

A Virtual Expedition to the Juneau Icefield

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INTRODUCTION

The Juneau Icefield Research Program (JIRP) and Upward Bound (UB) have partnered to offer new field and classroom programming to increase the number of UB participants, many of whom have identities that are underrepresented in the polar sciences, who go on to major in related fields in college. UB is a Department of Education-funded college preparation program for high school students from low-income families where neither parent holds a bachelor's degree. JIRP, operated through the University of Maine, has offered research opportunities and field training on the Juneau Icefield, Alaska, since 1946. Here, we outline a two-week virtual polar science course that complements the UB summer field programs on the Icefield.

Understanding, predicting, and responding to unprecedented climate changes, which are amplified in the polar regions (e.g., Rantanen et al., 2022), requires knowledge from a diverse group of researchers (Medin and Lee, 2012). Yet polar science has historically struggled to support racial, gender, economic, and ability diversity (Hulbe et al., 2010; Carey et al., 2016; Seag et al., 2020). Field experiences can attract students to the polar sciences but can also pose significant barriers to students with minoritized identities (e.g., Demery and Pipkin, 2021; Giles et al., 2020). Innovative programs like Inspiring Girls* Expeditions (e.g., Young et al., 2023) and GeoSPACE (Marshall et al., 2022) are re-envisioning inclusive geoscience field education. Since its inception, JIRP has been a pipeline to careers in the polar sciences; nearly 2,000 students, faculty, and staff have conducted research resulting in ~70 M.S. and Ph.D. dissertations and >1,000 reports and publications. The JIRP-UB partnership leverages the JIRP network and infrastructure to engage a new, diverse generation of polar scientists.

Students from the Washington State University (WSU) UB program, which serves residents of the Colville Reservation and the broader Okanogan County, were set to participate in the inaugural JIRP-UB field course in 2021, but this field experience was delayed due to COVID. To fill this gap, we designed a two-week virtual course titled “A Virtual Expedition to the Juneau Icefield,” which we delivered to WSU UB students in the summer of 2021. Authors AVC and ABK, at the time both Ph.D. students at Columbia University

in the Department of Earth and Environmental Sciences, designed and instructed the course. AVC, a first-generation college graduate, woman of color, and atmospheric scientist, was an undergraduate student at JIRP in 2015. ABK, a white woman and glacial geologist, served as JIRP research faculty in 2019. Our two-week virtual course used JIRP as a framework and mimicked the arc of a polar science research project, from conception to field expedition to data analysis and communication. We strove to also highlight the many ways to be a polar scientist beyond fieldwork and integrate our personal experiences as scientists.

THE VIRTUAL EXPEDITION

The two-week course was designed so that the second week built off the first, but students could participate in either week without being required to do the other. Throughout the course, we communicated via satellite text with author and JIRP Director SC, who was instructing JIRP's flagship field course during the same time period, so that students could ask questions about research and life on the Icefield.

Week 1: Designing a research project on the Juneau Icefield

In the first week, students developed tools to plan their own scientific expedition to the Juneau Icefield. Week 1 lectures, activities, and homework covered (1) the climate of the Juneau Icefield; (2) an overview of what it is like to live and work on the Icefield; (3) interactions between glaciers and climate; and (4) the basics of glacier mass balance, the sum of yearly ice accumulation and loss on a glacier.

During a climate observations activity, adapted from Doughty (2013), we split students into three breakout rooms, each with 3–4 students, to become “experts” in one of three climate factors: temperature, topography, or glacier distribution. To do so, the students made observations about the global patterns of their climate factor from maps. We then shuffled groups so that each new group contained at least one temperature, one topography, and one glacier expert. In the new groups, students hypothesized about how glaciers and climate interact. For example, one group hypothesized that “mountains have a colder temperature than its [sic] surrounding regions which can lead to forming of glaciers.”

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For the Week 1 final project, students created a plan for a scientific expedition to the Juneau Icefield. After learning about life on the Icefield, students developed a list of personal gear that they would bring on their expedition. The following day, we split students into their expedition groups, in which they picked a research question, wrote a paragraph describing their motivation for the study, and briefly described what measurements they would make in the field. Each group posed a research question; one asked, “How much snow is left after summer?” and the other asked, “What is the most common plant species on rock outcrops at the Juneau Icefield?” For homework, each student wrote one hypothesis for their proposed research project. On the last day of class, the groups presented their proposed research expedition.

Week 2: Making sense of scientific data from the Juneau Icefield

During Week 2, we imagined we had returned from our expedition to the Juneau Icefield with glacier mass balance data to analyze. Several new students joined in Week 2, so we reviewed glacier mass balance concepts and re-ran the climate observations activity. To reduce repetition for returning students, we added a global precipitation map to further emphasize the relationship between glaciers and global-scale climate patterns.

Our final activity was to analyze mass balance data sets from the Taku and Lemon Creek Glaciers, outlet glaciers of the Juneau Icefield that JIRP has monitored since the 1940s and 1950s (McNeil et al., 2020). Students performed the analysis in Google Sheets, following along with one instructor who was sharing their screen. The other instructor monitored the chat and was available to go into a breakout room with any students who were experiencing difficulties. Students produced figures to compare year-to-year variability in mass balance against the long-term trend. They also explored the relationship between glacier melt and warming temperatures by plotting glacier mass balance versus local summer temperature. In doing so, the students reproduced a figure from an article published in the *Journal of Glaciology*. For many, this was their first experience producing a figure from scientific data.

FEEDBACK AND RESOURCES

Survey responses at the end of Week 1 indicated students enjoyed learning about glacier mass balance and designing an expedition, and they looked forward to joining the second week. Post-course feedback from AE and other UB instructors emphasized that the course was effective in building enthusiasm for the polar sciences and engaging students in the scientific process. In 2022 and 2023, ~150 UB students participated in cost-free field programs in Alaska, with additional programs planned for 2024, demonstrating the overall success of the JIRP-UB partnership (Campbell et al., 2024). The curriculum described here serves as one of many classroom resources that JIRP-UB is developing to reach additional students. The curriculum is available at bit.ly/virtual-jirp. We hope other educators will adapt our course to bring the Juneau Icefield to their own classrooms.

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