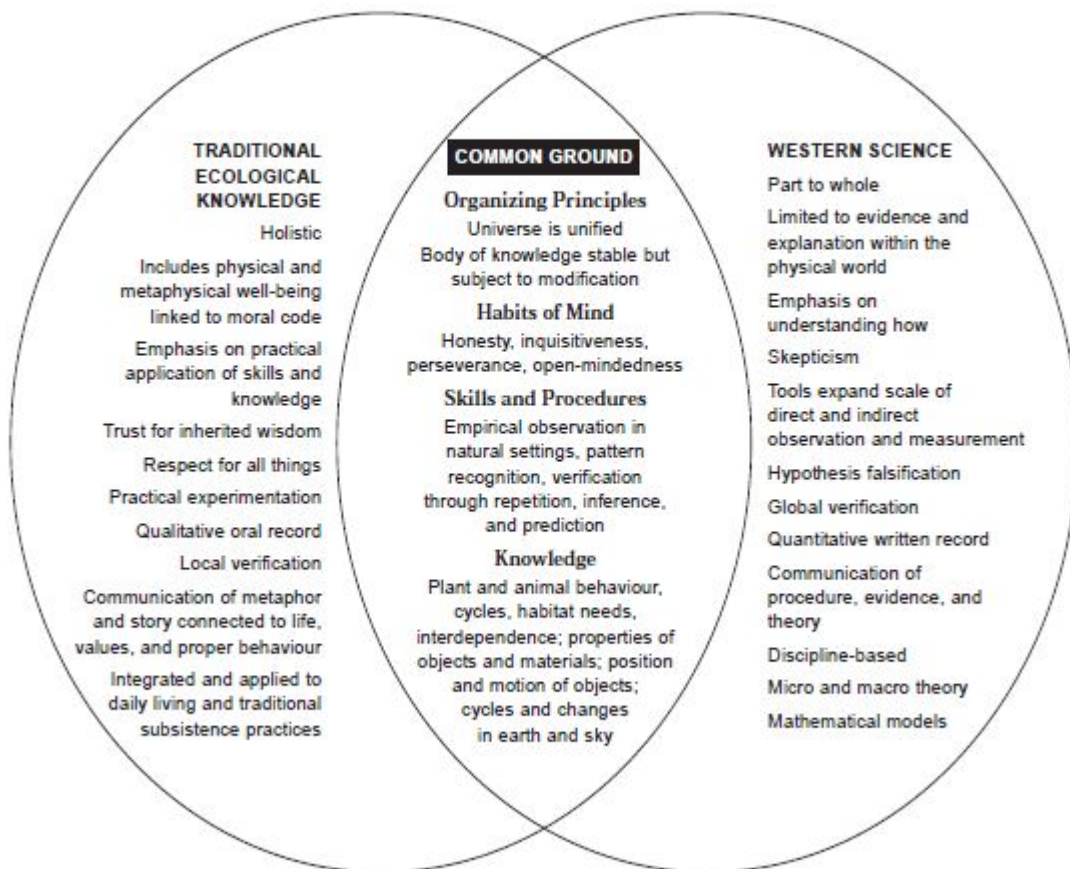


**Report of the Working Group on Culturally Responsive Science
Outreach and Engagement
To the North Pacific Research Board, Alaska Sea Grant,
and ARCUS**

**The Shared Characteristics of
Traditional Ecological Knowledge and Western Science***



Adapted from Stephens, 2000

INTRODUCTION

We convened as a working group (See participant list below) in late May, 2019, for the purpose of developing guidance to North Pacific Research Board (NPRB) and Alaska Sea Grant (ASG) to encourage and support outreach by researchers to Alaska's K-12 Indigenous students in culturally responsive ways. The impetus for the working group was a disconnect we perceived between an increasing emphasis on inclusion of Traditional Ecological Knowledge (TEK) and more broadly of Indigenous Knowledge (IK) as a means to “co-produce knowledge” alongside western science methods that hasn't been carried over into culturally responsive outreach and engagement activities implemented in Alaska schools with Indigenous students.

The Alaska K-12 science/STEM education community has a long history of evidence-based instruction and curriculum development that is responsive to the cross-cultural nature of K-12 education in Alaska communities. Despite these advances, ocean researchers and research grantors generally lack awareness that cultural responsiveness is an effective component of interactions among researchers, K-12 educators and students. A decade-long Alaska Rural Systemic Initiative (1995-2005) demonstrated that place-based education that includes cultural responsiveness to Alaska's diverse Indigenous cultures could narrow the academic gap for Alaska Native students. Leadership by Alaska Native and other educators to apply the results of this education reform effort culminated in the adoption of the Alaska Standards for Culturally Responsive Schools (1998) by the State of Alaska as options for incorporating cultural knowledge and values into all subject areas and into teacher practice. Despite this attention to cultural education in K-12 education, awareness seems generally lacking among researchers and research grantors that cultural responsiveness is a required, and effective, component of interactions among researchers and K-12 educators and students, or of researchers with any cross-cultural audience.

The workshop was convened with the financial support of NPRB and ASG. We also benefited from staff leadership by Janet Warburton, Project Manager for the Arctic Research Consortium of the United States (ARCUS) as Co-Chair of the Working Group and additional financial support from ARCUS for meeting expenses.

NPRB and ASG support research projects as grantors and encourage the inclusion of TEK and IK alongside knowledge developed using Western science methods. They also identify K-12 students, teachers, and informal educators as stakeholders in the research as well as audiences for the dissemination of research findings. These two organizations supported the convening of the working group to begin to identify challenges and opportunities for better serving the K-12 science/STEM education needs of Alaska coastal schools and communities to provide guidance in the form of “best practices” for K-12 outreach and engagement efforts of grant-funded scientific research.

Our working group is comprised of practitioners serving Alaska K-12 Indigenous students and educators as classroom teachers, education researchers, pre-service and in-service teacher trainers, informal educators, researchers engaged in K-12 outreach, and science outreach coordinators. It includes Alaska Native educators from many of Alaska's diverse Indigenous cultural groups (broadly described as Inupiat, Yup'it, Alutiit, Athabascan, and Tlingit) but not all of the broad cultural groups (e.g., The Haida, Eyak, and Unangans were not represented).

CONTEXT FOR DEVELOPING GUIDANCE TO GRANTORS

Marilyn Sigman, ASG's Marine Education Specialist (now retired), conducted a literature review of culturally responsive instructional strategies and existing guidance about culturally responsive outreach and engagement for researchers and research grantors. Prior to the meeting, ARCUS posted her annotated review of selected literature related to evidence-based "best practices" instructional strategies for Indigenous students along with summaries of relevant guidance from several sources. (See <https://www.arcus.org/tac/2019-workshop>.)

Relevant existing guidance from NPRB and ASG was included as a resource for the working group. Brendan Smith, the NPRB Outreach and Communications Director, participated in some of the working group sessions. NPRB uses the terms "outreach" and "education" and requires that all requests for proposals in each of their research programs include "a certain level of stakeholder and/or community involvement as well as outreach." Teachers and students are one of several target audiences. They have recently changed their process for funding outreach activities, from one of requiring at least \$2,000 dedicated to outreach activities in individual project proposals to that of successful research grantees being invited to apply for up to \$20,000 in a separate Outreach Sub-award to support outreach-specific efforts. The Long-Term Monitoring Program they fund also requires outreach, with a minimum of \$5,000 in "education/outreach" funding within research proposals submitted to this program. Finally, NPRB's Integrated Ecosystem Research Programs (IERP) have their own dedicated outreach funding independent from individual investigators. The NPRB website includes a collection of helpful resources for planning education and outreach components of scientific proposals at: <https://www.nprb.org/nprb/communications/outreach-resources>.

Marilyn Sigman, who co-chaired the Working Group, has been involved in the development of ASG's biennial Request for Proposals (RFP) for two-year research projects that address one or more of Sea Grant's strategic goals as well as emerging issues in Alaska. The ASG grant proposal review criteria provide "additional favorable consideration to proposals that include "meaningful collaboration" with industry, agencies, communities, and other stakeholders. A brief engagement plan is required for the pre-proposal and a more extensive plan is required in the invited full proposals. Sigman developed an engagement checklist for researchers that has been linked to the RFP for use in the development of engagement plans at <https://alaskaseagrant.org/research/engagement/>. The checklist encourages the incorporation of knowledge from Indigenous and other local residents, and the use of best practices in doing so and appropriate consultation with educators for engagement of K-12 audiences to ensure that what is proposed is feasible and that K-12 educational resources will be used..

ASG is a unit of the National Sea Grant network that sets the weighting at 15% for the engagement plan. The engagement checklist is thus advisory to researchers developing proposals and proposals that are ranked low in this component but highly in scientific merit during the review process may still fare well during the review process.

PLANNING A CULTURALLY RESPONSIVE MEETING

Planning discussions among Steering Committee members (Warburton, Sigman, Dr. Katie Spellman of UAF International Arctic Research Center, Malinda Chase of the Association of Interior Native Educators; and Phyllis Carlson of the Sealaska Heritage Institute) centered on how best to be inclusive of Indigenous educators and viewpoints. Chase and Carlson, the Indigenous members of the Steering Committee, and Jonella Larson White, the Indigenous workshop facilitator and rural specialist for the Foraker Group, articulated the importance of acknowledging the historical context of the treatment of Indigenous cultures and languages within Alaska's public school system that have created trauma for multiple generations of Indigenous students. We were also aware that a historical legacy exists in many Indigenous communities where a perceived "extraction" or appropriation of Indigenous knowledge by researchers occurred. Memories still linger about researchers who received and relied upon, community hospitality and logistic support for fieldwork but who didn't reciprocate by "giving back" data, reports, or other useful scientific information to the community or to local and tribal governments.

Working group members were selected using a "snowball" approach. First, steering committee members were asked to recommend educators, outreach professionals and scientists who had a depth of experience with science education and outreach in Alaska Native communities or in cross-cultural settings. Invitees were asked to recommend others, who were then invited by the workshop organizers.

The meeting participants, in addition to all but Malinda Chase from the Steering Committee, were: Maxine Dibert, classroom teacher, Denali Elementary School, Fairbanks (Athabascan)

Kaare Siikuaq Ericson, North Slope Science Liaison, UIC Science, Ukpeaġvik Iñupiat Corporation (UIC), Anchorage (Iñupiaq)

Eric Filardi, classroom teachers, City of Nenana School District, Nenana

Qaġġuna Tennessee Judkins, Unit Development Specialist, Inupiaq Education, North Slope Borough School District, Utqiagvik. (Iñupiaq)

Dr. Diane Hirshberg, Professor of Education Policy, University of Alaska Anchorage (UAA)

Tonia Kushin, classroom & Special Education teacher, Mat-Su Borough School District, Wasilla (formerly in St. Paul, Pribilof Islands School District)

Dr. Angela Lunda, Assistant Professor, Secondary Masters of Arts in Teaching Program, University of Alaska Southeast (Tlingit)

Mike Mahoney, classroom teacher, Mt. Edgecumbe High School, Sitka

Pauline Morris, classroom teacher and Native Elder, Ket'acik Aapalluk Memorial School, Kwethluk (Yup'ik)

Dr. Elena Sparrow, Education and Outreach Director and Research Professor, International Arctic Research Center, University of Alaska Fairbanks (UAF)

Shaylyn "Yosty" Storms, Regional Director, Alaska Native Science and Engineering Program, UAA (Iñupiaq)

Beth Trowbridge, Executive Director, Center for Alaskan Coastal Studies, Homer

Alexis Wills, Postdoctoral Research Fellow, UAF

We began the meeting by acknowledging our location in the traditional territory of the Dena'ina Athabaskan people. Following introductions that included not only our professional roles but information about where we were from in a place-based way, we adopted the following agreements about our discussions:

- Meet each other where we are, not where we want to be.
- Share time.
- There are no experts here; we are all human beings learning.
- Support taking risks, not boundaries.
- Speak to be understood and listen to understand.
- Assume good hearts and intentions.
- Confidentiality. (The meeting was not recorded. The quotations in this report are based on meeting notes and it was not always possible to identify the individual who said it. All members of the Working Group have had an opportunity to review the report and the quotations.)

After adopting the agreements, we then devoted time to acknowledging historical legacies affecting science outreach to Indigenous communities and the education of Indigenous students before moving forward to discuss how the situation could be improved. The Indigenous members of the working group and facilitator also helped us to conduct the workshop in ways that were respectful of traditional Indigenous ways of interacting to ensure all voices at the table were heard and to provide proper respect to the Elder who participated in the workshop.

“There’s a sense of awkwardness about these conversations. So many shifts are occurring [in Alaskan Indigenous communities] that it’s fatiguing, but we are talking about the rhythm of the world in villages”
- Jonella Larson White

“Indigenous people think differently about the land and place than the Western science perspective, for example, our many terms in the Inupiaq language for snow and ice. As a point of reference in communication, Inua is part of it – the spirit of the place.”
- Tenna Judkins

“Both [Indigenous oral tradition and Western education methods] ways of learning are valid . . . I grew up with stories by Elders. Much later in my life, when I walked into the library at Cambridge University, I realized that books are the ‘Elders’ of Western society.”
- Pauline Morris

SCOPE OF THE GUIDANCE DEVELOPED

Because the Working Group members had experience in all of the regions of Alaska, we did not limit our discussions to coastal communities. Arctic research and associated outreach and education activities received considerable attention due to the sheer volume of current research and associated outreach directed at schools and youth in Arctic communities.

The discussion focused on “best practices” to engage Alaska Indigenous students in STEM learning but also acknowledged that many of the practices we highlighted were best practices for all students.

WHO are the Potential Users of the Guidance Provided?

As described above, NPRB and ASG as grantors are the primary audience for this guidance. Over the course of workshop discussions, several members of the working group identified their affiliations with the National Science Foundation as researchers, including education research, or as NSF research coordinators. Because they were familiar with NSF’s broader impacts criteria and grant review process, they saw an immediate opportunity for the Working Group to provide input to the development of the recently-launched Navigating the New Arctic (NNA), which they include in their “10 Big Ideas” as priority areas for the next decade. The initiative includes an aspirational goal of improving STEM education in Northern communities. We discussed ways that NSF could encourage and support more effective broader impact activities directed at Alaska’s Indigenous K-12 students and decided to send recommendations and guidance to the NNA Program Officers. The letter was sent via email on July 1, 2019. (See Appendix 1.)

We also realized that much of the practical guidance that emerged was directed at the researchers themselves in terms of how they could become more culturally aware and plan and implement culturally responsive K-12 and community outreach and engagement in Indigenous communities. ARCUS has expressed interest in taking the lead on developing trainings for researchers based on the guidance that has been developed.

We also identified other potential audiences for which this guidance would be relevant:

- Community representatives, including Indigenous communities and tribal organizations, who serve on advisory boards to grantors
- Other marine research grantors (e.g., NOAA as an agency that places a priority of workforce diversity and inclusion)
- Tribal governments and Native corporations who conduct research (e.g., Seldovia Village Tribe, Kawerak) and education and heritage preservation programs of non-profit Native corporations (e.g., Chugachmiut Heritage Program)
- University researchers conducting research in Alaska whose institutions promote and/or require community involvement or engagement in research (e.g. University of Alaska, Alaska Pacific University)
- Organizations that provide logistical and outreach support (e.g., UIC Science)
- Researchers or agencies facilitating school-based citizen science, environmental monitoring, and/or community science projects
- Teachers and informal educators for organizations involved in K-12 science/STEM (Suggested venues: Alaska Science Teachers Association conference, Alaska Society for Technology in Education conference)
- Education researchers developing and field-testing models for improving STEM education in Alaska Indigenous communities

- School district administrators who may wish to develop their own “checklist” to guide discussions with researchers to develop partnership projects (Suggested venues: Alaska Association of School Boards, Alaska Superintendents Association, rural school caucuses)

WHAT Emerged as Guidance: Major Themes

1. The term “outreach” implies one-way delivery or transfer of information by a researcher to an audience. In contrast, “education” and “engagement” are more purposeful, interactive processes that identify and target learning objectives and a means to evaluate learning through specific gains in knowledge, changes in attitudes or behaviors, and the ability to perform specific tasks. Effective education is interactive, student-centered, place-based, and in Alaska, culturally responsive to Alaska’s Indigenous cultures

The term “outreach” is frequently used by researchers and research grantors to describe a variety of activities, that are often “one-offs,” related to specific research projects or scientific expertise that disseminate either research results or information to people who are not professional scientists. Science communicators, however, consider the term “outreach” somewhat limiting due to the implication that it involves authoritative, one-way communication from a scientist to a targeted audience rather than as an interactive and dynamic communication process that may include active participation in science by stakeholders and scientific thinking about societal issues.

In contrast, when researchers ask to visit classrooms or to lead field trips for K-12 students, they are intersecting with an education process that takes place over 12 years. The process involves a sequence of interactions between educators and students with learning outcomes aligned with state education standards that ideally results in students learning prescribed content and practices in particular subject areas in an age-appropriate, comprehensive and cohesive way. The Next Generation Science Standards (NGSS), recently adopted as Alaska science standards, integrate content and skills in Science, Technology, Engineering, and Math, i.e., STEM. In addition, the State of Alaska has adopted science literacy standards involving nonfiction reading and writing skills, as well as digital literacy standards.

Interactive communication between instructors and students with an objective of guiding students through thinking scientifically and critically is considered a best practice in the evidence-based approach to the reform of science/STEM instruction that culminated in the NGSS.

“[Interactive means] *Students are part of the experience. Learning goes both ways.*”

“*Students have a voice and share in what is occurring. They are allowed to provide their insights.*”

In the language of education, the emphasis is shifting from science/STEM educators being a “sage on the stage,” who delivers science content to students and memorization to serving as a “guide on the side” who assists students in constructing their own knowledge and improving their skills through a series of integrated learning experiences.

Place-based, culturally responsive approach to science and math education is also a best practice for Indigenous students that is well supported by evidence-based studies. (See summaries of these studies in the annotated bibliography at <https://www.arcus.org/tac/2019-workshop>).

2. Researchers' interactions with K-12 school systems take place in the context of engagement with communities.

The term “engagement,” generally refers in a broad sense to a suite of activities that may include what grantors describe as “outreach.” UAA’s Center for Community Engagement and Learning has adopted the Carnegie Institute definition of community engagement to describe “the collaboration between institutions of higher education and their larger communities (local, regional/state, national, global) for the mutually beneficial exchange of knowledge and resources in a context of partnership and reciprocity.”

Schools, particularly in small Alaska coastal communities, serve as community institutions and loci for the exchange of knowledge and resources. The term “engagement” for K-12 stakeholders (administrators, teachers, students/youth, community-based and tribal education organizations, communities) will be used in this report to describe partnerships and collaborations among members of the research community, including science communicators and outreach specialists, and stakeholders in K-12 school systems (ranging from local to regional to statewide) and out-of-school educational programs. Ideally, engagement in this sense will result in STEM outcomes related to Indigenous students learning specific scientific concepts and gaining specific skills, developing positive attitudes towards science, applying their knowledge and skills as scientifically-literate community members, and being prepared and motivated to pursue science/STEM-related jobs and careers. The choices made by Alaska Indigenous students to apply their STEM knowledge and skills as community members and citizens, however, are equally important.

Student-centered learning is a best practice in K-12 education because it allows students to establish the relevancy of knowledge and skills to them personally and to “construct” their knowledge and apply new skills in a more meaningful way that “sticks” much longer than facts that have been memorized and provided as answers to a test. Ideally, student-centered learning involves guiding students through open-ended learning activities that provide opportunities to gain skills in solving problems, making decisions, being part of a team, communicating and other aspects of “project-based learning” that can include scientific research and environmental monitoring projects. The longer-term commitment required and the open-ended nature of this type of learning is not always compatible with the objectives of outreach activities developed by researchers, including those who attempt to engage K-12 students in citizen science projects.

“Let students drive the wheel!”

“It’s all about creating relationships with the students and empowering them . . . Even after the scientists are gone, the research continues.”

- Mike Mahoney

The relationship that researchers develop to provide outreach to schools and engage K-12 students can’t really be separated from the relationship of researchers to communities because research relevant to the community is the key to relevance to the young people in that community. Moreover, in many small, rural Alaska communities, the school curriculum, the community, Indigenous culture, and the local environment are intertwined.

“Everything has a relationship to everything else. How will it affect people in communities?”

“Schools create community!”

- Eric Filardi

The engagement of K-12 students in both student-centered and community-centered research are thus

best practices for effective STEM education, particularly in small rural Alaska communities, and one that is also responsive to Indigenous cultural values related to individual and community leadership, environmental stewardship, and respectful relationships with plants and animals used for subsistence. We decided to use the term “community science” to describe student projects that are relevant to community issues, including ones that use citizen science data collection protocols (e.g., the GLOBE program). The emphasis on community involvement that already exists in NPRB and ASG grant guidelines provide context for the more specific guidance we developed for educational activities for Indigenous K-12 students as stakeholders in research that affects, or is relevant, to their communities.

As an overall recommendation, we suggest that research grantors consider a shift from considering the K-12 school system as an institution that is targeted for outreach to examining its potential role in the support of K-12 educational activities that further an educational goal of preparing scientifically-and culturally-literate students capable of playing key roles as community members and citizens. This approach would require greater collaboration with teachers and/or administrators at the school or district level as well as collaboration with community members.

“Remember that the structure of institutions and value systems [referring to both the system of scientific research and K-12 schools] comes from somewhere. We are working within western institutions, not Indigenous systems. . . . Love, community, culture and family are bigger than institutions.

- Jonella Larson White

3. Authentic engagement is a process that involves building and sustaining relationships and trust over time.

One of the most glaring disconnects between the granting process and collaborative processes was the lack of support for building relationships and developing collaborations. The problem is compounded in Alaska’s rural school districts because of high annual turnover rates of teachers and administrators, the majority of whom are not Indigenous or local to their communities. We identified several means for grantors to help fill the gaps that exist in many communities by supporting: 1) community and cultural “bridge people” to serve as liaisons for researchers to the community and the schools and to be the continuity for on-going educational programs; 2) the development and maintenance of a database of key community and school contacts; 3) providing planning grants to develop collaborations; and 4) allowing more flexibility for the outcomes of educational programs to empower students in asking questions and exploring issues of importance to their communities.

4. Culturally responsive education requires that Indigenous Knowledge and ways of knowing be given the same value and respect as western science and research using western science methods.

Our working definition of “culturally responsive education” (adapted from one developed by Oscar Kawagley and Ray Barnhardt) is “a process of education that follows guidance and standards developed by Indigenous educators and Elders about how students, teachers, schools, and communities can integrate the local culture and environment into the formal education process so that students are able to achieve cultural well-being as a result of their schooling experience.” Alaska K-12 educators have developed many excellent models and resources that demonstrate how this can be done effectively by researchers in collaboration with educators and community and cultural experts. (See Appendix 2 for examples, contacts, and links.)

5. Many researchers need help navigating school systems that are very different from the system of scientific research. They also need preparation for the realities of life in Alaska rural communities.

When researchers design outreach and education activities for K-12 students, they are intersecting with an education process that takes place over 12 years involving a sequence of interactions between educators and students that ideally results in students learning subject area content and skills in an age-appropriate, comprehensive and cohesive way. Education standards at the state and school district levels dictate what students should “know and be able to do” at various grade levels, both in the STEM subjects and for cultural education in Alaska. Researchers need to be aware that planning and collaboration are required so they can assist teachers in “teaching to the standards,” so all students become proficient. Researchers also need to learn to speak “the language” of the science/STEM standards to translate their research into the “big ideas” in science and the STEM practices that teachers focus on at different grade levels. In addition to making their science relevant to the everyday life of students, they also need to make it educationally relevant through alignment with the standards.

Many researchers lack cultural awareness specific to the communities they are visiting and basic knowledge that will allow them to be a “good guest” in exchange for the logistical support and hospitality they are provided in Indigenous communities, including in the schools. Schools may lack scientific equipment and supplies that the researchers expect. Travel delays often occur and long-scheduled outreach activities may be canceled so everyone can attend a funeral. In response to our experiences with basic cluelessness, the bulk of our guidance is directed at researchers in the “How” section of this report.

5. The ways in which researcher can interact with Indigenous students in culturally responsive ways are similar to the ways recommended to teachers who are not Indigenous and/or new to the community, although they may interact only briefly. (See the recommendations in the “Guidance for Researchers” section.)

The “WHYs” of Culturally Responsive K-12 Outreach and Engagement for Indigenous Students in Alaska

Throughout our discussions, the type of question that came up frequently was “why?” In terms of cultural diversity, Alaska’s diverse Indigenous students are only a fraction of the cultural diversity reflected by more than 100 different languages spoken in the homes of Anchorage School District students. So why focus on responsiveness to Indigenous cultures? One Indigenous educator responded to this question by summing up our discussion about the legacy of the unique impact of Alaska educational policies of cultural assimilation on Indigenous students that caused trauma that has extended over several generations:

“The reason we are focusing on Indigenous students is because of the unique history and role played by colonization and how it impacts Alaska students now in terms of how they connect and engage in school now.”
–Phyllis Carlson

The Working Group did not agree on the validity of the reasons expressed by grantors to encourage a priority for Alaska Indigenous students as a target audience for science/STEM education. Some group members were also puzzled by their interactions with specific researchers concerning their motivation for requesting letters of support for grant proposals (often at the last minute), classroom time, or participation in other types of partnerships such as lesson plan development.

Neither NPRB nor ASG have a specific policy that prioritizes Indigenous communities or K-12 students over other Alaska communities and students affected by research projects or as stakeholders in the research. Recently, however, ASG developed and adopted a visioning statement with a goal of weaving traditional and local knowledge (TLK) throughout the entire Sea Grant network to guide and inform research, outreach, and education and to uphold respect for producers and stewards of local knowledge at every level. One of the recommended strategies is to support education projects and programs that incorporate TLK.

For other federal grantors, targeting of Indigenous students revolves around the issue of educational equity, in which these and other students in small rural Alaska communities are considered “underserved” by science/STEM education (e.g. NSF broader impact criterion) and/or the desire to increase the diversity of the science/STEM workforce (e.g., NOAA’s Broadening Diversity Initiative).

The academic gap that persists for Alaska Native students in science and math test scores is often cited as evidence of being underserved educationally. In our letter to NSF, however, we questioned the underlying assumptions of this categorization as a basis for targeting of Indigenous students to achieve the broader societal impacts related to equity of STEM education for Arctic communities. These assumptions include:

- 1) additional STEM resources and opportunities to interact with Arctic researchers will stimulate engagement in STEM and interest in pursuing STEM careers even though the majority of these researchers are non-Indigenous and may have a relatively narrow research focus on some aspect of the Arctic environment; and/or
- 2) Arctic researchers and K-12 educators or outreach specialists have the skills to serve Alaska Native K-12 students effectively.

While educational equity considerations remain relevant and pressing, we also believe that the need to equip and engage K-12 students as active members of Alaskan communities beset by the impact of rapid climate change is of equal importance as the need to prepare more Alaska Native students to pursue STEM careers that may take them away from their communities.

What has been shown to narrow the academic gap for Alaska Native students is a culturally responsive, place-based approach to science and STEM education, i.e., the approach of a decade-long Alaska Rural Systemic Initiative (1995-2005). Much of the guidance for grantors and researchers in later sections of this report focus on how to encourage specific teaching and outreach strategies related to this type of approach.

Some of the “why” comments and questions around the motivation of individual researchers included: *“Scientists need to consider truly why they are seeking to do outreach. What is the purpose of the outreach beyond checking a box on the funding requirement?”*

“It seems like some researchers come to the school out of a sense of duty to share science with kids.”

“Scientists, teachers, and administrators all need to know why (precious) class time or the use of school facilities after hours is being requested.”

“Why do scientists want to provide lesson plans and other educational materials? Do they know that this has to fit into a curriculum and how that works?”

“Scientists need to convey to students why they are here (in the school and the community). What will the students be learning about and why is it important to them and to the community?”

“What context . . . For whom? Where is the real value in the interaction between researchers and Indigenous students?”

One question included the possibility of a different approach for both researchers and grantors: *“Can we change ‘the why’ from something defined by researchers or grantors to a process of finding out from teachers and students what would be most useful for students to understand?”*

The “WHEN” of Culturally Responsive K-12 Outreach and Engagement

Why researchers are requesting classroom time for outreach activities becomes an even more important question in the context of teachers in rural Alaska communities facing tremendous demands on class and professional time. Often, they have little time left to interact with scientists to collaborate in the development of effective STEM learning opportunities or to plan to extend the learning. It is thus important to coordinate the timing of researcher availability for classroom visits during the school year with course schedules of when particular topics are taught at specific grade levels or with community cultural calendars that include seasonal subsistence activities and traditional gatherings.

In an even larger context, the Alaska Native Elder explained that there are two types of time – the “clock time” of school schedules and “village” or “Native” time, which is different in different communities and Indigenous cultures. Other Indigenous educators described the latter type of time as the “rhythm of life” in Indigenous communities in relation to natural cycles related to subsistence activities.

“We have two rhythms and they are both important . . . Like my ancestors said, we are all guests of the globe.” - Pauline Morris

In addition, Indigenous cultures distinguish between the personal stories about experiences of people living now, stories about the experiences of people in the last few generations that has been passed down, and a mythological timelessness from which traditional origin stories emerged about aspects of the environment (e.g., the appearance and behavior of local plants and animals, patterns such as the appearance of the sun and the moon).

“[Researchers need to] be mindful of the concept of time in Native communities. It’s more free-flowing, but it’s also put into a generational context.” - Tenna Judkins

Local cultural calendars are often available from school districts who organize cultural education activities around them and regional calendars are often available from regional Native organizations with natural resource management responsibilities.

School schedules for in-service trainings for teachers, spring break, holidays, standardized testing, sports events, and science fairs, are set at least a year in advance. School visits by researchers and other science/STEM-related events need to be scheduled around these activities because they may require travel by students and the time of teachers as coaches, chaperones, and test administrators.

The final consideration about the timing of outreach and engagement activities is the reality that weather delays can thwart the best-laid travel plans, and community events like a funeral can require re-scheduling of school activities. Some flexibility is often required to accomplish educational activities as planned.

GUIDANCE FOR GRANTORS

Working Group discussions related to guidance for grantors focused on:

- 1) how the grant process could better encourage and support effective, culturally responsive K-12 outreach and engagement;
- 2) specific types of activities and research project personnel that we encourage grantors to support;
- 3) training for researchers; and
- 4) the need for better coordination of K-12 outreach and engagement efforts across all grantors to serve teachers and students more efficiently and effectively.

The Grant Process

We identified several aspects of the structure of grant invitations (i.e., Requests for Proposals) and proposal reviews that could be revised to increase researcher awareness and the priority accorded culturally responsive outreach and engagement of Indigenous K-12 and community stakeholders in research. ASG might address some of these aspects during the pre-proposal process to encourage more robust K-12 education components for invited proposals and NPRB might address these recommendations during its invitation for outreach proposals for research projects that have already been selected for funding.

Recommendations:

- **Expand pre-proposal or planning grant support for relationship-building and collaborative project design.**
 - Provide support for relationship building and planning before grant proposals are submitted (i.e., grants for pre-proposal work or open-ended planning grants) and/or allow flexibility for more collaborative planning with K-12 education and community stakeholders after a research grant is made.
- **Revise grant review criteria with respect to outreach and engagement components.**
 - A requirement for letters of support from school districts for proposed K-12 educational activities should be detailed enough to demonstrate collaborative planning and understanding of the purpose and intended educational outcomes of the educational activities.
 - A requirement for a science communication plan that spans the life of multi-year projects and includes K-12 educational activities and other engagement activities with communities.
 - More weight should be given to review criteria related to the adequacy and collaborative nature of the education or communication plan.
- **Explicitly allow and encourage budget items that properly compensate educators and community knowledge-bearers and cover the costs of educational activities.**
 - Compensation for IK knowledge-bearers and community to school “bridge” collaborators and coordinators (See discussion below.)

- Compensation for K-12 educators experienced in addressing the NGSS and Alaska’s cultural standards as project team members and collaborators in grant proposals (e.g., stipends or release time paid to the school district)
- Contracts with school districts to develop lesson plans and/or other educational resources
- Outside evaluators of K-12 educational outcomes for larger projects. (Federal grantors recommend 10% of the total budget for this purpose.)
- Contingency funds for travel to remote communities that may be extended by weather delays or unforeseeable school or community events.
- **Recruit and include Alaska K-12 educators with expertise in culturally responsive STEM education as peer reviewers for education components of grant proposals.**
- **Invite and include Elders and other Indigenous cultural experts in reviews of proposals involving IK.**
- **Make researchers accountable in implementation, assessment, and reporting of the success of proposed K-12 educational activities.**
 - Assessment should be rigorous with respect to learning objectives and include teachers in the assessment of student learning.
 - Some flexibility should be provided for collaborative or student- or community-centered implementation that may change the learning objectives and appropriate assessments of learning from those originally proposed.

Encouraging and Supporting Culturally Responsive Outreach and Engagement

Recommendations:

- **Encourage outreach and engagement activities that are both collaborative and interactive with Indigenous K-12 students and communities. These should include:**
 - facilitation of community-centered and student-directed learning processes by researchers or educator members of project teams. Allow flexibility to determine deliverables via this process rather than to specify them at the outset of the project.
 - development of opportunities for meaningful participation in research by K-12 students that is relevant to their communities. This includes citizen science-type activities with rigorous protocols and activities involving supporting student in analysis and interpretation of research project datasets as well as more open-ended student or class projects for which researchers provide guidance and resources but allow the students to “be in the wheelhouse” and determine how best to conduct the research project.
 - appropriate inclusion of IK and LK in K-12 education as well as in the research.
 - immersive educational activities outside the “four walls of the classroom” (e.g., field trips and activities, summer camps) and with other organizations providing or sponsoring youth activities (e.g., 4-H and Boys and Girls Clubs, local governments or community organizations sponsoring youth education programs)
 - Researchers as mentors for Indigenous graduate and undergraduate students
- **Identify and provide support for community “bridge people,” or liaisons, between researchers and schools (teachers and administrators).**

- The liaisons may be community leaders, school district Native language and education department instructors, Alaska Native aides in schools, tribal environmental specialists, youth program coordinators, Elders, community educators in tribal organizations or NGOs, homeschool facilitators, 4-H and Boys and Girls Club leaders, tribal environmental specialist, science coordinators for the community, and Alaska Sea Grant Marine Advisory Agents who can help researchers connect research with the needs of the local community, the culture, and to the teachers and students. This will serve to increase the relevance of the research and outreach and education activities to the school curriculum and to the community.
- Many Indigenous and rural Alaskan communities have a high annual turnover of teachers and administrators. Community liaisons (e.g., Tribal Environmental Specialists) provide the continuity for on-going school-based citizen science or community-based environmental monitoring projects and can recruit and train new teachers as participants.
- **Support development and maintenance of a database with contact information and areas of expertise for community liaisons with teachers, principals, school district administrators (including STEM curriculum directors) and specialists (e.g., staff of school district cultural education departments).**
 - Use of the database will require a user-friendly interface to “match” researchers with the community liaisons (i.e., “Tinder” for researchers and educators). The database can also support “match-making” for teachers and community partner seeking specific types of research or outreach/engagement on specific community problems.
- **Provide guidance for methods to measure the impact of outreach and educational efforts beyond just the numbers of students or community members reached.**
 - The extent to which learning objectives are met should be one focus of assessment for educational activities. (e.g., pre- and post-assessments for learning activities)
 - Encourage and provide support for outside evaluators for larger projects.

Training for Researchers

The majority of Alaska researchers lack training in K-12 education. The majority are also non-Indigenous, so are not knowledgeable about providing education in a culturally responsive way that is specific to the geographic area of their research.

One other type of training for researchers was identified – the need to increase understanding about the impact of historical trauma on Indigenous students along with ways to avoid additional trauma related to the impacts of climate change on Indigenous communities. Female researchers may also hear personal stories about sexual abuse from women in villages because as “outsiders” to the community, they may be perceived as a safe person to confide in.

Recommendations:

Support the development and/or participation of researchers or other research project personnel through:

- Cultural awareness trainings specific to the Alaska Indigenous cultural areas where the research will be conducted. (One size does not fit all in terms of engagement and outreach.)
- Trainings in effective, culturally-responsive STEM education, including assessment strategies

- Awareness about the effects of trauma on young people and appropriate ways to respond (The State of Alaska provides trainings for teachers and school counsellors to develop “trauma-informed” schools.)

Coordination of Outreach and Engagement Geographically and By Community

Educational equity and workforce diversity initiatives by grantors and federal agencies have somewhat paradoxically resulted in an over-saturation of researchers seeking classroom visits and other outreach opportunities in some rural Alaska communities, particularly in the Arctic. As described above, many of these communities have a high rate of teacher and administrator turnover, hence could benefit from support of a community liaison to engage new teachers in on-going research projects. A lack of coordination among grantors thus results in overwhelming the capacity of the teachers and schools to develop collaborative and effective STEM education activities and programs.

Coordination of outreach and engagement in larger Alaska communities with a significant population of Indigenous students is also needed to develop and sustain productive teacher-scientist partnerships to provide for cohesive and relevant STEM education support at different grade levels.

Recommendations

Encourage and support:

- The planning and implementation of well-designed community/school STEM events that are inclusive of IK and cultural activities related to the subjects of the research. (Examples: Bering Sea Days, UIC Science Fair in Utqiagvik and other North Slope villages, Sitka Whale Festival)
- Engagement activities (e.g., citizen science projects, ones related to a common community issue related to climate change) that link educators across several communities within a school district, across school districts, statewide, or to communities beyond Alaska.
- Facilitation of sharing of research results among communities (in contrast and in addition to scientists sharing their research to each individual community)
- Coordination of outreach and educational activities with the inclusion of culturally responsive resources and teaching strategies in Alaska communities where research or researchers are concentrated. (e.g., Utqiagvik, Juneau, Sitka) (Examples: the Southeast Educational Exchange (SEE) network, Sitka Sound Science Center’s annual needs assessment with Mt. Edgecumbe High School, Science Coordinator activities in Utqiagvik)

Guidance for Researchers Designing and Implementing K-12 Educational Activities Involving Indigenous Students and Communities

As described in the “Why” section of this report, Alaska’s Indigenous students are often targeted for outreach and engagement efforts in response to grantor guidelines that identify the need to increase educational equity for this student population considered to be underserved by STEM education. Alaska’s Indigenous community members have also expressed their desire for the involvement of youth in

community-based science efforts to monitor or adapt and respond to the impacts of a rapidly changing environment.

Much of the practical guidance that emerged from Working Group discussions was directed at ways that researchers could design more effective STEM activities and programs for K-12 students in general, with an emphasis on effective implementation in the context of Alaska's Indigenous students and communities. We recognized, however, that the majority of researchers lack the expertise to design effective K-12 educational activities aligned with state educational standards, so we recommend that a K-12 educator be added to research project teams that involve K-12 educational activities, particularly those targeting Indigenous students. The guidance below is also directed at K-12 educators who may lack experience and expertise in teaching situations in rural Alaska and with Indigenous students and communities.

Developing relationships in both schools and an Indigenous community are essential to the design of a successful K-12 educational program. Some flexibility is usually required on the part of a researcher or an educator during implementation.

The importance of the relevance of science presentations and interactive learning activities to engage Indigenous students was emphasized repeatedly during Working Group discussions. We identified connections of science/STEM content and concepts to familiar elements and processes in the local environment and the forging of cultural connections through traditional stories, Native language, and immersion in the traditional uses of plants and animals as particularly effective in making scientific information relevant.

Engaging students in the “doing of real science” is an effective STEM strategy recognized in the NGSS for all students. Citizen science projects, with prescribed data collection protocols, can provide these types of opportunities. However, for Alaska's Indigenous students, their engagement in the very real problems their communities face during a time of rapidly changing environment is more immediately relevant than the collection of scientific data to broader-scale research or environmental monitoring projects that do not directly benefit their communities. We thus use the term “community science” and “community-based science” as a best practice, while recognizing that the protocols from citizen science projects such as those developed for the GLOBE program can be employed in projects directly relevant to a community need for scientific data collected by their youth or other community members.

GUIDANCE FOR RESEARCHERS

Best practices for culturally responsive outreach and engagement include:

- Recognizing and appreciating Indigenous knowledge, Indigenous knowledge systems and other ways of knowing and learning alongside the western science knowledge system and way of knowing.
- Making relevant cultural connections to scientific concepts and skills.
- Providing opportunities for students and other community members to share cultural knowledge.
- Showing respect by active listening to Indigenous knowledge.
- Expressing gratitude after receiving Indigenous knowledge.
- Being open and adaptable.
- Respecting the equality of all people.
- Creating trusting relationships.
- Creating relationships with individual students that empower them.
- Being mindful that IK should not be appropriated and that the sharing of IK should be compensated as a way of showing respect for its value
- Using inclusive language about the practice of science (“we” and “our” vs. “me”-centric language).

DEVELOPING GRANT PROPOSALS

Considerations during the Pre-Proposal Stage to Develop Relationships and Collaborations

- **Early in the development of your proposal, identify, connect with, and collaborate with a “bridge person” as a liaison between you as a researcher, the local school system, and the local Indigenous culture. These liaisons can assist you in designing and scheduling educational activities that are relevant to local students and take into account the local Indigenous culture.**
 - Potential “bridge people” include school district Native language and education department instructors, Alaska Native aides, tribal environmental specialists and youth program coordinators, Elders, community educators in tribal organizations or NGOs, homeschool facilitators, 4-H and Boys and Girls Club leaders, tribal environmental specialist, science coordinators for the community, and Alaska Sea Grant Marine Advisory Agents.
 - Do not assume that teachers are familiar or connected with the local Indigenous culture. The majority of teachers in rural Alaska communities are not Indigenous and many are newly arrived due to high turnover rates.
 - Work with your liaison person to coordinate your plans for school activities with other researchers to avoid overwhelming the capacity to respond to multiple requests from researchers for class time.
 - Determine a role of the liaison throughout the project. Consider including them on your project team to facilitate implementation of the education activities and include appropriate compensation in your project budget.

- **Allow plenty of lead time to contact teachers and school administrators to collaborate on planning educational activities and getting their “buy in” and commitments to participate.**
 - Don’t expect busy teachers or school administrators to respond quickly, especially to “cold calls.” (This is where a community/school liaison can be helpful.) .
 - Be prepared for the possibility that some teachers may not have the time or interest in collaborating with you in a grant proposal.
 - Obtain commitments at appropriate level in the school system to ensure that activities will be implemented by the school or school district. Consider the lag time between the proposal process and implementation of a funded project. Ask for specific commitments as the culmination of a collaborative process, not as a last-minute request for a general letter of support that may not be honored if teacher or administrator turnover occurs.

Considerations during the Project Planning Process

- **Develop shared expectations about educational activities during the planning stage of your proposal, ensuring that the educational purpose of the activities is clear and addresses a need identified by teachers and/or school administrators.**
- **Negotiate and include appropriate compensation for teachers, community educators, or outreach/ education coordinators.** For teachers, this may be in the form of stipends or payment for release time from their contract if the proposed activity (e.g., a teacher training workshop) requires time away from the classroom.
- **If you are planning to include Indigenous Knowledge in your school activities, you will need to form or sustain an on-going relationship with appropriate cultural knowledge experts and include them in the planning process.**
 - Be sensitive to the sacred nature of some Indigenous knowledge that Elders and other cultural experts may choose not to share. They may have other reasons for not possessing or agreeing to share their knowledge with you. Some knowledge is owned by specific people, families or clans and cultural experts are most often experts in particular types of knowledge (e.g., sea ice dynamics), not all types of cultural knowledge.

“Indigenous people think differently about the land and place than the Western science perspective, for example, our many terms in the Inupiaq language for snow and ice. As a point of reference in communication, Inua is part of it – the spirit of the place.” - Tenna Judkins

- Elders and other cultural experts should be compensated appropriately for their time and the use of that knowledge. Don’t assume it will be given to you without compensation and without clear and shared expectations about how you plan to use it, including in school activities.
- **Plan for logistical challenges in rural Alaska.**
 - Determine what equipment and supplies must be supplied by you and include the cost in the project budget.
 - Find out what transportation will be needed for field trips and any associated costs. Ensure that any liability is covered by the school district or a community organization (e.g., 4-H).

- Find out what communication technology is available at schools and plan accordingly in terms of teacher or student access to online educational resources.
- Provide flexibility for extended stays in remote communities to accommodate weather delays or unexpected community events.

Considerations in the Design of Educational Activities

- **Include “best practices” instructional strategies for science/STEM education that are particularly effective for engaging and supporting learning by Indigenous students.** (See next section.)
- **Recognize that there are multiple ways that knowledge can be shared.** Don’t assume that the way you are most comfortable transferring scientific knowledge to your peers is the only way.
- **Design interactive learning experiences that researchers, teachers, cultural experts, and students are all participating in and sharing their knowledge and insights.**
- **Consider afterschool educational activities, activities in other settings like summer science and culture camps, and hiring and mentoring Indigenous student interns.**
- **Collaborate with teachers and your community/cultural liaison to design the following types of culturally responsive activities:**
 - Connecting your research to cultural education in other subject areas like art, social studies, and English/Language Arts
 - Inviting an Elder with knowledge about your research topic
 - Sharing IK appropriately according to the knowledge-sharing protocols of the community
 - Participating in a community/school science event that includes traditional activities
 - Working with teachers to facilitate student or class projects that are student-driven (but not necessarily tied to your research)
 - Discussions of STEM-related jobs and careers in the community that also involve IK
 - Mentoring students in development of science fair or community science projects with a cultural component
 - Providing opportunities for students to share and present the results of their projects to the community
 - Designing assessments of student learning that will demonstrate how well your educational objectives were met with a consideration of multiple ways that culturally diverse students can demonstrate the knowledge or skills they have gained.
- **Consider, and collaborate with teachers about what they can “pre-teach” ahead of a visit by a scientist or science educator and how the learning can be extended using follow-up visits** by a researcher via distance delivery or by the teacher.
- **Consider providing opportunities for students to present the results of a project at science conferences** like the Alaska Marine Science Symposium and Alaska Forum on the Environment, or at national or international science conferences. (You will need to determine the travel costs for students, teachers and/or chaperones and include this in your project budget.)
- **Think ahead about collecting samples during the summer field season for students to use in activities during the school year, taking into account when freeze-up and break-up occurs.**

“Best Practice” STEM Instructional Strategies

The instructional strategies listed below will increase the relevancy and effectiveness of STEM-related activities, but they are particularly relevant and effective in the context of cultural responsiveness for Indigenous students.

- **Learning activities that are age- and developmentally-appropriate.** The NGSS can provide guidance to the level of conceptual understanding that the “average” student should be capable of at a particular grade level, but teachers will have a better idea of what their students (including Special Needs’ students) have already learned and are capable of learning.
- **The content and skills are relevant to student experience and their everyday lives. These include:**
 - Place-based activities that are relevant to the local environment
 - Immersive, experiential activities beyond the “four walls” of the classroom or school
 - Activities that build on student’s cultural knowledge and skills through appropriate cultural connections (i.e., appropriate inclusion of IK; local Native language; the context of subsistence activities, community gatherings, etc.)
 - Participation in a community science project (i.e., one based on a community-centered approach and focused on an environmental problem or a need for monitoring environmental parameters of particular concern to the community and one for which students can make a real contribution).
- **Learning is student-centered and student-driven. Strategies include:**
 - Engage students in discussion rather than lecture at them. Provide them with opportunities to share their insights and curiosity.
 - Elicit the prior knowledge of students through open-ended questions about something they are likely to have experienced related to the science concept or skill you are sharing.
 - Encourage and support students in posing their own scientific questions.
 - Provide opportunities for students to participate in multiple or all steps in the process of research (e.g., asking questions, collecting data, communicating results to the community, writing abstracts, problem-solving).
 - Engage students in research projects that can range from citizen science-type activities with prescribed methods to open-ended project-based learning where students determine what they want to study and how.
 - Ensure that students have a voice and opportunities to share their insights and reflect on what they are learning.
- **Teaching strategies that take into account traditional styles of communication and learning in Indigenous cultures.**
 - Hands-on, interactive learning involving tangible objects that students can touch, smell, etc. and/or manipulate (e.g, research equipment)
 - Storytelling

“We are creatures of story. My grandmother used to say ‘Watch my mouth and pass down everything I say.’”
– Pauline Morris

“Stories transcend everything, including time. Communities [should be encouraged to?] need to share

stories about what has been happening before European scientists arrived for example, birch canoe design, and use cultural science to help explain and complement research [stories].”

- Working in pairs and small groups in which students take on a variety of roles for both quieter and more extroverted students (e.g., note-taker, data collector, reporter to the class).
- Older students sharing with younger students, activities that engage students as participants in experiences.
- Opportunities to listen respectfully to Elders or to observe them engaged in traditional activities.

Preparing for a School Visit in a Community with Indigenous Students

- Increase your knowledge and understanding of the Indigenous culture of the place where you plan to conduct or are conducting your research and before you interact with Indigenous students and youth.
- Find out the cultural importance of the species or aspects of the environment that you are studying, particularly for subsistence ways of life (e.g., hunting, gathering medicinal plants, etc.)
- Examine your own assumptions, biases, and expectations of Indigenous students and be prepared to be open to cultural differences and the circumstances of remote rural communities in Alaska. What a school classroom or home looks like in rural Alaskan communities may be very different from what your school and home look like in a more urban or suburban setting. Think about what you can bring to the community.
- Learn at least a few words and their correct pronunciation in the local Indigenous language (e.g., place-names and what they mean near your study site, the name of the organisms you're studying, words for different forms of ocean conditions such as forms of sea ice) or arrange for a Native language instructor, Elder or other cultural expert to do that.
- Arrange for a pre-meeting with teachers and/or school administrators, community members and/or students (in-person or via distance delivery) before your planned visit to a school.
- Be prepared for changes in schedule. Unplanned community events like a funeral and subsistence activities may take precedence over a schedule set up months ahead of time. Be prepared to be flexible and patient.

“Scientists are people too! They should think about ‘What can I bring?’ as a person not only as a scientist.”

– Brendan Smith

Guidance for Specific Types of K-12 Educational Activities

- **K-12 curriculum resources.** Before developing new curriculum materials, look online for free place-based, culturally responsive education resources relevant to your research focus in terms of a community issue and the Indigenous cultural group you will be working with. If you decide you need to develop new resources, collaborate with local Alaska teachers, school district STEM curriculum specialists, and cultural experts to accomplish this. Appropriate compensation for their services should be included in research project budgets.
- **Citizen science and community science projects** (i.e., projects that are matched to community needs for scientific data to support problem solving) require local community “champions” for sustainability in schools with high turnover rates of teachers and administrators.
- Certain types of **data collection** may require community or tribal government approval for cultural reasons and may need to be adapted to accommodate cultural beliefs.
- **Multi-day school/community STEM events** can be planned collaboratively with community members to include traditional activities.
- **Student projects** and **school/community STEM events** can often be publicized by volunteering to be interviewed by reporters for local newspapers or radio stations.

Interacting with Indigenous Students during Classroom Visits or Other Educational Activities

- Introduce yourself by “who you are,” not what you do. Students and other community members will want to know where you are from and something about your family. They will likely be interested in your local experiences.
- Recognize that communication styles within Indigenous cultures and by students can be diverse and that Indigenous students may prefer non-verbal communication. Posing questions to the class may result in silence. Open-ended questions are a better approach as is leaving students with a question that only they can answer.
- Demonstrate respect for Indigenous Knowledge and cultural values as equal in weight to knowledge developed using the western science way of knowing and the values of western science culture.
 - Provide opportunities for students, Native language and cultural instructors, Elders, and/or other community members to share their knowledge and listen respectfully.
 - Learn about and make comparisons between “Native science” and modern technology involving empirical knowledge to solve similar problems (e.g., birch canoes and skin boats vs. skiffs; traditional sea ice probes to test the safety of the ice for walking)
 - Learn about and share ways that traditional knowledge has complemented and enhanced western science methods (e.g., traditional knowledge about bowhead whale behavior and development of more accurate census methods as a basis for setting harvest quotas).

“You may need to reassure students that eating your study animals is okay! Focus on a common goal of healthy communities.”

- Alexis Will

- Employ humor, but appropriately.
- Be mindful of using technical jargon. Whenever possible, use words that are part of the day-to-day vernacular of the local community. Consult with the teacher about more technical scientific terms you plan to use in terms of the science concepts students will be learning over the course of the year so that some terms can be introduced and reinforced as vocabulary words with their associated meaning.
- Use a PowerPoint presentation only if it is largely visual and contributes to telling a “science story.” Include a minimum number of graphs (1 or 2 max.) unless the focus of your activity is data analysis. The graphs should be tailored to the appropriate level of the students’ expected reading and math skills. Don’t just recycle a PowerPoint presentation that you made at a science conference to your peers.
- Use “we” and “our” in reference to people who “do” science (or are doing it in the classroom) to reflect the reality that science is a shared endeavor.

“Community members consider all K-12 students ‘our’ students . . . ‘our’ and ‘we’ language is more inclusive.”

“Scientists are learners too! Present yourself as a member of a community of learners that includes the students.”

- Eric Filardi

- Be willing to express uncertainty and to be challenged and have your data challenged although some students may consider this inappropriate in cultures where they do not question Elders. You may need to encourage students to engage in questioning as a scientific skill related to weighing evidence.
- Avoid:
 - Showing up in an Indigenous and/or rural Alaska community with no prior planning and expect teachers to accommodate your schedule and research topic.
 - Just talking to students because you do not have a plan or are not prepared to address the objectives you included in your research proposal for outreach or engagement of K-12 students.
 - Bringing a sheet of notes and flipping through them. This will be distracting to students.
 - Making inappropriate comments especially about cultural knowledge or traditional ways of life (e.g. subsistence harvests).
 - Being disrespectful or arrogant with respect to western science being the only or only “true” way of creating and vetting knowledge.

Tips for Building and Sustaining Relationships in Indigenous Communities

- Developing relationships and sharing knowledge respectfully and appropriately with Indigenous community members takes time.

“Listening is an important part of it – to learn what is going on, also appreciation.” - Yosty Storms

- Be an ambassador for science! Don’t perpetuate a legacy of scientists who are long-remembered as “taking” (i.e., appropriating) Indigenous Knowledge or taking data collected by students and other community members without “giving back” to the students and to the community.
- Determine and provide appropriate financial compensation for whoever is a contributor to your project, including those who share valuable Indigenous knowledge.
- Reciprocal relationships are “the norm” in Indigenous cultures – not only between people but also between people and other species. Respect the spiritual aspect that is an essential part of the Indigenous way of knowing. Express gratitude to the people who are hosting you in the community, sharing their knowledge, and keeping you safe.
- Avoid presenting yourself as someone who knows more about community issues and how they can best be solved than local community members. Do offer whatever scientific information you can or help students consult community experts or design studies to gather more information.

“Trust is the basis of collaboration and communication. . . . If I invite a guest in to my home, I don’t expect that the first thing they will do is tell me how to rearrange my furniture in a way that’s ‘better for me.’ Establish relationships; time is part of that.” - Elena Sparrow

- Sharing food, especially the harvest, is an important cultural practice in all Indigenous cultures. Participate in traditional cultural events such as potlatches and whaling celebrations if they coincide with your time in a community. (Get up and dance!) If Native foods are offered to you as a guest in the school or community, you should eat them to show cultural respect (especially if it is your study animal you are being served). When you are arriving in a community off the road system, personal gifts of fresh vegetables and fruits are always welcome by community members, including teachers and other school staff. If you have food left over at the end of a visit, consider leaving it behind as a gift. You can also bring old research posters related to locally relevant research to leave behind in the school or a community center to extend the learning (provided the language is not technical).
- Food and tickets for door prizes can be an effective way to encourage participation. “Swag” (tee shirts, hats, etc.) from your university or agency as door prizes are great incentives for participation in special STEM-related school/community events. (Include food in your grant budget if the grantor will allow it.)
- Acknowledge Indigenous knowledge holders, students and other community members who contribute observations or data to your project in publications.

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Appendix 1.

To: Navigating the New Arctic Working Group, National Science Foundation

From: Working Group to Develop Guidance for Culturally Responsive Outreach by Researchers to Alaska K-12 Audiences

Re: Requests for Proposals to Navigating the New Arctic (NNA) Research Initiative

We recently convened a working group in late May, 2019, with the purpose of developing guidance for research funders to encourage and support culturally responsive outreach to Alaska's K-12 indigenous students. Our work was supported by awards from the North Pacific Research Board (NPRB) and Alaska Sea Grant (ASG). We also received financial and staff leadership support from the Arctic Research Consortium of the United States (ARCUS). Both NPRB and ASG support research projects as grantors and encourage inclusion of Indigenous knowledge, also described as traditional knowledge, alongside knowledge developed using western science methods. They also identify K-12 students, teachers, and informal educators as stakeholders in the research as well as audiences for dissemination of research findings.

The working group (see attached list of members) is comprised of practitioners serving Alaska K-12 Indigenous students and educators as classroom teachers, education researchers, pre-service and in-service teacher trainers, informal educators, researchers engaged in K-12 outreach, and science outreach coordinators. K-12 outreach and engagement activities in Alaska's Arctic region were a recurring focus in our discussions due to the sheer volume of research taking place in and around Alaska Arctic communities. Several of the working group members have received NSF support for Arctic STEM education research, outreach, or outreach coordination.

We decided that we would like to share the results of our discussions with NSF, particularly with those involved in shaping the "navigating the new Arctic" initiative. We are excited that NSF has made "navigating the new Arctic" one of its 10 Big Ideas and allocated substantial resources for research in the Arctic region, including investments to improve STEM education in northern communities. However, after much thoughtful discussion, we have concerns about how Indigenous students are being incorporated into NNA (and other NSF) proposals, and want to provide feedback and recommendations to NSF before finalizing the report to NPRB and ASG from our recent meeting, so as to provide timely input to the development of future NNA calls for proposals.

To provide some context, the decade-long Alaska Rural Systemic Initiative (1995-2005) demonstrated that place-based education that includes cultural responsiveness to Alaska's diverse Indigenous cultures can narrow the academic gap for Alaska Native students. Leadership by Alaska Native and other educators to apply the results of this science and math education reform effort culminated in the adoption of standards by the State of Alaska for incorporating cultural knowledge and values into all subject areas and into teacher practice. The Alaska K-12 science/STEM education community has a long history of evidence-based instruction and curriculum development that is responsive to the cross-cultural nature of K-12 education in Alaska communities. Despite these advances, there remains a lack of general awareness about among Arctic researchers and research grantors that cultural responsiveness is required, and effective, component of interactions among researchers, K-12 educators and students. We do

recognize that NSF has included Alaska Native students as “underserved audiences” in proposals and have also encouraged researchers in the Arctic to reach out to rural Alaska communities and classrooms. Although well intended, there still remain challenges and issues for all those involved. Specifically, the inclusion of Alaska Native students as an underserved audience by NSF has somewhat paradoxically resulted in an over-saturation of researchers seeking classroom visits and other outreach opportunities in some rural Alaska communities, particularly in the Arctic. All too often, the issue is one of quantity vs. quality. A single classroom visit is often viewed by researchers as an effective means for addressing the broader impact activities required by NSF grants. Teachers in rural Alaska communities face tremendous demands on class and professional time that leaves little left to interact with scientists to collaborate in the development of effective STEM learning opportunities or to plan to extend the learning. Consultation with teachers and school administrators is often cursory or lacking during researchers’ pre-proposal preparation process. The timing of researcher availability for classroom visits during the school year is often not coordinated with course schedules of when particular topics are taught at specific grade levels or with community cultural calendars that include seasonal subsistence activities and traditional gatherings. The accountability and difference in rigor of evaluation that NSF requires for broader impacts activities and STEM education research projects is striking. Teachers are rarely asked to assess the effectiveness of scientists’ outreach in terms of STEM learning or student interest in pursuing STEM careers.

It is with this context in mind, that we feel the need to provide detailed recommendations and additional guidance to researchers and proposal reviewers to better serve Alaska’s Indigenous students and educators working in rural Alaska. An annotated review of selected literature that defines culturally responsive education and provides evidence for the recommended instructional strategies is available at <https://www.arcus.org/tac/2019-workshop>.

1. We recommend that, in the NNA grant program, NSF re-examine the reasons for targeting Alaska Native students in Arctic communities as audiences for outreach solely because they are “underserved” by STEM education and/or underrepresented in the STEM workforce in general and as researchers in particular.

The underlying assumptions in categorizing Alaska Native students as underserved and a target audience for outreach to achieve broader societal impacts are:

- 1) additional STEM resources and opportunities to interact with Arctic researchers (the majority of whom are non-Indigenous and who may have a relatively narrow research focus on some aspect of the Arctic environment) will stimulate engagement in STEM and interest in pursuing STEM careers, and/or that
- 2) Arctic researchers and K-12 educators or outreach specialists have the skills to serve Alaska Native K-12 students effectively.

In the “new,” and rapidly-changing, Arctic, while educational equity considerations remain relevant and pressing, we also believe that the need to equip and engage K-12 students as active Arctic community members is of equal importance to preparing more Alaska Native students to pursue STEM careers away from their communities. Arctic communities have repeatedly expressed needs for their youth to be engaged right now in the work of monitoring environmental change and community resilience and adaptation to climate change. K-12 students in Arctic communities need to be doing “real science” and seeking and communicating science-based and engineered solutions to community problems – all of which has been envisioned in the performance expectations for the Next Generation Science Standards. The engagement of the next generation of Indigenous K-12 students as citizens with conceptual knowledge about the dynamics of Arctic ecosystems and STEM skills is a critical pathway enabling the NNA research outcomes of resilient, sustainable Arctic communities.

2. We recommend that NSF require that outreach to Alaska Native K-12 students and their teachers be designed, implemented, and its success evaluated in ways that are culturally responsive.

Providing STEM education in a culturally responsive way with cultural values taught “side by side” with knowledge derived using western science methods has the benefits recognized in Alaska’s cultural standards as well as other societal benefits. Alaska Native cultures are diverse but their cultural values have collectively sustained individuals and communities despite historical stresses of colonialism, epidemics, and the shift to a mixed cash-based and subsistence economic system. These values and a holistic relationship to place have survived and been reinvigorated despite historical federal education policies of cultural assimilation and suppression of Indigenous languages that forced a generation of high school students to leave their communities. The trauma of the boarding school era has had long-term multi-generational effects that influence the desires of many communities to exert control over what is taught in schools so their children can learn the Indigenous values and knowledge still needed for survival along with the canon of a western education. Indigenous knowledge and values are increasingly recognized as critical to a positive identity for individuals and to the resilience of Indigenous communities during the current stresses of a rapidly changing environment.

3. We recommend that NSF recognize that strengthening STEM education in schools in Alaska’s Arctic communities is a complex undertaking that requires:

- 1) a sustained investment in relationship-building with school administrators and community members, and**
- 2) partnerships with educators within the school system and/or community members who can serve as bridges between the school, the community, and the scientific community as well as those who can serve as bridges between STEM knowledge and cultural/Indigenous knowledge.**

The most recent NNA call for proposals recognizes the need for partnerships with stakeholders that include STEM educators and students as well as community members, and prioritizes direct collaborations with Indigenous residents and local institutions and organizations. Arctic researchers have made significant contributions to STEM education and there is no doubt that they have been and can continue to be a tremendous resource for strengthening STEM education in Arctic communities. Alaska’s Arctic rural school districts need STEM resources in the form of equipment and supplies, place-based curriculum materials aligned with the NGSS and cultural standards, and sustained and repeated science teacher trainings due to high annual turn-over rates. But as the research funding system is currently set up, these needs are rarely addressed in a systemic way by researchers in the context of their outreach.

We recommend the guidance that NSF provides to researchers for the development of grant proposals recognize not only schools as potential partners in individual research projects, but also the importance of treating Arctic school districts as stakeholder institutions in STEM education and as social systems. Curriculum and instruction is coordinated, revised, and supported at the school district level. Meaningful and systemic impact occurs at this level, not at the level of a single teacher, who may have a short tenure in a community, or of a single school in a single community.

4. We recommend that NSF address the potential for over-saturation in some communities by developing or supporting strategies that will serve to coordinate outreach by multiple researchers to K-12 students and teachers at the school district level.

Ideally, coordination would also occur among all Arctic research funders who fund research that includes a K-12 outreach and education component in Arctic communities.

5. In the request for NNA proposals and the proposal review process, we recommend that you discourage the following as outreach components of research projects:

- Outreach to Indigenous K-12 students as a one-way transfer of information about research approaches and outcomes.

- “One-off” classroom visits, in person or via distance delivery methods, without a clear purpose and an established partnership with a K-12 educator or district administrator to ensure alignment with the school district curriculum and the means to extend the learning.
- The development and web publishing of K-12 lesson plans and other curriculum resources for Indigenous K-12 students (or that reference Indigenous knowledge) by project team members who lack training in culturally responsive pedagogy.

6. In the request for proposals and proposal review process, we recommend that NSF encourage and support:

- Track 2 planning projects that include the development of a science communication plan. For projects with a stated purpose of “advancing Arctic science and engineering through education” and/or that identify Indigenous K-12 students and their teachers as target audiences, the project team should include cultural experts, culturally responsive educators, and school district administrators, with appropriate financial compensation for their time. The planning process should include a needs assessment for K-12 outreach, development of a coordination process for K-12 outreach and engagement activities, and development of metrics and evaluation methods for education outcomes.
- Student-centered and community-centered learning activities that engage students, in developmentally-appropriate ways, in critical thinking about research questions relevant to their community, the collection of data and observations, data analysis, and evidence-based problem-solving.
- Other active learning methods, including field trip activities, “hands-on” learning activities, opportunities to gain skills in the use of sampling equipment and computer technology, etc.
- Training in cultural awareness for researchers and educators to work effectively with Indigenous K-12 students and to make appropriate cultural connections to traditional knowledge in partnership with “bridging” educators and community members.
- Accountability for researchers to K-12 education outcomes for all students and for Indigenous students in particular.

We appreciate NSF’s recognition in the NNA of the importance of “new enhanced research communities that are diverse, integrative, and well-positioned to carry out productive research at the intersection of Arctic natural and built environments and social systems.” We recommend that NSF approach schools and school districts as a critical and potentially well-integrated component of new enhanced research communities and promote the participation by K-12 students (in meaningful ways) in productive research at this intersection. The engagement of K-12 students in research outcomes will also “enable resilient, sustainable Arctic communities” when the resilience of the students as productive members of their communities and cultures is also enhanced. Other types of culturally responsive contributions to STEM education are an essential element of responsiveness to the needs of Alaska indigenous communities.

Thank you for consideration of our comments. We will also send you the final report and guidance developed by the working group at our recent meeting. The working group also plans to expand the resources available on the ARCUS website and develop training opportunities for Arctic researchers on this topic.

Working Group on Culturally Responsive K-12 Science Outreach and Engagement

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Culturally Responsive Education Models and Resources

Grant Process Model

NASA grant process that requires one year of collaborative planning with communities to initiate a grant project to develop a more detailed outreach and engagement plan.

Scientist/Community Networks

Suvel “What’s Up?” Science Portal (in development) **Contacts:** Kaare.Erickson@uicscience.com, Janet Warburton, warburton@arcus.org

Juneau STEM Coalition/SouthEast Exchange (S.E.E.) network and networking events.
<https://juneaustem.org>, <https://southeastexchange1.wixsite.com/southeastexchange>
Contact: Anne Beaudreau, abeaudreau@alaska.edu

Community/School STEM Events

Bering Sea Days (model for coordinating outreach across projects) **Contacts:** Veronica Padula vmpadula@gmail.com, Hiruki-Raring. Lisa.hiruki-raring@noaa.gov

North Slope Community Science Fairs (model for coordinating outreach across projects, model of science liaison work) **Contact:** Kaare.Erickson@uicscience.com

Utqiagvik “Science and Soup” nights. **Contact:** Kaare.Erickson@uicscience.com

Alaska SeaWeek/Alaska Seas and Watersheds program. **Contact:** Alaska Sea Grant Director.

Culturally Responsive Science Fairs

COSEE Alaska: culturally responsive ocean science fairs. **Contact:** Sean Topkok, cstopkok@alaska.edu.

Culturally Responsive Professional Development and Curriculum Development

Alaska Large Marine Ecosystem workshops, COSEE/ARCUS/AOOS teacher-scientist workshops to develop place-based, culturally responsive lesson plans. **Contact:** Janet Warburton warburton@arcus.org

Research Experiences for Teachers (RETs):

PolarTREC <https://www.polartrec.com/>. **Contact:** Janet Warburton warburton@arcus.org

NOAA Teacher at Sea. <https://teacheratsea.noaa.gov/> **Contact:** Lisa.hiruki-raring@noaa.gov

Raising Educational Achievement through Cultural Heritage (REACH Up) program.
<http://k12reach.org/> **Contact:** Sam Norlin, stnorlin@alaska.edu

NSBSD Mapkuq Project. **Contact:** Tennessee.Judkins@nsbsd.org

Sealaska Heritage Institute/Juneau Indian Studies Curriculum Kits:

Contact: phyllis.carlson@sealaska.com

Chugachmiut Heritage Program TEK/STEM kits. <http://spoonfrogclients.com/chugach/index.html>

NOAA Planet Stewards program: Mini-grants for teacher professional development and student projects.

<https://oceanservice.noaa.gov/education/planet-stewards/>

Engagement in Community Science Projects

Climate change in My Community courses. **Contacts:** Katie Spellman, klspellman@alaska.edu, Elena Sparrow, esparrow@alaska.edu, Malinda Chase, malindac@apiai.org

Use of GLOBE program protocols. Contact: Elena Sparrow, esparrow@alaska.edu

Other citizen science data collection protocols suitable for schools. <https://adaptalaska.org/educator-resources/> Search database by topic, “citizen science,” and/or “data sheet/protocols.”

LEO network <https://www.youtube.com/watch?v=8YvTToK7w7M&feature=youtu.be>. **Contact:** Erica Lujan, enlujan@anthc.org

“Data Jams.” NSF Long-term Ecological Network. Contact: Sam Norlin norlin@nceas.ucsb.edu

Community Service Projects

Denali Backcountry Intensives. Contact: Eric Filardi, efilardi@nenanalynx.org

Student Reporting Opportunities

Alaska Forum for the Environment Youth Track <https://akforum.org>

Alaska Marine Science Symposium. **Contact:** brendan.smith@nprb.org

Sealaska Heritage Institute Digital Storytelling Showcase. **Contact:** phyllis.carlson@sealaska.com

AdaptAlaska.org student success stories. **Contact:** Davin Holen, dlholen@alaska.edu

Alaska STEM Education Organization Partners

Alaska AfterSchool Network/Alaska Children’s Trust. <https://www.akafterschool.org/>