

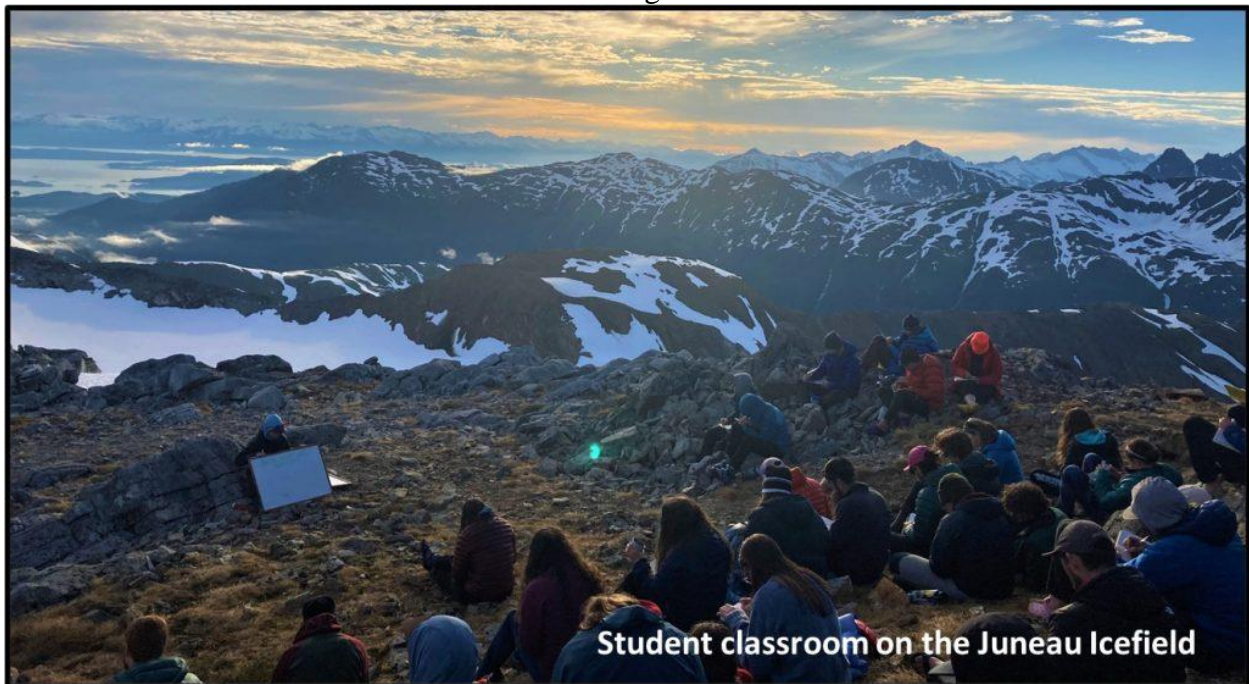
Polar Education Conference: Improving JEDI for students interested in Polar STEM Careers

Whitepaper Summarizing the 2022 Polar STEM Conference

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University of Alaska - Southeast, Juneau, AK

climatechange.umaine.edu/polaredconference/

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NOTE: Workshop Notes are attached to the bottom of the Whitepaper PDF for reference.

Overview

Geoscience fields have long lacked diversity and are hampered by many barriers to entry for historically marginalized students (e.g., Marín-Spiotta et al., 2020, Berhe et al., 2022, Burton et al., 2023). This is especially evident in Polar and climate science fields for k-12 and higher education (Seag et al., 2019, White et al., 2019, Baber et al., 2010). Living and working in remote field environments that are associated with polar and climate research can be a barrier to students who have limited access to required equipment, supplies, and pre-field opportunities and training, and who face greater health and safety risks in the field. Under-represented students also often have limited exposure to related polar science content in school, are confronting cultural concerns about a career in these fields (e.g., Polar sciences not being viewed as a viable career or option limited local resources to support students entering into the field), and battle individual, institutional, and systemic forms of oppression within these fields. The heavy use of fieldwork as a marketing tool by geoscience programs can also alienate students who have no prior experience or knowledge of these fields nor a desire to become a field scientist. Additionally, although most environmental challenges disproportionately impact marginalized communities, few nation-wide environmental programs effectively support or mentor students from these populations.

The Department of Education-funded Trio Upward Bound Program (UB) is one such program. During the summer of 2022, UB collaborated with the Juneau Icefield Research Program (JIRP), an established Polar STEM training program, to create field experiences for 30 UB students from low-income families or families where neither parent has a college degree. To complement this pilot program, we hosted an education conference to develop collaborative strategies for bolstering justice, equity, diversity, and inclusion (JEDI) within the Polar STEM community. The conference was open to attendance for all UB staff, earth science educators, and Polar scientists across a wide range of career levels. The conference focused on 1) developing new strategies for engaging under-represented students in the field and back in the classroom; 2) developing relationships and collaborations between UB educators and professional scientists; and 3) establishing a dialogue towards long-term UB engagement with the Polar STEM community. Conference attendees also had the opportunity to experience some of the same trips and field experiences as UB students to get a better understanding of program activities and needs.

Intellectual Merit

Positive undergraduate experiences and outdoor interest are two factors that have been attributed to attracting undergraduate students into geosciences and a strong connection with mentors as well as summer research experiences are dominant factors in retention (O'Connell and Holmes, 2011). Therefore, it is intuitive to develop programs that provide opportunities for long term mentoring from faculty and inspiring summer field or non-field research experiences for students within target demographics. This conference focused on developing these opportunities in the Polar community by leveraging existing research and education resources.

Pre-Conference and Participant Professional Backgrounds

In advance of the conference, we created an online interest form for anyone interested in participating. The focus of the form was to gauge the professional backgrounds of all participants and general interest for such a conference. We received 74 responses to the form which provided

valuable feedback for planning daily discussions. Participants came from a wider range of fields in education (Figure 1).

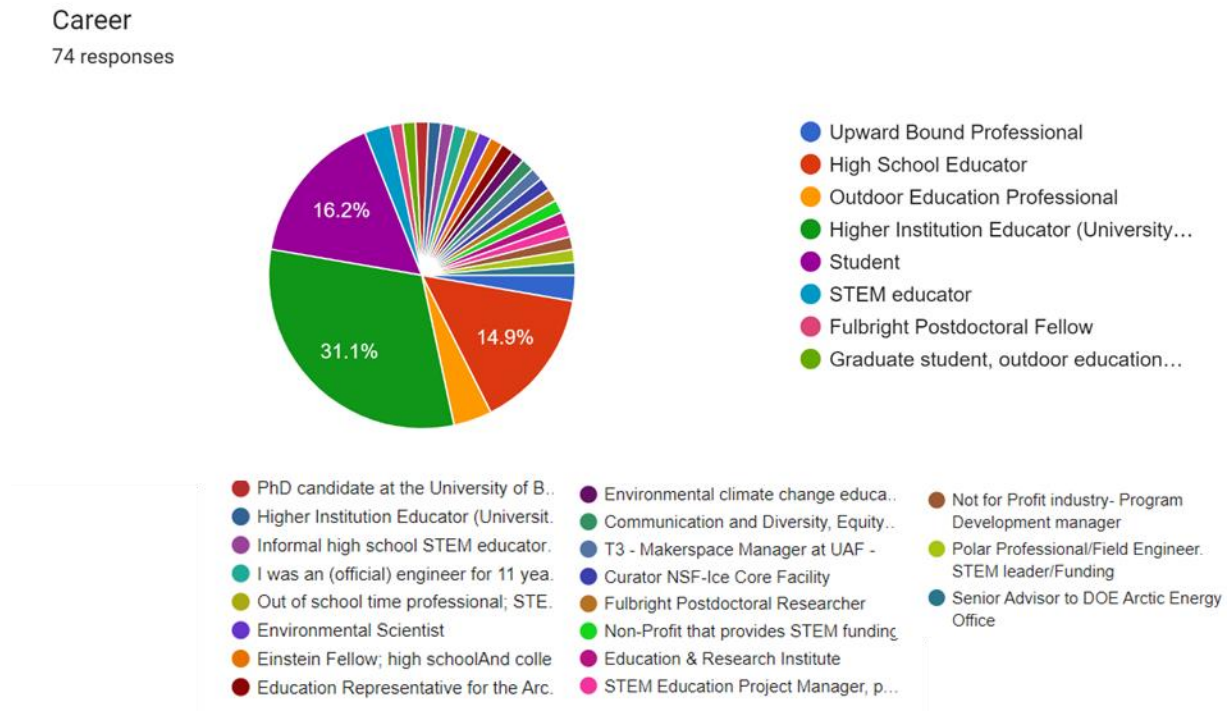


Figure 1. Summary of responses from participants interested in attending the Polar STEM conference.

Advertising

The conference was advertised on available cryosphere-related listservs such as cryolist, and ArcticInfo, and on social media (e.g., twitter). To encourage broader fields, early career, and underrepresented community participation, we also advertised through the Association for Polar Early Career Scientists (APECS), Earth Science Women's Network, Interagency Arctic Research Policy Committee (IARPC), UArctic, and classical Polar workshops (WAIS Workshop, Arctic Workshop, and AGU Cryosphere Discussions). We hoped to encourage early career engagement with this advertising approach and were successful.

Daily Conference Summaries

Discussions during each of the three days of the conference were driven by the following questions:

- What current resources, funding, opportunities, and technology exist to support Polar STEM field and in-classroom experiences?

- What are the current needs of students related to Polar STEM, what are the logistical challenges and barriers to these students, and how can we break barriers and build community within Polar STEM?
- How can we best create engaging and real-world Polar STEM and related experiences for students in the classroom?

We had a total of 11 conference talks from attendees and two invited speakers. All talk abstracts can be found [in the conference agenda](#). Each day started with three to four talks. Following daily talks, the group divided into smaller breakout sessions and were provided with discussion question(s) and a group moderator. Responses from participants were recorded in shared Google Slides where participants could anonymously respond to the discussion questions. This helped reduce reservations for participants and make the venue more amenable to people with opinions that differed from the group (e.g., early-career participants). Below, we summarize the key takeaways from each group. However, the full responses in the Google Slides can be viewed via a link listed on the following webpage, as well as full video recordings of the conference:

https://docs.google.com/presentation/d/11uSdnVX7wzkuMcBeUDF_i2-k7vH4KwtMJhj-KXTVXq4/edit?usp=sharing

Day 1

7/28/22: What current resources, funding, opportunities, and technology exist to support Polar STEM field and in-classroom experiences?

The day started with presentations from four speakers to spark conversations and to share experiences and information about existing programs that work with students. The following presenters discussed:

1. **A Tale of Two Cities: Empowering Students on the Frontlines of Climate Change through Field Experience** – *Alex Chumbley (in-person) & students (virtual)*
2. **Navigating the New Arctic Community Office: Connecting educators with Arctic research** – *Jenna Vater (in-person)*
3. **Current and future outreach resources for incorporating Arctic field science in the classroom from a research station in Arctic Alaska** – *Haley Dunleavy (in-person)*
4. **“New” Earth and Planetary Sciences Polar Proving Ground – The Juneau Icefield Research Program** – *Seth Campbell (in-person)*

In addition, we had a keynote talk by the invited speaker, [Dr. Ben Santer](#).

Following these talks, participants were placed into breakout groups and provided with several questions to help guide discussions. Below are summaries from each breakout group.

Group 1: The discussion focused on existing federal and local programs and opportunities available to educators and students. On the federal level, the group identified the following programs: [TRIO-Upward Bound](#), [Talent Search](#), [STEM, Student Support Services program](#), [McNair Scholar Program](#), [US Fulbright Program](#), [Einstein Fellows](#), and the National Science Foundation-funded Research Experience for Undergraduates ([REU](#)), [Juneau Icefield Research](#)

[Program](#), [Toolik Field Station](#), [Inspiring Girls Expeditions](#), [Wrangell Mountain Center](#), [Polar Science Early Career Community Office](#), numerous general community foundations for student travel support, the recently ending [PolarTREC](#), and recently established [Polar STEAM](#) Program. Additionally, most colleges and universities have education and outreach initiatives (e.g., Colorado College summer geology program; University of Alaska Fairbanks [International Arctic Research Center summer school](#)) which can be relied upon as local resources. This list of programs is by no means exhaustive and are a sample of available programs this group was aware of. The group also listed a number of research projects and organizations as well as data sets and curricula available for educators (see [Google Slides](#) - slide 3).

The group also highlighted some of the challenges associated with current resources and funding. It seems like a lot of opportunities and funding exists, but facilitating collaboration and communication of these opportunities to the right people remains a critical hurdle. How do we get these programs and experiences into the hands of educators who have direct impact with students?

Another avenue that was explored and discussed related to the use of Virtual Reality technology and educational video games to use in the classroom. The idea is not new, but it is not commonly used in the classroom despite its potential. Virtual Reality seems to be a scalable method. This also is a way to provide a lot more access to more students - especially those who are underserved. Because it can be financially and time prohibitive to bring students to Polar environments in person, virtual reality may be a cost-effective way to expand the reach of these experiences.

Group 2: This group asked a very specific question: *How do we start an Arctic field program for our students (step-by-step)?* Because this conference had several attendees from organizations that hosted student groups in Alaska, the group brainstormed on how to get involved in that process for their own students. Some major takeaways from the assembled list (see [Google Slides](#) - slides 6-7) were pointing out that many high school programs do not offer Polar STEM courses. This might mean that students and teachers come in with little background knowledge. A key takeaway from this is to be sure that educators have resources available to learn the science so that they can incorporate and teach it in the classroom. Another major point was on funding and cost sharing for sending students on a field-based course.

This group identified the same challenge as Group 1 in that getting knowledge out to educators about the resources and opportunities is critical because many simply don't know that these opportunities exist for them and their students.

Group 3: The group focused on each part of the 'question of the day' and broke down their discussions accordingly. For *Resources*, the group mentioned the need for collaborative programs that included different organizations as well as the local communities. For *Funding*, the focus was on taking advantage of existing programs such as the Juneau Icefield Research Program and Toolik Field Station to apply for funding through non-profit foundations. For *Opportunities*, the group highlighted the need to provide opportunities for teachers as well as students. The idea is that teacher professional development has the potential to impact a large number of students through classroom experiences. The group also listed a number of research projects that include outreach components and may be good existing resources (see [Google Slides](#) - slide 9).

One challenge that the group identified is how to track the progress of student success on these programs. They suggested developing a database to record this information, however the question of who would manage and fund this remains.

Group 4: This group created a detailed list of organizations that provide outreach and educational opportunities for high school students with links included (see [Google Slides](#) - slide 10). Some of the challenges this group recognized were how to reach and engage all students from different schools and programs on a topic such as Polar STEM and to get an understanding of the costs per student per day associated with field-based trips.

Group 5: This group all joined the conference virtually and created a list of outreach and Arctic science organizations that would be useful to educators. Also included is a list of glaciology and climate teaching resources. (see [Google Slides](#) slide 11-12 & 15).

The group also created a list of actionable items with tangible outcomes (slide 13). The first goal is to connect teachers to funding for Polar STEM experiences. This would include providing teachers with tools and resources to write grants (potentially include examples of previously funded grants). The group also suggested having a list of available funding agencies (non-profits, government, private). A second goal focused on connecting researchers with educators. These types of partnerships already exist with organizations such as the Juneau Icefield Research Program and Toolik Field Station.

Day 2

(7/29/22): What are the current needs of students related to Polar STEM, what are the logistical challenges and barriers to these students, and how can we break barriers and build community within Polar STEM?

The day started with presentations from four speakers to help spark conversations and to share experiences and information about existing programs that work with students. The following presenters discussed:

1. **Inspiring Girls Expeditions of Alaska: Removing barriers to accessing field sciences and the outdoors for teenaged youth and early career professionals** – *Joanna Young (virtual)*
2. **PSECCO: A New Community Office for Supporting Early Career Scientists and Advancing Equity and Inclusion in the Polar Sciences** – *Mariama Dryak (virtual)*
3. **The Intersection of Sustainability and Resource Development** – *Taylor Ferguson (in-person)*
4. **Making connections – Field experiences for high school students with Upward Bound and the Juneau Icefield Research Program** – *Scott Braddock (in-person)*

Following these talks, participants were placed into breakout groups and provided with several questions to help guide discussions. Below are summaries from each breakout group.

Group 1: The group decided to create an outline for a pilot program that would bring teachers into the field. The aim of this approach with a focus on educators is because teachers can reach many students. The proposed field experience would be hosted by an existing field station such as

Toolik and provide teachers with experiences and knowledge that can be used to effectively teach Polar STEM to their students back home. A full outline with outcomes is included in [Google Slides](#) 18-19.

Group 2: The group created a list of needs and challenges to students to build on similar feedback from Day 1. The list included the need to include teachers as well as students on these programs. As mentioned by previous groups, teachers have the ability to make their experience and knowledge accessible to a huge number of students over many years. Another takeaway was how to leverage cooperation with existing field programs (Toolik and JIRP) to make the trips economically viable. The full list can be seen in [Google Slides](#) 20.

Day 3

(7/30/22): How can we best create engaging and real-world Polar STEM and related experiences for students in the classroom?

The last day of the conference ended following the keynote speaker. The day started with presentations from three speakers to help spark conversations and to share experiences and information about existing programs that work with students. The following presenters discussed:

1. **Icebergs In Maine** – *Erin Towns (in-person)*
2. **How T3 Alliance and Upward Bound are engaging students in STEM** – *Tate Barhaug (in-person)*
3. **Democratizing STEM with Polar Science** – *Christine Hirst Bernhardt and Dr. Holly Miller (in-person)*

In addition, the keynote talk was provided by the invited speaker, [Dr. Heather Sauyaq Jean Gordon](#).

Following these talks, participants were placed into two breakout groups and provided with several questions to help guide discussions. Below are summaries from each breakout group.

Group 1: The group focused on ways to bring a field experience to the classroom for school systems and students unable to access field-based programs. Making the experience virtual was one idea that gained a lot of interest at the conference. This approach would require a large upfront investment to purchase virtual reality equipment and training but would then be a long-term option for teachers to use. Another approach suggested by the group was to have student participants document field-based programs by creating video, art, or written accounts of their experiences that they could share with classmates back home. The idea of a cross-cultural exchange was also discussed, to include students from different communities meeting and sharing their communities, environmental challenges, and solutions, with other communities (e.g., Alaska Native communities and Florida communities co-sharing).

Group 2: Individuals within the group offered ideas and programs that would be most relevant and beneficial to their specific programs. Some group members wanted to focus on programs designed for students while others focused on providing trips and funding for teachers. This was a common theme for all three days and highlighted participants' suggestions that teachers be heavily

involved in these programs as well. The group also asked how outcomes could be measured for these programs.

Key Takeaways

Conference Discussion Takeaways

Over the course of three days, daily attendance averaged 20 in person and 5 virtual participants. Our aim of hosting this conference in-person over three days was to increase discussions among participants and to foster new collaborations. In this, the conference was hugely successful in securing funding for future programs and building new partnerships between high schools, secondary education institutions, and other field programs.

What current resources, funding, opportunities, and technology exist to support Polar STEM field and in-classroom experiences?

- While Polar STEM opportunities and funding for students exists, there remains the challenge of communicating about these programs and experiences with educators who have access to students and can promote these opportunities.
- Because it can be financially and time prohibitive to send students to Polar environments for in-person field courses, virtual reality may be a cost-effective way to bring polar field experiences to those who are unable to travel there, due to either financial or other accessibility barriers.
- There is an unmet need for programs that provide educators with professional development and resources (e.g., through Research Experience for Teachers programs) to learn the science themselves, which should allow them to successfully incorporate Polar STEM into their classroom teaching.
- How should success be measured in Polar STEM programs?

What are the current needs of students related to Polar STEM, what are the logistical challenges and barriers to these students, and how can we break barriers and build community within Polar STEM?

- Discussions centered around the need for teacher professional development in the form of field experiences as a means of reaching the greatest number of students.
- Students come to Polar STEM programs with a range of identities and academic, socioeconomic, and cultural backgrounds. Programs that fully support the expansive intersectionality of students' identities, e.g., Inspiring Girls* Expeditions are needed to break barriers.
- Careers in Polar STEM extend beyond that of an academic researcher. Highlighting the diversity of science careers in polar and climate research, such as research positions within government, non-profit, and private agencies, science communicators and artists, and field logistics support, will broaden student pathways into Polar STEM.

How can we best create engaging and real-world Polar STEM and related experiences for students in the classroom?

- Conversations focused on field experience programs designed for students and for educators.
- Polar STEM experiences and curricula need to be created through co-inquiry and co-production between educators, scientists, and local communities. All involved must approach the collaboration by fully respecting the knowledge, experience, and authority each party brings with them.

New Opportunities/Outcomes

Additionally, the conference generated new high school student opportunities including bringing high school and undergraduate students to Alaska for field programs. In 2023, two groups of Upward Bound students from Oregon will travel to Alaska. One group will be based at Toolik Field Station, and another will work with the Juneau Icefield Research Program (JIRP). Also, a group of undergraduate students from Oregon State University and the University of Texas - San Antonio will work in Alaska with JIRP in the summer of 2023. Participants for these programs will come from low-income families and/or be first-generation college students.

In addition to new student groups joining the field-based programs in Alaska, the conference participants had the opportunity to write a proposal to Battelle to secure funding for Polar STEM outreach programs. Two proposals were written with one focused on Arctic programs and the other in the Antarctic. Both proposals were funded. The Arctic proposal was designed to test a new high school program at Toolik Field Station in Alaska for low-income high school students or students that will be first-generation college students. This program includes high school teacher engagement and opportunities for students to work with scientists on Polar field research. The second proposal funded was to purchase a suite of computers, drones, 360-degree go-pro cameras, and iPhones with LiDAR capabilities, 3D modeling software, and virtual reality headsets. This equipment will be used as a shared resource between JIRP, Toolik Field Station, or other interested programs who are keen to teach students about Antarctic and Arctic sciences.

During this conference, we received feedback from a wide range of stakeholders in the education community, including high school teachers, outdoor program educators, early-career researchers, academic scientists, and representatives from a private non-profit company that offered insight into seeking funds for educational programs. This combination of participants encouraged discussions that were centered around the need for improved pathways for students from underrepresented backgrounds to learn about and participate in Polar STEM careers. Some key takeaways from the needs of educators include:

- getting knowledge out to educators about the resources and opportunities available because many simply don't know that these opportunities exist for them and their students.
- Increase teacher professional development because this has the potential to impact a large number of students through classroom experiences.
- Develop a method to track the progress of student success on these programs.

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Appendices

Polar STEM Conference Agenda

July 28-30, 2022

(Times listed in Alaska Standard Time)

Check out the abstracts at [Polar STEM conference abstracts](#)

Day 1 – Thursday 7/28

Leading Question: What current resources, funding, opportunities, and technology exist to support Polar STEM field and in-classroom experiences?

0900 – Breakfast

1000 – Welcome and orientation & rules of engagement (Seth, Deb, Scott)

1015 – Presentations

1. A Tale of Two Cities: Empowering Students on the Frontlines of Climate Change through Field Experience – *Alex Chumbley (in-person) & students (virtual)*
2. Navigating the New Arctic Community Office: Connecting educators with Arctic research – *Jenna Vater (in-person)*
3. Break
4. Current and future outreach resources for incorporating Arctic field science in the classroom from a research station in Arctic Alaska – *Haley Dunleavy (in-person)*
5. “New” Earth and Planetary Sciences Polar Proving Ground – The Juneau Icefield Research Program – *Seth Campbell (in-person)*

1115 – Break

1130 – Discussion group breakout rooms

1300 – Lunch

1430 – Discussion group breakout rooms

1515 – Break

1630 – Keynote Speaker: Dr. Benjamin Santer – Additional information here: [Dr. Ben Santer](#)

1730 – Daily Summary & Group Discussions

1800 – End of Day – Dinner

Day 2 – Friday 7/29

Leading Question: What are the current needs of students related to Polar STEM, what are the logistical challenges and barriers to these students, and how can we break barriers and build community within Polar STEM?

0900 – Breakfast

1000 – Welcome and orientation (Seth, Deb, Scott)

1010 – Rules of engagement (Seth)

1020 – Presentations

6. Inspiring Girls Expeditions of Alaska: Removing barriers to accessing field sciences and the outdoors for teenaged youth and early career professionals – *Joanna Young (virtual)*
7. PSECCO: A New Community Office for Supporting Early Career Scientists and Advancing Equity and Inclusion in the Polar Sciences – *Mariama Dryak (virtual)*
8. Break
9. The Intersection of Sustainability and Resource Development – *Taylor Ferguson (in-person)*
10. Making connections – Field experiences for high school students with Upward Bound and the Juneau Icefield Research Program – *Scott Braddock (in-person)*

1120 – Break

1130 – Discussion group breakout rooms

1300 – Lunch

1430 – Discussion group breakout rooms

1515 – Break

1630 – Keynote Speaker: TBD

1730 – Daily Summary & Group Discussions

1800 – End of Day – Dinner

Day 3 – Saturday 7/30

Leading Question: How can we best create engaging and real-world Polar STEM and related experiences for students in the classroom?

0900 – Breakfast

1000 – Welcome and orientation (Seth, Deb, Scott)

1010 – Rules of engagement (Seth)

1020 – Presentations

1. Icebergs In Maine – *Erin Towns (in-person)*
2. Break
3. How T3 Alliance and Upward Bound are engaging students in STEM – *Tate Barhaug (in-person)*
4. Democratizing STEM with Polar Science – *Christine Hirst Bernhardt and Dr. Holly Miller (in-person)*

1120 – Break

1130 – Discussion group breakout rooms

1200 – Keynote Speaker: Dr. Heather Sauyaq Jean Gordon – Additional information here: [Dr. Heather Sauyaq Jean Gordon](#)

1300 – Lunch

1430 – Conference Summary & Group Discussions

1600 – End of Day – Dinner

Primary Conference Topics of Interest

Note: Topics listed below are from original participant questionnaire.

1. Research opportunities for summer experiences
2. Current resources & funding opportunities available for these experiences
3. Technology resources for classrooms
4. Connecting fieldwork and non-fieldwork roles in Polar research
5. Creating engaging, real-world Polar research in local classrooms
6. Logistical challenges for student participation in summer experiences
7. Current needs for participating communities
8. Breaking down barriers to entry into Polar STEM
9. Building communities in Polar STEM

Polar STEM Conference Abstracts 2023

Title: A Tale of Two Cities: Empowering Students on the Frontlines of Climate Change through Field Experience

Presenter: Alex Chumbley (virtual) & students (virtual)

Abstract: A group of approximately 20 high school students from Miami-Dade College - Homestead Campus's Upward Bound program was hosted by the Juneau Icefield Research Program for a one-week field experience in July 2022. This one-week experience left our students excited for the field of polar science and poised them to make nuanced connections between the two cities: Miami and Juneau. During this talk, our students themselves will share both their experiences in Alaska and the ways they connected this experience to their everyday life. They begin by sharing the details of their field experience, such as coring trees, analyzing a soil pit, identifying glaciers, and collecting water samples for future analysis; in their stories, you will hear the ways the students have deepened both their content knowledge and their appreciation for climate science. Afterwards, they will share how they leveraged these experiences in Alaska to make complex and nuanced connections between the changes seen in Juneau to the changes they live every day in Miami-Dade County. The connections the students made between Alaska and Florida coalesced around four major themes all undergirded by the impact of climate change: How have the people, the local economies, the land, and the waterways shifted as result of climate-change? This talk will focus on the latter two themes: the story of land and the story of the water. The story of the land foregrounds the connection between glacial melt in Alaska with sea-level rise in Florida. Students now have first-hand experience seeing the impact of glacial isostatic rebound in Alaska and have experienced intermittent flooding on sunny days in Southern Florida during a "King Tide." Experiencing drastically different impacts from the same overarching phenomenon of climate change positioned our students to grapple with this information on a deeper level and reach a more complex understanding. The story of the water focuses on the unexpected ways circulation patterns in our world's oceans influence the coastal ecosystems of Florida and Alaska. Additionally, students connect the ways that marine life have been impacted by climate change in both in Florida and Alaska. Overall, we hope our students' presentation illuminates the power of field-experiences. In particular, we contend that this experience has deepened our students content knowledge thereby empowering them to make more nuanced connections than possible in a traditional brick-and-mortar school setting. Ultimately, their experience travelling to a city 4000+ miles away has allowed our students to better understand the impacts they are experiencing on a daily basis in their own backyard.

Title: Navigating the New Arctic Community Office: Connecting educators with Arctic research

Presenter: Jenna Vater (in-person)

Abstract: Connecting educators with Arctic research, outcomes and products is imperative to inspiring learners to engage with Polar STEM fields. Organizations like the Navigating the New Arctic Community Office (NNA-CO) can act as a bridge between Arctic researchers and educators. In this presentation, we will introduce the NNA-CO, its education and outreach efforts, and how educators can engage with the office. This session will also highlight several examples of Navigating the New Arctic (NNA) projects that inform about and/or engage educators and students in Arctic research.

Title: Current and future outreach resources for incorporating Arctic field science in the classroom from a research station in Arctic Alaska

Presenter: Haley Dunleavy (in-person)

Abstract: Toolik Field Station is an Arctic research station located on the northern foothills of the Brooks Range, Alaska. The station aims to facilitate a deeper understanding of the Arctic by fostering science and education, and hosts up to 500 scientists and students every year while supporting the publication of thousands of peer-reviewed studies over the course of its nearly 50 year existence. Despite its significant impact on advancing science’s collective understanding of the Arctic, Toolik’s outreach to STEM education programs does not reach its full potential. Here, we present an overview of currently available resources and potential future initiatives that Toolik is interested in using to further develop our science outreach and communication to classrooms and STEM programs both within and outside of the state.

Currently, Toolik offers resources, accessible via its website, that could be used in the development of classroom modules on environmental data analysis and natural history observations. Toolik’s Spatial and Environmental Data Center (SEDC) collects long-term, open-access monitoring datasets on weather, snow and ice thickness, atmosphere and air quality, plant phenology and growth, and bird migrations. Many visiting researchers archive their data collected from the Toolik region in open-access online databases like DataOne or the Arctic Data Center. In addition to these quantitative resources, the SEDC also offers qualitative materials through which students could learn about the Arctic, including animal and plant guides, a virtual herbarium, time lapse photographs of nearby tundra and lake sites, and virtual “street view” tours of the field station and experimental plots. Since 2006, the Toolik Naturalist Journal has provided daily accounts of natural history observations, also available on Toolik’s website. These entries are written at a middle school reading level, include accompanying photographs, and are often translated into Spanish by Toolik staff. Additionally, the Toolik GIS and Remote Sensing department collects and analyzes spatial data derived from drone and satellite imagery and bathymetry surveys, in addition to creating a variety of maps. In the future, Toolik GIS hopes to create an interactive online platform for accessing and visualizing drone imagery.

As we expand our Polar STEM efforts, we hope to 1) increase the accessibility of current resources via improvements to our website, 2) build new resources specifically for outreach, and 3) increase classroom visits, either virtual or in-classroom, to share with students about Toolik and its research community. Current work on this goal includes contributing to the growing effort on changing the narrative about who “belongs” in science. Through social media, web stories, Skype-A-Scientist sessions, and other outreach products, we are working on highlighting the diverse identities within Arctic science that are represented at Toolik as well as emphasizing the availability and variety of career pathways into science. As the largest scientific research station in the Arctic, Toolik Field Station values the importance of developing a STEM outreach program that matches the strength of its research support. We welcome further feedback and future collaboration towards advancing this initiative.

Title: “New” Earth and Planetary Sciences Polar Proving Ground – The Juneau Icefield Research Program

Presenter: Seth Campbell

Abstract: This presentation outlines the current and future directions of the Juneau Icefield Research Program working with high school, undergraduate, graduate students, and early career scientists. Additionally, this presentation will summarize initiatives being pursued to support justice, equity, diversity, and inclusion across underrepresented communities to bolster education and engagement within Polar STEM fields.

Title: Inspiring Girls Expeditions of Alaska: Removing barriers to accessing field sciences and the outdoors for teenaged youth and early career professionals

Presenter: Joanna Young (virtual)

Abstract: Inspiring Girls Expeditions empowers 16-18 year-old high school girls and gender-expansive youth through 12-day backcountry expeditions that combine science, art, and outdoor exploration. At Inspiring Girls Expeditions of Alaska based at the International Arctic Research Center at the University of Alaska Fairbanks, we offer three expeditions per summer: 1) Girls on Ice Alaska, our flagship mountaineering expedition with a focus on glacier and alpine ecosystems, 2) Girls on Water, a sea kayaking expedition examining the nearshore marine ecosystem, and 3) Girls in the Forest, a packrafting and hiking expedition that explores the Interior Alaskan boreal forest landscape. Given that field sciences and outdoor recreation are traditionally male-dominated, Inspiring Girls was created in order to welcome young women into these spheres. Though we acknowledge our name is imperfect, Inspiring Girls has since evolved to welcome girls, non-binary youth and gender non-confirming youth. We take an intersectional approach to inviting marginalized groups into field sciences by intentionally building teams of participants from a diversity of socio-economic, racial, ethnic, and family backgrounds. Importantly, our tuition-free format removes a substantial barrier to access to extracurricular science and outdoor programs. In addition to participants, Inspiring Girls also serves as a learning opportunity for the early career scientists, artists, and outdoor guides who we employ as instructors, through professional development trainings in e.g. culturally-responsive pedagogy, LGBTQ+ allyship, and traditional Land Acknowledgement. This presentation will discuss the approaches Inspiring Girls Expeditions of Alaska uses to create opportunities for both high schoolers and young professionals in field science and outdoor recreation, rooted in best practices from the literature and 10+ years of experience hosting expeditions in Alaska.

Title: PSECCO: A New Community Office for Supporting Early Career Scientists and Advancing Equity and Inclusion in the Polar Sciences

Presenter: Mariama C. Dryak^{1,2}(virtual), Rebecca Batchelor¹, Bradley Markle², Anne Gold¹

1. CIRES Education & Outreach, University of Colorado Boulder

2. INSTAAR, University of Colorado Boulder

Abstract: While the polar sciences offer unique opportunities for international, transdisciplinary research as well as connections with Indigenous knowledge systems, the US polar science community remains unrepresentative of the diversity of the country itself. While there are many reasons for this, including those familiar throughout STEM as well as the explicit historical exclusion of certain groups in polar science specifically, early career scientists in the polar community are driving efforts to broaden participation in polar research. **The newly launched Polar Science Early Career Community Office (PSECCO) seeks to empower, elevate and**

give agency to the early career polar scientists who are leading the charge to make the polar sciences more welcoming, inclusive and diverse. The office will foster community among early career polar scientists and educators, provide funding, training and travel opportunities, partner with other organizations to share opportunities, resources and support leadership development, while working together towards a more just, inclusive, diverse, equitable and accessible polar science environment. Launched early in 2022, we invite all current and future polar scientists and educators to join PSECCO in building community together.

Title: The Intersection of Sustainability and Resource Development

Presenter: Taylor Ferguson (in-person)

Abstract: Lack of access to information and an in-depth understanding of the Arctic's resources are major barriers for many students, especially underrepresented populations, when considering career choices in Alaska. Alaska Resource Education (ARE) is working to knock down these barriers for students across Alaska. ARE has several programs to teach students K-12 about Alaska's natural resources, the science behind them, their associated careers, and most importantly their role in a sustainable future for the Arctic.

Title: Making connections – Field experiences for high school students with Upward Bound and the Juneau Icefield Research Program – Scott Braddock (in-person)

Presenter: Scott Braddock

Abstract: During the summer of 2022, Upward Bound high school students from Miami and Washington joined researchers from the Juneau Icefield Research Program on week-long field experiences in Juneau, Alaska. The overall aim of the collaboration between the Juneau Icefield Research Program and Upward Bound is to introduce high school students to Earth and Climate sciences through participation in science research, exploring outdoor classrooms, and making connections between their homes and a rapidly changing Arctic environment. The collaboration between UB and JIRP is funded to continue over the next 3 years as we look for ways to build on and improve this amazing experience for students.

Title: Icebergs In Maine

Presenter: Erin Towns (in person)

Abstract: Trying to make the Arctic relevant can be challenging in the classroom. Participants will be introduced to a student created photography exhibit (shown in person and virtually) that served as a capstone project for an interdisciplinary Arctic course that combined social studies, polar climate change studies, and visual arts. PolarTREC teacher, Erin Towns will share how she took her field experience as part of the Greenland Subglacial Tremor Project and directly related it to local and state contemporary issues, making learning fun, tangible, and relevant for her students.

Title: How T3 Alliance and Upward Bound are engaging students in STEM

Presenter: Tate Barhaug (in person)

Abstract: T3 Alliance works with programs such as Upward Bound to facilitate an engaging environment for students interested in STEM. Seeing the clear picture that young students have the capability and desire to make a positive difference in their communities, these programs work to cultivate community-oriented leaders with problem solving skills and a growth mindset. Through a network of educators at universities and high schools, students are exposed to real world

problems and the tools that they need to ideate and prototype solutions. The network provides a wealth of information through connecting students to experts while simultaneously giving them the opportunity to engage with technology. This technology is housed in a Makerspace where students are encouraged to experiment with new techniques and learn through a hands-on working environment. The students also have the opportunity to engage in the Upward Bound Summer Program where they experience this process over a five-week period at University of Alaska Fairbanks. Just as the students grow, the programs grow as well with each new educator, researcher and community member that joins to make a positive difference in the lives of others through technology, culture, and opportunities.

Title: Democratizing STEM with Polar Science

Presenter: Christine Hirst Bernhardt & Dr. Holly Miller (in person)

Abstract: Earth and Space sciences encompass the most neglected realm of science education in the United States, as well as the lowest representation of Women and People of Color. For over a century, high school science coursework has minimally included biology, chemistry and physics, integrating Earth sciences in middle grades and eliminating astronomy. There has been no national test, curricula or standardization, which immediately eliminates rich opportunities for learning, such as the integration of polar science. The scarcity of course offerings and absence of Advanced Placement or IB courses have relegated coursework to university settings, by which time the moment to select a STEM field has likely passed. Secondary and primary environments are critical for the formation of a STEM identity, particularly amongst girls and students of non-dominant groups. This talk will explore the integration of polar sciences in formal education settings to foster STEM identities and build bridges between science, community, and the classroom. Utilization of Earth Systems science with a lens to the poles can unify learning from other contents, while providing opportunities to explore the evidential sources of knowledge of our world. The inclusion of Earth and Space content (ESS) into NGSS courses, provides a unique opportunity to contextualize science learning. NGSS assigned equal weight to the content areas of life, physical and ESS, which is a stark difference from the previous 100 years of education and allows for a drastic restructuring of course sequencing. There is now a far greater emphasis on Earth-Space systems across all grade levels, reflecting the interdisciplinary nature of the field. The exposure to meaningful and relevant science activities can provide an inclusive environment to traditionally marginalized students who do not see the real-world applicability of science in their lives. Students in urbanized settings may have even less academic exposure to astronomy and space sciences through a vicious cycle of deficit thinking and systematic oppression. Circularization and oversimplification may look like non-local examples, unrelatable representation, and a failure to incorporate areas of relevancy and urgency from daily life into the classroom. This can further complicate the incorporation of polar sciences, which may seem abstract, complicated, and unnecessary. One can only imagine the magnification of this separation following a year of remote, removed learning mediated by a screen. By providing mechanisms of access to polar sciences connected to local environments, educators can facilitate authentic learning experiences to previously excluded students in these fields. Earth sciences and polar education has potential to disrupt colonial narratives while providing greater access to 21st century skills.

Keynote Speaker: Dr. Heather Sauyaq Jean Gordon

Heather Sauyaq Jean Gordon is a research scientist in the youth development program at Child Trends. Heather was born and raised in Homer, AK on the beautiful Kachemak Bay. She is Iñupiaq and an enrolled tribal member of the Nome Eskimo Community, a federally recognized Tribe. Dr. Gordon has a B.A. in race and ethnic studies (University of Redlands, CA), an M.S. in sociology (University of Wisconsin-Madison), and a PhD in Indigenous studies (University of Alaska Fairbanks). For her dissertation, *Self-determination, Sustainability, and Wellbeing in the Alaska Native Community of Ninilchik*, Dr. Gordon conducted ethnographic futures research interviews in partnership with the Ninilchik Village Tribe to explore how individual, community, and Tribal self-determining actions lead to community sustainability and wellbeing. She not only wrote a dissertation but produced a 20-year roadmap for the community, outlining the results of the research for community development. She did her master's work on *Building Relationships in the Arctic*, which articulates the importance of mutually beneficial participatory research involving co-production, respect of sovereignty and self-determination, privileging Indigenous knowledge, and engaging in free prior and informed consent.

Dr. Gordon comes to Child Trends from the Division of Program Evaluation and Planning at the Administration for Native Americans, a part of the Department of Health and Human Services (HHS). There she conducted project evaluations, published papers and reports, gave presentations, served on executive order committees on equity issues, designed data collection and measurement instruments, reviewed grant applications, worked with the Native Youth Initiative for Leadership, Empowerment, and Development grantees, worked on missing and murdered Indigenous Peoples initiatives, and explored how culture is a protective factor in Indigenous communities. She also served as a subject matter expert on working with Indigenous people. In that capacity, she advised the Administration for Children and Families (ACF) on their work around missing and murdered Native Americans, the Office of Planning, Research, and Evaluation (OPRE) on methodologies appropriate to working with Indigenous people and other vulnerable and minority populations, the Interagency Arctic Research Policy Committee (IARPC) on drafting the Arctic Research Plan (ARP) 2022-2026, and the White House Office of Science and Technology Policy on documents and work around Indigenous knowledge.

Dr. Gordon's research interests include continued work with Indigenous youth, families, and Elders around colonization and historical trauma, culture as a protective factor, futures research, and Indigenous self-determination. Her research interests also include sustainability, health and wellbeing, missing and murdered Indigenous people, social inequality and stratification, criminology and restorative justice, Indigenous healthcare, and Indigenous migration. She seeks to continue participatory work that brings voices often not heard to the forefront by working with Tribes and Indigenous organizations to produce mutually beneficial research that not only benefits the Indigenous community but informs policy and granting organizations.

Keynote Speaker: Dr. Benjamin Santer

Research

Ben Santer is an atmospheric scientist. He recently retired from Lawrence Livermore National Laboratory and is now a Visiting Researcher at UCLA's Joint Institute for Regional Earth System Science & Engineering. He studies natural and human "fingerprints" in observed climate records. His early research contributed to the historic 1995 conclusion of the Intergovernmental Panel on Climate Change: "the balance of evidence suggests a discernible human influence on global climate". He served as lead author of a key chapter of that report. Since 1995, Ben has identified human fingerprints in atmospheric temperature and water vapor, ocean heat content, sea surface temperature in hurricane formation regions, and many other climate variables.

Education

Ben holds a doctorate in Climatology from the University of East Anglia, England. After completing his Ph.D. with Prof. Tom Wigley in 1987, he spent five years at the Max-Planck Institute for Meteorology in Germany. While at the Max-Planck Institute, he worked with Prof. Klaus Hasselmann on developing and applying climate fingerprint methods. Ben was at Lawrence Livermore's Program for Climate Model Diagnosis and Intercomparison from 1992 until October 2021.

Other information

Ben has received a number of awards for his research. These include a MacArthur Fellowship (1998), membership in the U.S. National Academy of Sciences (2011), and the Procter Prize (2019). The most significant awards are the friendships he has made during his career. In addition to his research, he cares deeply about the communication of climate science to a wide range of audiences. He writes for the Scientific American blog and has appeared on "Late Night with Seth Meyers". Together with Chip Duncan and Dr. Hernando Garzon, Ben is a member of "The Three Tenors of Climate Change". The Tenors are devoted to the task of improving public understanding of the science and impacts of human-caused climate change. In his spare time, Ben is an avid rock-climber and mountaineer.