1. Provide students an unparalleled field-based research opportunity
2. Guide students through the development, data collection and analysis, completion, and presentation of an individual research project
3. Involve students in the ongoing research of faculty and adjunct researchers
4. Deliver an earth-system-science curriculum with a focus on the cryosphere and interactions within the glacier-climate system
5. Introduce students to team building through expeditionary field training and participation

**Physical requirements:** Students must be fit and able to hike from sea level to 1500m through the alpine to the Lemon Creek and Ptarmigan Glaciers. From there, during the following 6 weeks, they will ski and hike across the upper reaches of the icefield, reaching elevations of 1,600 – 1,800 m. before descending the Llewellyn Glaciers to Atlin Lake, British Columbia. Each student will be required to provide his or her own expeditionary backpack, glacier clothing, skis, poles, ice axes, sleeping bag, pad, and boots. A complete equipment list will be provided.

**Fiscal responsibilities:** All students interested in this class must apply for acceptance in the Juneau Icefield Research Program, and be prepared to pay a field fee which supports all logistical aspects of the course (lodging in Juneau and on the icefield, all food, and gear transport from Juneau to Nunatak Camps, plus student transport from Atlin, B.C. back to Juneau by bus via Skagway, Alaska and the Alaska Marine Highway Ferry).

**Required Reading:** A list of reading references will be made available as PDF files that can be uploaded from the course website. It will be anticipated that this list will be consulted and reviewed by students before arriving in Juneau.

**JIRP background:** Juneau Icefield exploration was initiated in 1946 by Dr. Maynard M. Miller, who founded and directed the Juneau Icefield Research Program (JIRP) in the mid-1950s, with support from the Foundation for Glacier and Environmental Research (FGER)

## Faculty members lecture on many of the following topics:

1. Orientation
2. Alaska Meteorology
3. Trail Briefing
4. Equilibrium & Thresholds
5. Introduction to Climate and Glaciers
6. Introduction to Glacial Ecosystems
7. Experimental Forest Ecology
8. Introduction to Glacial Dynamics
9. UAS Mendenhall Research
10. Climate and Glaciers
11. SE Alaska Glacial/Geological History
12. Intro to Living on Juneau Icefield
13. Knots and Pussiks
14. Knot Tying
15. Helicopter Safety
16. Basic Glacier Travel
17. Anchors and Crevasse Rescue
18. Crevasse Rescue on Glaciers
19. Stove and Lantern
20. Intro. to Meteorological Observation
21. Ski Practice—Roped Skiing
22. Seamonster Project
23. Introduction to GPS
24. Mass Balance Procedures
25. Overview of JIRP Surveys
26. Mass Balance, Part 2
27. Video: *Extreme Ice Survey*
28. Satellite Radar Survey
29. Lemon Creek Glacier Hydrology
30. Global Climate Change
31. Composition and Photography
32. Climate Change: Juneau Icefield
33. Photojournalism: Science and the Environment
34. Alaska Weather Patterns
35. Weather Ops
36. Juneau Icefield Geobotany
37. Little Ice Age
38. Introduction to Mapping/GPS
39. How reliable are Climate Models?
40. Glacial Surveys in the Alps
41. Introduction to Aerial Photography
42. Video: *Hillary/Tenzing on Everest*
43. Geology of Camp 10 Nunatak
44. Why Do We Know CC is Caused By Humans?
45. Kinematic Surveying
46. Glacial Energy Balance
47. Mountain Uplift
48. Atmospheric Chemistry
49. Long Range Transport of Atmospheric Pollutants
50. Geological History of Alaska
51. Introduction to Photogeometry
52. Confronting the Climate/Energy Challenge
53. Glacial erosion, transportation, and deposition
54. Glacier classifications
55. Glacial landforms

## Weekly schedule of JIRP Summer Field Course

### ***Week 1: Orientation and Training in Juneau***

- Orientation and introduction to JIRP, Team Building, expeditionary responsibilities, and lectures on fundamentals of glaciers
- NOAA-USWS personnel – site visit
- NMFS-Ocean Conditions – site visit
- UAS faculty – Mendenhall Mass Balance, Glacier Bay NP, Biogeochemistry
- Sea Level Glacier Expeditions and Safety Training

- Mendenhall and/or Herbert Glacier – Crampon/ice axe use, crevasse safety; steep/slippery rock scrambling; scree slope descents; thinning/retreating ice characteristics; local geology; Neoglacial to LIA history of Northern Southeast Alaska

***Week 2: Ascend to Camp 17***

- Lemon Creek Glacier
- Lectures on:
  - Camp Protocols, Safety, Stove/Lanterns/ Daily maintenance
  - Glacier Safety Training: knots, crevasse rescue, first aid, glacier travel
  - Intro to Glacier Research: Intro to Mass Balance Study techniques
- Students begin to develop individual research project ideas with mentors
- Lectures on pertinent topics as per faculty/staff available

***Week 3-4: Travel across Lemon Creek Glacier, Dead Branch of the Norris Glacier, SW Branch of the Taku Glacier and the Main Taku Glacier (~25 miles) 2 day overnight to Camp 10 on Taku Glacier.***

- Research:
  - Students polish their own research hypotheses developing data.
- Mass Balance and velocity surveys, and meteorological data collection on main branch, Demorest branch, and NW branch of Taku Glacier.

***Weeks 5-6: Students travel up Taku and Matthes to Camp 18 overlooking Gilkey Trench and Headwaters to Berners Bay System***

- Mass Balance and velocity surveys, and meteorological data collection on high plateau; Gilkey Trench hydrology, ogive history, Paradise Valley survey.
- Students begin to evaluate data and prepare their field reports, and develop abstracts

***Week 7: Students descend to Camp 26 and Llewellyn Glacier System***

- Observation of Interior Glacier Climate differences, Stikine Geologic terrain, nunatak ecological changes (marmots, goats, vegetation etc.), supra-glacial hydrology

***Week 8: Students descend to Atlin Lake***

- Final JIRP camp in Atlin.
- Atlin area Field trips, Quaternary glacier history, Tertiary Gravels Gold mining and Cache Creek Terrane bedrock features. Student research presentations for Atlin Public.
- Return to Juneau by rented bus and Alaska Marine Highway from Skagway to Juneau.
- Depart from Juneau by Air.

***Weeks 9-15***

- Students complete written research reports, take and submit final exam, and complete course evaluations; all items are uploaded to course web site at UAS Online (or future affiliates)

**Assessment of student performance and grading procedure** –Students are evaluated on criteria that measure academic and expeditionary performance. Of significance are project selection and design, methods of investigations, data collection and organization, analysis of data, and development of multiple working hypotheses leading to conclusions. Fundamental to successful project completion is teamwork and alignment with established group priorities. The overall course mark will be determined as follows: Participation in the JIRP field program, 50%; evaluation of written report of independent research, 30%; evaluation of final examination, 20%.