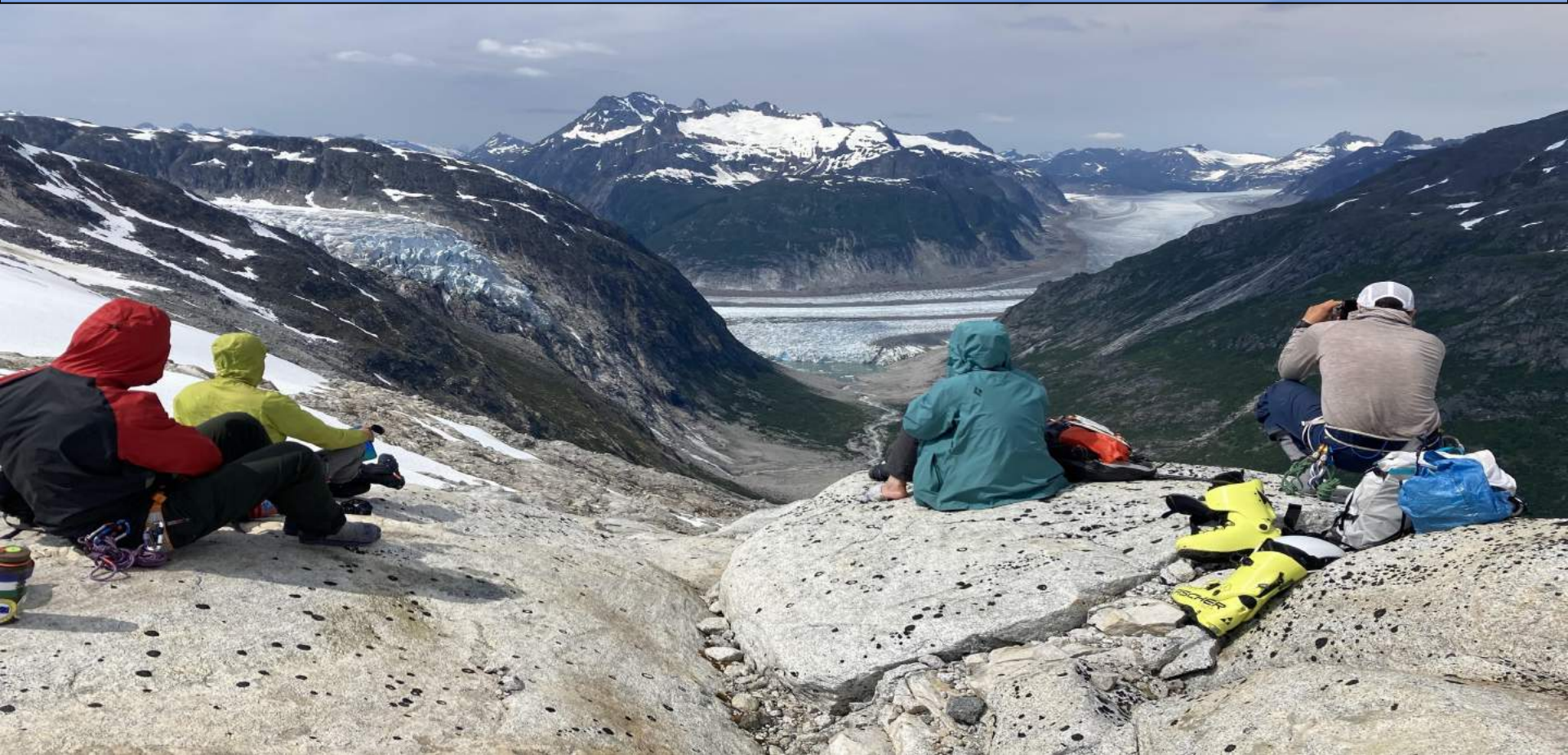
Day 1: What current resources, funding, opportunities, and technology exist to support Polar STEM field and in-classroom experiences?



Day 1

Group 1 (in person)

- Federal programs: TRIO-Upward Bound, Talent Search, STEM, SSS, McNair, Fulbright, Einstein Fellows, Research Experience for Undergraduates (REU) through NSF
- Local programs: JIRP, Toolik Field Station, Girls on Ice, Grace Harbor Community Foundation (scholarships), general community foundations for student travel support, PolarTREC, local college/university outreach initiatives (e.g. Colorado College summer geology program), IARC summer school, Wrangell Mountain Center, PSECCO,
- Research projects/organizations: NNA projects with ed & outreach components, NNA-CO, IARC at UAF, ARCUS, Arctic & Earth SIGNS, Fresh Eyes on Ice, GLOBE observations,
- Sources of data and curricula
    - AntarcticGlaciers.org, https://www.antarcticglaciers.org/students-3/
    - Toolik Station data resource, https://www.uaf.edu/toolik/sedc-home.php
    - https://www.nna-co.org/nna-co-arctic-educators-fair-2022
    - Skype a Scientist
    - https://www.arcus.org/tac
    - Lots of resources from IARC: https://uaf-iarc.org/education/
    - Imagery and diverse geospatial data: https://earth.gsfc.nasa.gov/cryo/data

Day 1

Group 1 (in person)

- Challenges:
  - It seems like a lot of opportunity (and money) exists, but the problem is the collaboration and communicating these opportunities to the right people (how do we get these programs and experiences into the hands of educators, who have direct impact with students?
  - Even sharing out the information about this conference was a challenge due to disparate sources for sharing. Is there a space that can host these opportunities (a listserv, a website, etc.) so that it can be a one-stop shop?
  - Teachers are also assumed to be willing to work for free during the summers which is not an appropriate assumption. However, many non-profit funding sources limit salary support for teachers or others working on education related projects beyond their current teaching load.

Day 1

Group 1 (in person)

Opportunity to partner with Virtual Reality companies

- Students developing the experiences OR students participate in this experience.
    - Some suggested students partnering with a school, a company, and/or a university.
    - Taught teachers during the summer, prepared students in the fall, and then worked with the students in the Spring
- Developing Video games:
    - Some have had success bringing give kids an experience using drones, virtual reality imaging, and audio to give students a virtual like experience
- Virtual 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.
- Partnering with trade schools
    - Some are hoping to partner with construction or other trade schools and to have students apply their studies to refurbishing facilities, equipment, or other resource related to Polar STEM
    - This echoes the theme that others have shared with the multiple pathways
- Polar field experiences can help students build these broad skills (both hard and soft skills) that are applicable to multiple career fields, however, are unique in their power of facilitating transformative growing experiences AND the urgency of a rapidly changing Arctic and Antarctic. This empowers students to advocate for climate justice in the Arctic and in their home
    - BUT let’s expand this with virtual reality

Day 1

Group 1 (in person)

- Strategically targeting specific districts (like large public school districts) to optimize the districts that have a large set of resources
- Thinking about interdisciplinary connections to polar research
- Alaska Native Science & Engineering Program ANSEP (elementary school-grad students) Looking to increase their curriculum on climate science
- Using the power of creating a consortium of field stations and camps in Alaska/Polar regions to garner big private donations
- VIrtual reality projects of training Alaska Native students in creating VR experiences of their home and sharing that with others

Day 1

Group 2 (in person)

- How do we start an Arctic field program for our students (what are the steps?)
- Giving students the experience helps them as an incentive to continue to learn forward
- It doesn't have to be just one path (only college for example), it is about the "life experience" and there are many other paths. Our job is to help inspire students to choose to move forward
- There is minimal Polar STEM sciences in many high schools so how can this be incorporated?
- Extra-curricular activities (depends on teacher interests, administration, etc. Can we have a Polar Interest Club, Science Club, or some other club to start the engagement with students. Or students working on specific project that is associated; or summer camp
- Science Teachers needs to understand about the science & resources available to incorporate Polar STEM into the classroom
- Portal for Polar Education resources (central location for GETSI/Carleton, UNAVCO, and all other education resources that is user friendly, can be searchable, etc.)
- Project Based Learning (BPL) - 95% proficiency with students experiencing PBL vs students that didn't have a PBL (far lower proficiency)
- California State university has 23 campuses, and each campus runs separately. Some policies apply to all schools and some policies are school by school basis. Intro to Field Geology (can we bring students via van?) Can be a limitation based on university policies. (Community colleges may have the opportunities that 4-year didn't have because of variations in policies or administrative issue to figure out)

Day 1

Group 2 (in person)

- Internship options to give student salary support, but may also get academic credit
- Students can get academic credits through a university for field experience (e.g., UAS for $25/credit at JIRP)
- ½ of our students are special ed so some adult support may be added into the trip which is beneficial for the student and also helps collaborative field experiences.
- Robotics or other teams may have funding options. How to search out funding at a high school to support their students on such activities
- Cost share between high school, grant funding to University (NSF, NASA, DoD, etc.)
- Feel alone in education: Training on searching for education resources funding (designed around a background of options and helping participants pick a funding source and apply to the funding)
- Future Farmers of America (Forest, fish, and flowers in AK) - students present their project and show what they are doing it helps students acquire their funding themselves
- Battelle funds science and education initiatives! $20-50k (often deadline in the Spring or Fall but can be flexible)
- NSF has K-12 funding (e.g., GEOPaths or INCLUDES)
- Partner with academic or non-profit programs (e.g., T3 Alliance, JIRP, Wrangell Mountain Center, etc.)
- Find links between field experience and back in the classroom (with other students as well!)
- Training on all the data resources out there!
- Teaching the kids to do the science instead of just “showing” the students along the entire path

Day 1

Group 2 (in person)

Getting the knowledge out about resources to educators

- Clearinghouse of resources-good job for a grad student (but must be ongoing)
- NSTA, science teacher associations
- Conference sessions, workshops and webinars
- Teacher advisory board?
    - Look at NGSS (and similar) standards to identify where polar STEM opportunities
    - Curate/modifying resources for multiple grades and courses-not just geosciences but cross disciplinary with bio, chem, middle and elementary
    - Network, professional learning communities

Create multiple pathways to experience polar science

- Create opportunities to provide local work to offset costs
- Connect field experience to home community

Day 1

Group 3 (in person)

- Resources
  - Cross-collaboration between entities, communities, programs
- Funding
  - Collaborate with other programs that already are supported with funding
  - Networking with Sponsors
  - Go through non-profit foundations to acquire grant funding
  - The funding agency hold grantees accountable for the funding and outcomes
    - Foster a symbiotic relationship with sponsors
  - Possible sponsors: NSF, Bettelle
  - Direct student grant funding
- Opportunities
  - Reach the students that can't go to after school and summer programs (challenge accessibility)
  - Student impact while treating students equality
  - Engaging students in science elementary on through post-college
  - Engaging teachers to inspire students
    - Teacher professional development
    - Partnering with teachers to co-produce generate curriculum and educational experiences
    - Building at a district level
  - Partner with local trade schools
  - Student exchange (international component)
  - Building a program that does the outreach for the researchers
  - Connecting politicians with students in these programs
  - How to teach researchers and scientists how to teach students and facilitate a learning an environment
  - Research projects with outreach components: SEARCH, Arctic LTER, Beaufort Lagoon LTER, Bonanza Creek LTER, Northern Gulf of Alaska LTER,
  - Organizations for increasing DEI in polar science: Polar Impact, Pride in Polar Research

Day 1

Group 4 (in person)

- Technology
  - Developing a database that tracks students success through these programs
- K-12 Educator: PolarTrec, NOAA Teacher at Sea, National Geographic Grosvenor Fellowship, EarthWatch Institute
- High School: Inspiring Girls Expeditions, this link, scroll to bottom to “programs for under 18”
- Undergrad: Wildlands studies, NSF REUs (more for individual students/changes year to year)
- American Rescue Plan - Elementary and Secondary School Emergency Relief Fund (expires in 2024)
- Engage Every Student
- Research expeditions with outreach teams, (e.g., MOSAiC)
- Polar Educators International
- Science organizations that may have opportunities at the grad/postdoc leve: SCAR, BEPSII, IARPC
- ArcGIS Online, National Snow & Ice Data Center, citizen science projects (Living Snow Project, ebird, inaturalist)
- Questions: how much does it cost per day, per student?

Day 1

Group 5 (virtual)

- Potentially look to local levels for funding
- Could be great to connect Upward Bound programs based in the Arctic and those based in the lower 48
  - Some of these experiences are not accessible to folks who are less physically abled.
  - Is there a way we can expand on virtual resources? E.g. https://cvl.eo.esa.int/early-adopters-call
  - Can we put 360 imagery resources in once place?
- UB students to connect folks who went to the field to those who couldn't - sharing data and virtual experiences
  - Ultimate goal is to create curricula to be used in classrooms everywhere
- CIRES Education and Outreach has a plethora of resources related to polar education and teacher trainings:
  - CIRES E&O: https://cires.colorado.edu/outreach/
  - CLEAN: https://cleanet.org/clean/educational_resources/collection/index.html?search_text=polar&q1=sercvocabs__18%3A4
  - This is a good example of a past teacher training workshop: https://datapuzzles.org/data-puzzle-collection
  - MOSAIC related polar education exercises - https://mosaic.colorado.edu/activities
- Glaciology and climate teaching resources
  - (they even have a game to show how snow and ocean water temps influence glaciers): https://www.antarcticglaciers.org/
  - NatGeo has explorer classrooms
  - explore by the seat of your pants talks to a lot of different scientists doing field work
  - PolarPASS - https://serc.carleton.edu/polarpass/index.html

Day 1

Group 5 (virtual)

- There's also a climate change game from a research center in Japan… would have to contact International Glaciology Society for more info
- idea/need: central location for compiling resources available to K-12 educators
- **Resources:**
  - Good maps of the Arctic?
    - REMA - Antarctic: https://www.pgc.umn.edu/data/rema/
    - ArcticDEM - Arctic: https://www.pgc.umn.edu/data/arcticdem/
    - ESA has maps
    - Air navigation maps - FAA - https://www.faa.gov/air_traffic/flight_info/aeronav/print_providers/
    - NOAA - https://www.nauticalcharts.noaa.gov/publications/print-agents.html#paper-charts
    - Arctic Data Center - UMN
    - GEBCO (for bathymetry in the Antarctic), IBCAO (for bathymetry in the Arctic)
    - USGS - https://store.usgs.gov/product/115261
  - Data access? NSIDC, CIRES E&O, geological geospatial data for Antarctica: https://data.gns.cri.nz/ata_geomap/index.html?map=Antarctic
  - PIUs (outside classroom credit) could provide incentive for higher education educators to get involved
- **Opportunities:**
  - Inspiring Girls Expeditions - funds HS girls and non-binary folks to go on immersive science expeditions in the field
  - Connecting ECRs to outreach opportunities w/ classrooms (e.g., Skype a Scientist)
- Polar Educators International might have trainings and resources as well: https://polareducator.org
  - Resource book: https://polareducator.org/featured-resources/prb-2/

Day 1

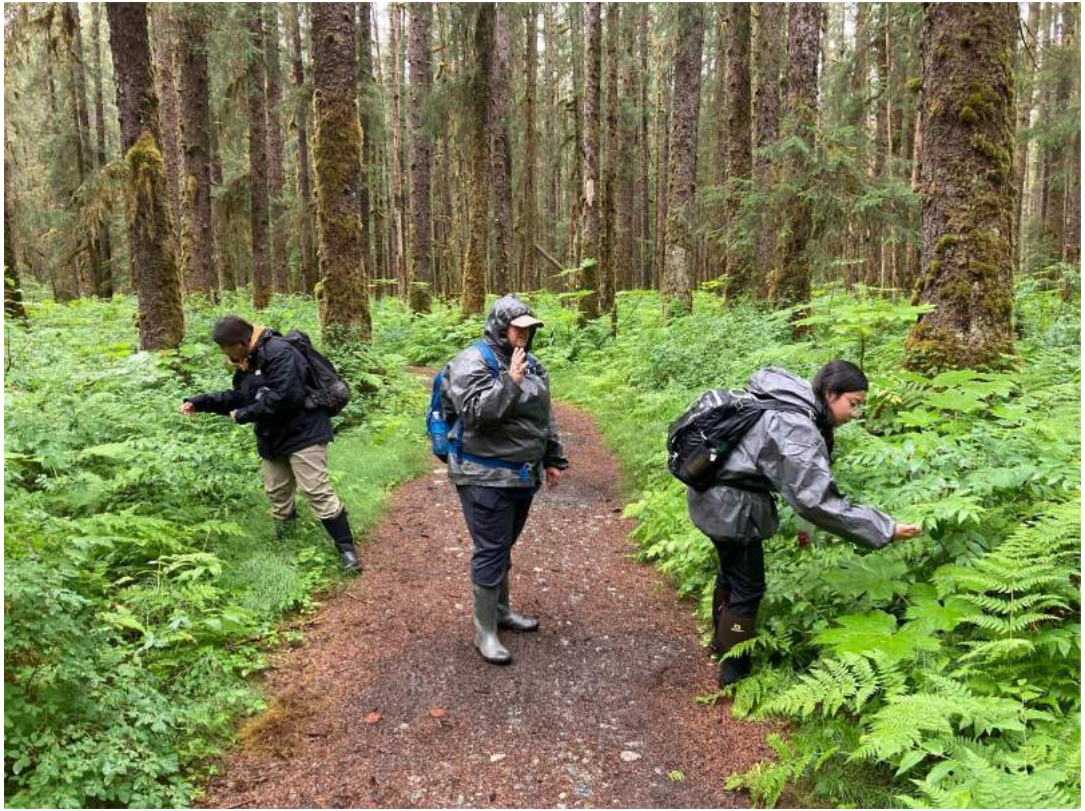
Group 5 (virtual)

Planning to attend AGU in person or from the comfort of your own home?
Please consider submitting an abstract to education sessions (currently virtual & in-person)

Example: AGU session “Arctic Education & Outreach” at the AGU fall meeting (12/12-12/16 in Chicago and online).

Abstract submission link is here.
Session Abstract: ED004 - Arctic Education & Outreach - Effective ways of engaging diverse learners in Arctic science - The changing polar environments have created important scientific and societal concerns in high and lower latitudes. In this session we will share effective approaches, frameworks and examples of how to promote a broad understanding and awareness of the changing Arctic and the related societal implications. The session will highlight effective strategies to inspire learners in both formal and informal learning contexts as well as communities. We also invite papers on effective ways of community engagement, co-design of educational and outreach activities, and fostering intergenerational or cross-cultural learning through Arctic Indigenous knowledge, science and observation.
Co-conveners Anne Gold, Katie Spellman, Malinda Chase, Elena Sparrow

Day 2: 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?



Day 2 Group 1 (in person)

Arctic Teacher Field Study Teachers field study

Why:

- Inspiring teachers are the gatekeepers and reach many students
- Empowering teachers as professionals to develop the materials that they know the need at conclusion of the program
- For the Antarctic is difficult, due to the expenses and logistics; however, it could be possible a tour to the Antarctic peninsula via icebreaker, but it is also very expensive…
- It is possible for undergraduates to do a guided research project on Antarctic data, (and virtually connect to the Antarctic field scientists while they are in the field), but students get no field experience.
- Partners: Toolik, JIRP, WMC, and Alaska Resource Education

Outcomes:

- Teacher curated and co-constructed materials
- Partnership with a researcher-1 event with researcher in classroom
- 1 community or outreach event
- 1 end all report

Program timeline –mid June or early August

- UAF teacher training with lab equipment (0.5-1 day)
- ARE training (1-2 days) curricula explorations, Alaska lessons
- Toolik field station (7 days)
    - Shadow researchers, form relationships, do gruntwork
    - Researcher partnerships to eqiup researchers as better teachers/outreach
- Return to fairbanks, ARE, 2 days co constructing curriculum and materials, make a plan, develop white paper

Day 2

Group 1 (in person)

Student work:

- Develop experiments to be run by scientists and grad students, similar to ISS experiments; students get data
- Connect with students from other teachers
- Connect with grad students

Outcomes:

- Teachers develop meaningful student activities to incorporate polar and climate science
- Researchers gain best practice for outreach and education
- Teachers take a role in an existing research project OR design their own to bring back to their classes
- Teachers develop a long term relationship with a researcher and virtually bring them into their classes at least once

Day 2 Group 2 (in person/virtual)

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?

- Students coming from all of the locations from within conference participants; Toolik, JIRP, fairbanks; teachers getting trained as part of the program.
- Collaborate between Alaska Resources Education and GEOPaths or other education grants
- **Teachers need to learn the science of this to move forward. Not alot of science talks in the presentation so training the teachers would be valuable.**
- If students can't go to Antarctica, can they come to Alaska, Rainier, Olympic National Park
- Collaborations: LTER in Barrow, Toolik, Bonanza Creek in Fairbanks, JIRP/UAS/USDA/Alaska Rainforest Center, Cascades, Iceland, Atlin BC, Klaune, NP (LTER has to do education/outreach for partnering)
- Large percentage of teachers haven't had experience doing science besides their own high school and basic college classes so a "teach the teachers how to do science" could be really useful
- All about the numbers of students we reach with Battelle (little bit of ARE, LTER, Toolik, LTER; what would it look like?
    - How much to get teachers there and costs associated (e.g., $2k from lower 48 to Juneau or Toolik)
- Obvious need for linking teachers to resources (PSECCO could be the site for data and lesson coordination and resources coordination)
- Can we put teachers on zoom and have the students travel for the experience?
- Can PIs leverage existing grants towards the benefit of non-profit or other funding for teacher training of ARE, Toolik, JIRP, or others providing curriculum?
- Students go to multiple locations in small groups to get experience and then meet to exchange experiences (citizen science activities, compare coastal erosion/sea ice/permafrost/glaciers/etc, from different sites)
- Different geographical regions, diversity means students with different experiences coming to the table (climate variability)
- Could students work together in all of their different locations on a project and share data and efforts towards a common goal
- Can a program be run at Washington and Oregon State out of their home areas (speak with UWashington for resources)

Day 2

Group 3 (virtual)

Actionable items leading to tangible outcomes

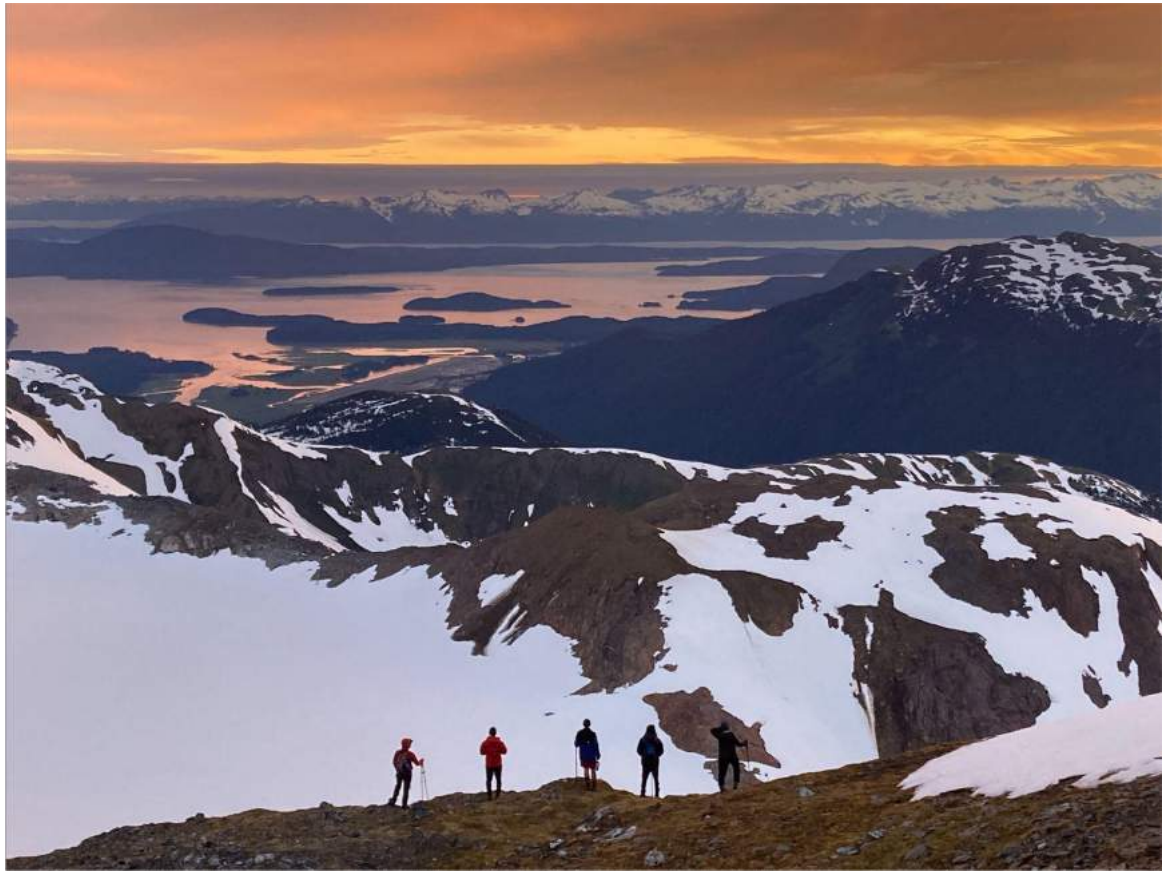
- Goal: Connecting teachers to funding to access Polar STEM experiences
  - Giving teachers the tools and resources to write grants
    - Private non-profit organizations
    - Government
    - Tailoring grants to interested parties (playing politics)
    - Scalable and replicable programs
      - Start small, then expand
      - Quality vs quality - meetings on how to expand and improve your system (mentorship)
      - Building the network
      - Building a structure to ensure that the program continues after key people leave
        - Get rid the single point of failure
    - Teacher impact and student impact growth
    - Accessibility, equity, inclusivity
  - Develop database and grant writing courses/guidelines
  - Reaching out to private companies for funding
- Goal: Connecting researchers to students and educators
  - Develop outreach program (plug and play concept)
  - Partnering with student engagement program through funding agency

Day 2

Group 3 (virtual)

- Polar Literacy Principles for education exist through Polar Ice project, led by PI Janice McDonnell of Palmer LTER. Polar Ice website also has a polar data page that includes various polar education activities.
    - Polar Literacy for Early Career Polar Reseachers paper
- The LTERs in Alaska focus on Polar data collection and there are Edu & Outreach folks for all 4 of them, and they are looking to collaborate with EOC folks
- NSF RET and REU Funds
- ARCUS posts funding opportunities in monthly newsletter
- LTERnet.edu posts funding opportunities in monthly newsletter
- NSF has Office of Polar programs that will fund research & edu
- NSF has a BIORET grant for research & edu (I am currently part of one with ARC, SBC and AND LTER sites)
- Citizen science funding
- National Geographic
- Who do we want to educate and what do we want them to know? All levels? K-12? Undergrads? Graduate students? Pre-service and in-service teachers? Adult learner audiences? Policy makers?

Day 3: How can we best create engaging and real-world Polar STEM and related experiences for students in the classroom?



Day 3

Group 1 (in person)

- Making the experience virtual
  - Oculus $299 each
  - Virtual reality with 3D Models
  - Use in virtual courses with interactive curriculum
  - Purchasing the tech to generate the virtual experience as well as the tech for the students to engage in it
  - 360 video from Antarctica
- Hire a student “Storyteller”
  - Film & story writing to capture the process/experience
  - Use the product to share/deliver with others (students, organizations, funding entities)
  - Students and community members telling the story
- Needs
  - Providing an educational experience that explores the connection between different scales of data collection
    - Connecting in real time (challenges: timezone, large staff, weather, tech)
  - Equipping the teachers with the knowledge and tool needed to teach students new data using hands on methods in the classroom
  - Finding the connection between Polar STEM to the students local environment
  - Networking with community centers and other educational organizations around the area (city, state, nation)
  - Student and visiting staff gear
  - Addressing cultural, emotional, mental support what students need
  - Thinking of the needs that are specific to underrepresented groups (e.g., communicating when bathroom breaks are and where they will be, how women and gender expansive can use the restroom outdoors privately)

Day 3

Group 1 (in person)

- Engaging Indigenous groups
  - Partnering with organizations that already have the trust of the local community to engage more students
  - Meeting students where they are at, communication with visiting staff and building staff team
- Theme
  - Focus of the curriculum? Climate change?
- Student/program exchange
  - Hawaii - Alaska giving students a cultural experience while timing it to allow more students to come

Day 3

Group 2 (in person)

- Student focused opportunity: teachers select students from different schools from all over the nation. The schools that are present here. Students do 5 day trip. Find another funding stream to give more schools the opportunity.
- Combination of different regions. (e.g., ~192 students (130 High School and 62 Undergrad students) to JIRP AK between 2022-2023; merging HS students from CA, OR, WA, ME, TX, AK)
- Bringing public school students. Low income students. Immigrant refugees. Inner city. Rural. Preferably students who are interested in STEM, but not necessarily.
- Provide professional development for teachers. Give teachers the five day trip. Then they are able to take this opportunity to 180 kids (or however many come). Once the teachers have made these connections they can continue to interact with the professionals that they meet here via zoom. We would recommend teachers to participate.
- Beginning with these teachers and giving them the JIRP experience and giving the hands-on field research. The moving forward these teachers would recommend other teachers to expand. Also we need to purposefully recruit teachers that are members of under-representative groups. Bring as many teachers as we can fund.
- We could combine half as students and half as teachers. Having a recruitment policy could remove some of the barriers. The team is very interested in how we can use funds to remove barriers. How can we reach a different group of students.
- What are the costs that cannot be currently covered that a grant could cover for education programs?
- What are the measurable outcomes for this? What is the result from this?
- Perhaps having a conference for kids to express the ways that they are experiencing climate change in their own background and then contextualize it here.