Understanding and Overcoming Collaborative Arctic Research Challenges

2021–2022 Proceedings of the ARCUS Interdisciplinary Research Committee

ARCUS
Arctic Research Consortium of the United States

ARCUS INTERDISCIPLINARY RESEARCH COMMITTEE MEMBERS

Members
Pips Veazey, University of Maine
Holly Hapke, University of California Irvine
Gisele M. Arruda, University of Aberdeen
Mia Bennett, University of Washington
K. Fred Huemmrich, University of Maryland, Baltimore County
Cana Uluak Itchuaqiyaq, Virginia Tech
Martin Jeffries, Cold Regions Research and Engineering Laboratory (retired Nov. 2020)
Julie Raymond-Yakoubian, Kawerak, Inc.
Peter Webley, University of Alaska Fairbanks
Elizabeth Weinberg, Interagency Arctic Research Policy Committee
Caitlin Wylie, University of Virginia

Staff
Helen Wiggins, ARCUS Executive Director
Brit Myers, ARCUS Strategic Engagement Director
Jan "Kuba" Grzeda, ARCUS Project Coordinator

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TABLE OF CONTENTS

1.   INTRODUCTION

Since 1988, the Arctic Research Consortium of the U.S. (ARCUS) has served to develop strong and productive connections among U.S. and international Arctic researchers, educators, Indigenous and traditional knowledge holders, Arctic residents and local experts, and other stakeholders to improve understanding of the changing Arctic. Membership is open to all organizations and individuals interested in working together to achieve the strategic goals of the Consortium and to build and sustain the network of collaborative relationships that enable Arctic research.

The ARCUS Interdisciplinary Research Committee was an ad-hoc committee established in 2021 by the ARCUS Board of Directors to play an active volunteer leadership role in realizing ARCUS' 2021–2025 Strategic Plan goals and objectives (Arctic Research Consortium of the U.S. 2021a). Specifically, the committee was convened to advance ARCUS' ongoing efforts to:

- Facilitate and support Arctic research collaboration
- Provide resources and promote innovative practices for collaborative and interdisciplinary research
- Connect and support the Arctic research community around shared topics of interest
- Partner with other Arctic organizations to catalyze and broaden networking opportunities
- Promote exchange, collaboration, and co-production between the ARCUS community with U.S.-based Arctic Indigenous community members

The committee convened virtually for 1–1.5 hour-long meetings six times between May 2021 and January 2022 to discuss interdisciplinary research collaboration in the context of wider Arctic research programs and initiatives; identify challenges; explore existing collaborative research programs, tools, and resources; and to recommend specific actions that might be taken to increase the capacity of the wider Arctic research community to productively undertake collaborative, co-produced, and convergence research. This report synthesizes the ideas compiled by the committee and is intended to serve as a resource for anyone working to support the growing number of collaborative research projects and programs taking place in the Arctic today.

The committee embraced an inclusive approach to developing the ideas shared in this report. The recommendations below have not undergone a consensus review process. Instead, they capture the diversity of ARCUS Interdisciplinary Research Committee member perspectives.

2.   CONCEPTS, VALUES, TERMS, & DEFINITIONS

Foundational Concepts & Values for Team-Based Research

U.S. federal agencies and the National Academy of Sciences have become prominent advocates in recent years for the use of collaborative research to inspire innovation and address major societal challenges (National Academy of Sciences, National Academy of Engineering, and Institute of Medicine 2005; Arnold and Bowman 2019). Since 2017, the National Science Foundation's (NSF's) "10 Big Ideas" have become a focal point for the promotion, definition, and evaluation of many collaborative research networks, programs, and projects. Intended to serve as a set of cutting-edge research agendas and processes for future investment to "push forward the frontiers of U.S. research and provide innovative approaches to solve some of the most pressing problems the world faces, as well as lead to discoveries not yet known" (Kurose 2018), each Big Idea requires that "researchers from traditionally distinct disciplines come together at the onset of project creation to jointly form research questions, novel methodologies, and innovative theoretical approaches" (NSF 2021; NSF 2022).

All of NSF's *10 Big Ideas* have not focused directly on Arctic research. However, substantial investments made in both "Growing Convergence Research" and "Navigating the New Arctic" programs as part of this agenda have resulted in many new funded projects involving the Arctic research community. Through these programs, incubation grants have also been extended to aid in the development of team formation and research co-production with Indigenous Knowledge holders, Arctic residents, and other partners. In practice, pursuing the high standards of convergence and co-produced research promoted by these programs has encouraged many Arctic researchers to give extra attention and scrutiny to the definition, practice, and performance of team-based science.

No matter which definition(s) of collaborative research are ultimately used or adopted by a researcher, team, or organization, the ARCUS Interdisciplinary Research Committee strongly supports the inclusion of the following foundational concepts and values in Arctic team-based research:
- Inclusive ways of knowing
- Adoption of both academic and non-academic conceptual frameworks
- Adherence to diversity, equity, and inclusion principles
- Efforts to avoid inherent disciplinary bias or privilege
- Embracing both science and arts/humanities perspectives
- Solutions-oriented research
- Co-produced research when working in and with communities

Collaborative Research Terms & Definitions

Research that spans multiple disciplines, ways of knowing, and/or conceptual frameworks is regularly described using a variety of terms. Members of the ARCUS

Interdisciplinary Research Committee reviewed a number of terms used to describe research collaboration (Table 1 and Table 2) as a way to establish a shared team vocabulary and align the group's understanding of key concepts. For the purpose of this report, "collaborative research" has been adopted as a term to refer to all types of group research discussed in the tables below.
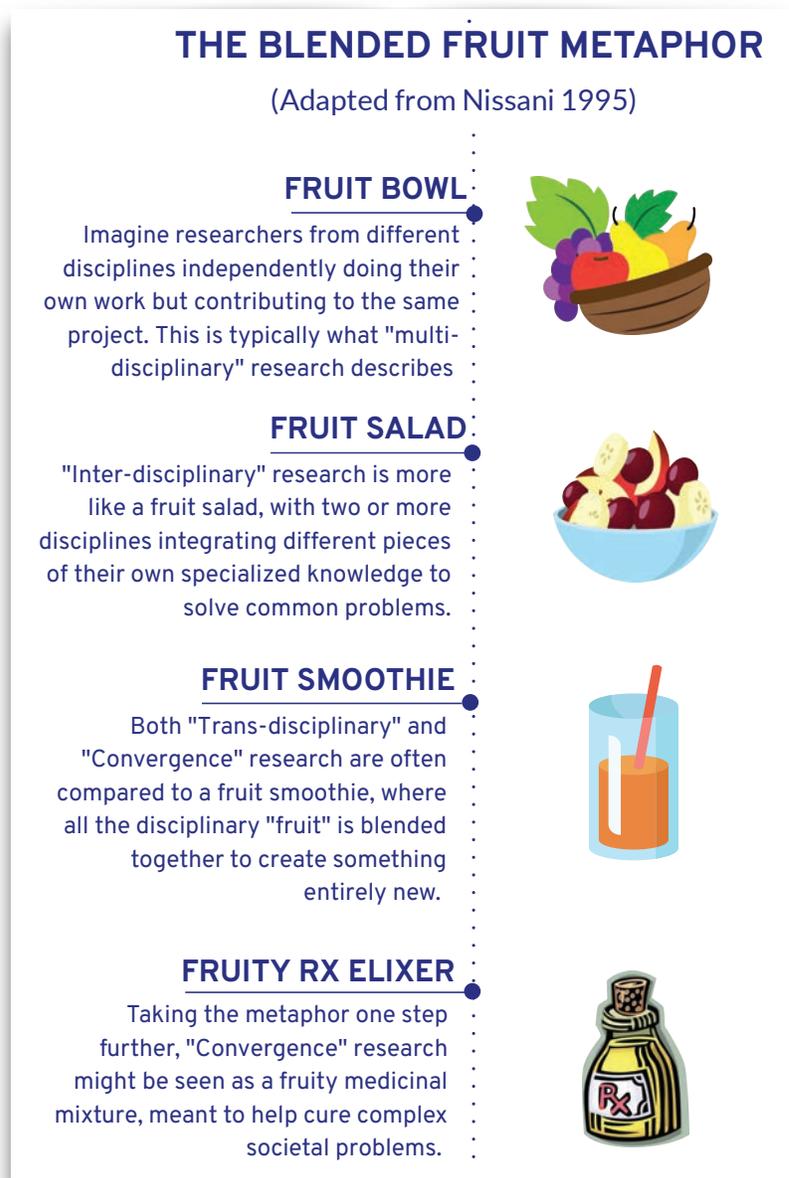
The terms and definitions included in Table 1 are those used for collaborations occurring between researchers of both the same and different academic disciplines, placing these terms in order of increasing levels of interdisciplinary integration.

TABLE 1: Research Collaboration Types Occurring Between One or More Disciplines

LESS INTER-DISCIPLINARY INTEGRATION	**Uni-disciplinary**	"a process in which researchers from a single discipline work together to address a common research problem." (Stokols et al. 2003)
	Cross -disciplinary	"in some cases, integrate[s] concepts, methods, and theories drawn from two or more fields". Interdisciplinary, Multidisciplinary, and Transdisciplinary research are often described as "different approaches" to cross-disciplinary research." (Stokols et al. 2010)
	Multi-disciplinary	"a sequential process whereby researchers in different disciplines work independently, each from his or her own discipline-specific perspective, with a goal of eventually combining efforts to address a common research problem." (Stokols et al. 2003)
	Inter-disciplinary	"a mode of research by teams or individuals that integrates information, data, techniques, tools, perspectives, concepts, and/or theories from two or more disciplines or bodies of specialized knowledge to advance fundamental understanding or to solve problems whose solutions are beyond the scope of a single discipline or area of research practice." (National Academies of Sciences 2005)
	Trans-disciplinary	"an integrative process in which researchers work jointly to develop and use a shared conceptual framework that synthesizes and extends discipline-specific theories, concepts, methods, or all three to create new models and language to address a common research problem." (Stokols et al. 2003)
MORE INTER-DISCIPLINARY INTEGRATION	**Convergence Research**	"a means of solving vexing research problems, in particular, complex problems focusing on societal needs. It entails integrating knowledge, methods, and expertise from different disciplines and forming novel frameworks to catalyze scientific discovery and innovation. Convergence research is related to other forms of research that span disciplines - *transdisciplinarity, interdisciplinarity, and multidisciplinarity*. It is the closest to transdisciplinary research which was historically viewed as the pinnacle of evolutionary integration across disciplines." (NSF 2021)

The term "convergence" research was further explored by the committee using the blended fruit metaphor originally developed by Nissani (1995) to help reduce uncertainty surrounding the term "interdisciplinarity" (Figure 1). Because of the emphasis that convergence research definitions place on addressing specific problems and meeting societal needs, however, the metaphor was adapted and further extended beyond the original blended "fruit smoothie" concept to emphasize this new term's curative or corrective intentions.

Additional terms used to describe collaborative research methods that incorporate community engagement are also outlined and defined in Table 2. In particular, the committee emphasized the distinction between "co-produced research" that can occur with many different types of partners vs. "Indigenous Co-Production of Knowledge (CPK)", which specifically seeks to blend Indigenous Knowledge systems and science to generate new understanding. It was also recognized that, although "co-produced research" is often discussed or encouraged within the context of convergence research, the inclusion of community partners and/or Indigenous Knowledge systems is not a requirement of convergence research collaborations.

THE BLENDED FRUIT METAPHOR
(Adapted from Nissani 1995)

FRUIT BOWL
Imagine researchers from different disciplines independently doing their own work but contributing to the same project. This is typically what "multi-disciplinary" research describes

FRUIT SALAD
"Inter-disciplinary" research is more like a fruit salad, with two or more disciplines integrating different pieces of their own specialized knowledge to solve common problems.

FRUIT SMOOTHIE
Both "Trans-disciplinary" and "Convergence" research are often compared to a fruit smoothie, where all the disciplinary "fruit" is blended together to create something entirely new.

FRUITY RX ELIXER
Taking the metaphor one step further, "Convergence" research might be seen as a fruity medicinal mixture, meant to help cure complex societal problems.

Figure 1: A blended fruit metaphor originally used by Nissani (1995) to define interdisciplinarity was adapted and extended by the committee to reflect the emphasis that "convergence research" places on solving complex societal problems. Graphic developed by Brit Myers, ARCUS.

TABLE 2: Research Collaboration Types Occurring with Community Partners

Community-Based Participatory Research	"a partnership approach to research that equitably involves community members, organizational representatives, and academic researchers in all aspects of the research process. It enables all partners to contribute their expertise, with shared responsibility and ownership; it enhances the understanding of a given phenomenon; and, it integrates the knowledge gained with action to improve the health and well-being of community members, such as through interventions and policy change." (CAPHE n.d.)
Research Co-Production	"an approach in which researchers, practitioners and the public work together, sharing power and responsibility from the start to the end of the project, including the generation of knowledge." (INVOLVE 2018) **Note:** Research co-production may happen with many different partner types. It does not always refer to research co-produced with local community members or Indigenous Knowledge holders.
Indigenous Co-Production of Knowledge (CPK)	"a process that brings together Indigenous Peoples' knowledge systems and science to generate new knowledge and understandings of the world that would likely not be achieved through the application of only one knowledge system. CPK emphasizes the importance of attaining equity in research relationships. ... CPK is the process of bringing together two different knowledge systems, in true partnership and equity, to enhance, learn, and create new understandings on a specific topic." (Ellam Yua et al. 2021)

3.   COLLABORATIVE RESEARCH CHALLENGES

Many of the challenges confronting Arctic research project groups are those that might be experienced within any of the collaboration types described above. Moreover, most issues are not unique to either the Arctic or to research collaboration. Instead, they are the kinds of issues that often arise during any instance of team-based work. However, understanding how these challenges might express themselves while working in specific scientific or Arctic community contexts may be beneficial for anyone looking for resources to support their Arctic-focused project or team.

At the same time, some of the challenges addressed in the section below are conspicuously linked to specific Arctic research collaboration contexts and circumstances. For example, many of the issues surrounding Indigenous CPK do require a much greater awareness of and sensitivity to the scientific community's varied history of engagement with Arctic communities, organizations, and individuals.

In this section, a wide range of collaborative Arctic research challenges identified by the ARCUS Interdisciplinary Research Committee have been described. Challenges are organized in Table 3 around the different stages of research where challenges are likely to emerge. Additional consideration of stage-independent challenges related to community collaboration and Indigenous CPK as well to the broader themes of diversity, equity, inclusion, and belonging are also discussed.

Challenges at Different Stages of Research

Categorizing collaboration challenges by the different stages of research where issues are likely to emerge provides an opportunity to think holistically about the "ecosystem" of people, organizations, programs, or events that support research collaboration. This can assist with the identification of gaps in currently available collaboration support resources, as well as highlight areas where more outreach is needed to ensure that existing resources are well-advertised and accessible.

Conceptualization: Conceptualization represents the initial phase of research focused on selecting project partners, identifying shared project goals, and outlining the topics and research questions that will form the basis of a more developed research plan or proposal. In collaborative projects, researchers are often looking for ways to connect with potential partners working in areas beyond established disciplinary, departmental, or institutional silos. Although many professionals involved in research often face calendars packed with networking events, meetings, and conferences designed to bring people together, using these forums to make the transition from casual points of connection to constructive interdisciplinary partnerships and shared mental models can be challenging. Additionally, residents of remote Arctic communities may not have access to or interest in the forums where researchers typically convene, raising critical equity concerns. Without access or inclusion in these spaces, the needs of researchers

are more likely to be privileged over those of Arctic rightsholders asking to be partners in research projects that affect their communities. Unfortunately, funding and other resources to help researchers travel to visit or spend time with potential community partners during the conceptualization phase of a research project can be limited. Arctic researchers are eager for solutions that make it easier to identify and engage compatible partners in an equitable and sensitive way, understand the wider landscape of research activities relevant to a research focus area, overcome communication barriers, and implement proven research conceptualization techniques.

Proposal Preparation & Submission: Proposal preparation and submission represents a unique stage of research for projects funded through competitive grant processes. A large portion of Arctic research is supported, for example, by government funding from agencies such as NSF. Unfortunately, the complexity of federal grantmaking excludes many institutions and individuals with highly specialized knowledge, expertise, and the potential to greatly enhance collaborative projects from taking part in Arctic research. Complicated research proposal submission systems and norms inherently privilege western scientific institutions of higher education. If initial funding requests are successful, ongoing grants administration and accounting burdens can also be highly involved, creating further barriers for small organizations, businesses, community partners, or other entities without dedicated grants administration support staff.

Beyond these administrative burdens, the proposal development phase of collaborative research may also escalate a number of partner development concerns. Developing contracts and agreements between institutions can be time-consuming, difficult to negotiate, and may require legal expertise. As proposal deadlines approach, last-minute collaboration requests can also overwhelm potential partners and reduce their ability to meaningfully contribute to research design, which can contribute to inequity. In the past, this has been true particularly for organizations and individuals that serve as key connection points between researchers and Arctic Indigenous communities. Rushed efforts to establish co-production partnerships may also fail to recognize that Institutional Review Board processes are unlikely to address all the questions and concerns that Indigenous or local Arctic residents may have about projects proposed to take place in their communities.

Finally, the proposal preparation phase of research also elevates a number of challenges related to ensuring the fair and equitable compensation of project contributors. Many individuals involved in both research proposal development and funded projects risk not being adequately compensated for their time. Helping a more diverse pool of applicants surmount these and other types of barriers to take part equitably in research proposal development is another important role organizations can play.

Collaboration Management: Collaboration management refers to the types of tasks and activities that enable project teams to work together effectively as complex research projects are launched and implemented. Although management of this kind is involved in all phases of research, the period of time after funding has been awarded or a project has been authorized is an important period for the development of detailed systems, tools, and communication norms that will shape the work of a collaborative research team. The role of individuals responsible for research collaboration management efforts has seen increasing levels of professionalization over the past few decades, particularly as the science-of-team science field has matured. New studies and assessments have given us a greater appreciation for the core competencies and skills required of individuals who fill these positions (Woodley et al. 2021, Veazey 2017) as well as an expanding toolkit of templates and best practices to help surmount the challenges that accompany the ongoing management of collaborative research teams. Collaboration management might include tasks such as the development of preliminary team work agreements or terms of reference, defining team roles and anticipated project outcomes, as well as the day-to-day facilitation of team meetings or online workspaces. However, the majority of principal investigators (PI) leading Arctic research collaborations are already faced with the ongoing challenge of staying informed and engaged within their own areas of disciplinary expertise. Organizations and individuals with expertise in collaboration management can aid research leaders by synthesizing lessons learned in collaboration management and working alongside them to encourage the widespread adoption of best practices.

Research Plan Implementation: Research plan implementation requires collaborative teams to successfully follow through on the team's agreed upon research design. However, even with the best laid plans, obstacles often arise. Changing policies surrounding travel and site accessibility due to the COVID-19 pandemic, for example, are rapidly evolving issues that are difficult to foresee. As research activities get underway, the intricacies of ethical data capture, management, and sharing become more prominent. Teams working with Indigenous Knowledge holders or community partners may lack familiarity with the principles of Indigenous data sovereignty, which can, at times, be very different from open science best practices. Physical scientists less familiar with the use of social science data may also find themselves overstepping ethical boundaries as they attempt to engage community partners. Researchers—particularly those new to Arctic research—may also face more general difficulties with the discovery, reuse, and interoperability of existing Arctic data. Both the need for, and incentives to, coordinate with project partners, other project teams working in the same geographic region, and local communities also become more apparent at this stage of research. Collaborative research can benefit—in all of these circumstances—from the ability to leverage wider and stronger connections to broader networks of organized people, policies, and resources.

Evaluation: During evaluation, collaborative research activities are reviewed to assess the project's findings compared to goals and objectives. Research outcomes may be reviewed by many different individuals—both internal and external to the project—using a variety of frameworks to determine merit. Personal and institutional benefit lenses are often defined by academic tenure and promotion of researchers involved in a project. Bibliometrics reflect the perceived value and utility of published research to consumers of academic literature. Funding made available by policymakers and agencies can indicate the perceived public benefit of various research topics or outcomes. Enduring partnerships between Indigenous community members and those of a research project or program might speak to beneficial partnerships built around principles of trust and reciprocity. Most mainstream research evaluation metrics do not typically provide insight, however, into the perceived quality of a collaboration—particularly from the standpoint of community partners—or explore how better ways of working together might be achieved. Additionally, what might be perceived as a benefit or positive research outcome to one group may be seen differently by another. The outreach activities and products required to demonstrate the value of a research activity can also be very different depending on the audience involved.

Translation & Use: Translation and use refers to the circulation and communication of a research project's findings and its relevance to different target audiences. Translational research—research that focuses on the transformation of basic research concepts into results that provide direct societal benefit—is a relatively new subset of applied sciences that, like convergence research and the science-of-team-science, has grown in prominence with the work of major national biomedical health initiatives and research institutes. As the field of translational research has grown, so has the promotion of solutions-oriented research within the wider research contexts, including the Arctic. Within Arctic research, local and Indigenous voices have also amplified calls to focus research investments around people living in the Arctic and their needs. Consequently, Arctic researchers from many different backgrounds and disciplines are attempting to respond. However, missteps have and continue to occur as many well-meaning researchers—many without specific expertise or training in social sciences, policymaking, public outreach, or communication—work to decipher which social needs to prioritize and how to go about transforming the results of their studies into real-world change. Arctic research teams are being called upon to become more diligent about adequately communicating their findings with local community participants and to remain sensitive to the ethical concerns surrounding the ownership and use of community-derived information. Paywalls preventing access to research published in academic journals and other barriers, which limit ongoing use of data or products by contributing community members, are issues of concern. Boundary or bridging organizations can be valuable in this translational space, working with researchers to identify and fill gaps in capacity, flagging needed course corrections, and brokering knowledge exchanges to enable research outcomes to better meet diverse user group needs.

Project Continuation or Conclusion: A final step in the evaluation of a collaborative research activity will be the decision to either conclude a team's research activities or to pursue their continuation (e.g., through a new grant proposal). Developing strong collaborative relationships is a time-intensive investment. Finding resources to sustain and grow connections beyond single grant periods or the dynamic shifts that might occur in a long-term research program's focus or leadership can also be challenging. By sustaining broader community ties and serving as long-term repositories of institutional or community memory, organizations or groups focused on collaborative management can help hold together and maintain Arctic research connections when project collaborations do end.

TABLE 3: Types of Challenges Faced at Different Stages of Research

Research Stage	Types of Challenges Faced
Conceptualization	• Institutional silos • Resource scarcity for pre-project planning & relationship development (e.g., lack of funding for personnel time or travel) • Language & communication barriers (including jargon, acronyms, definitions) • Difficulty finding collaborators (particularly from other disciplines or within communities) • Difficulty finding institutional support for centering Arctic community needs & equitable participation in research design • Difficulty knowing about all the other research that has been/is being done on a topic or in a region • Difficulty finding innovative approaches to a research topic • Difficulty selecting a compelling research problem or question • Difficulty identifying potential sources of data • Difficulty arriving at shared conceptual models of the research • Misconceptions about an individual's expertise &/or the role a collaborator will play in a project

Proposal Preparation & Submission	• Long timeframes needed to develop strong interpersonal working relationships may not be compatible with proposal development timeframes • Collaboration pressure placed on Indigenous organizations & Indigenous community liaisons during key proposal submissions windows • The complexity of establishing institutional relationships among partnering organizations (e.g., negotiating contracts or other agreements) • Inaccessible funding processes & grants management complexity • Research control board oversight or requirements that are not uniquely tailored to working with Arctic Indigenous communities • People not paid for their time (e.g., not paid for proposal writing or treated as voluntary sources of information rather than experts to be compensated for their time)
Collaboration Management	• Different perceptions of project goals &/or responsibilities • Difficulty initiating/maintaining participant buy-in • Managing team interactions across time zones & geographic dispersion • Managing personality dynamics &/or conflict • Building & maintaining trust • Different levels of skill/adoption of collaboration tools & platforms among team members • Different communication &/or learning styles among team members • Uncertainty around who is responsible for facilitation & leadership

Plan Implementation	• Uncertainty regarding the process of collaboration that should be used or followed during different stages of research • Difficulty sustaining momentum between in-person meetings of team members • Uncertainty around who is responsible for data • Lack of awareness surrounding the ethics & use of Indigenous or community data • Challenges accessing or sharing data & data interoperability • Lack of access to technologies, facilities, or field sites
Evaluation	• Different types of products desired &/or produced by different disciplines or audiences • Rules & priorities shaping tenure & promotion • The need for research investments to make a positive social impact • Competing social benefit criteria • The need to make space for Indigenous Knowledge holders & community partners to take part in evaluation processes & to influence change in future research practices
Translation & Use	• Research results not being communicated or shared in meaningful or useful ways to all project participants, community members, or relevant stakeholders • Equity issues around the ownership of Indigenous Knowledge • Misconceptions that conflate social science with outreach & communication • A failure to apply what has been learned to meeting community needs (particularly other communities beyond those involved in the original project) • Other efforts or disciplines failing to incorporate or benefit from what has been achieved or produced

Project Continuation or Conclusion	• A focus on partnerships that end after a project vs. sustained long-term partnerships • Lack of resources to maintain connections • Failure to include collaborators in decisions or plans that may impact their livelihoods • Disruptions to collaborative relationships such as those caused by individuals moving away from organizations to new career positions

Indigenous Co-Production of Knowledge (CPK)

As the Arctic research community's interest in Indigenous CPK grows, precautions are needed to ensure that the historic inequities and legacies of past colonization do not persist within current research practice. Arctic Indigenous communities are elevating the need to establish more ethical and equitable engagement practices and models for co-produced research (Inuit Circumpolar Council 2021a; 2021b; 2021c; Kawerak, Inc. 2020; Kawerak, Inc. 2021). Many other individuals, programs, and organizations have also been working to amplify this call, producing new guidelines, resources, and collaboration frameworks (Ellam Yua et al. 2021; Itchuaqiyaq 2021; Early 2021; IARPC 2018; Arctic Research Consortium of the U.S. 2021b). Efforts to center research around Arctic Indigenous values and to empower Arctic Indigenous leadership within research projects are important components in laying a foundation for greater equity and inclusion. To achieve these outcomes, however, both researchers and Indigenous community members must overcome important issues of capacity, means, and ability (Kawerak, Inc. 2021, p.30). Investments in the individuals and organizations working to bridge Indigenous and western scientific communities are needed. However, systemic barriers often prevent all but a very small handful of Indigenous community members (e.g., those who meet highly specialized criteria, such as possessing a PhD) from filling these roles. Training, compensating, and including more Indigenous facilitators in Arctic research activities would be beneficial to assist with expanding the use of CPK frameworks, providing cultural competency training, and developing more meaningful Arctic Indigenous engagement in research. Organizations have an important role to play in listening to, respecting, and leveraging the efforts of Arctic Indigenous-led efforts to empower their own communities and to influence the Arctic research outcomes that impact their people, lands, and traditions.

Additional Challenges Related to CPK

• Overburdened contacts in roles that bridge scientific and Indigenous communities
• The difficulty of increasing trainings for researchers on how to respectfully collaborate with Indigenous communities
• Indigenous Peoples experience ongoing legacies & reenactments of colonialism.
• Inappropriate assumptions that individual Alaskan Native community members can speak for a whole tribe or community
• Different perspectives and tensions around whose voices/needs should center a project (e.g., Indigenous communities where Arctic research takes place vs. broader non-Arctic audiences)
• Researchers failing to learn about the needs of the communities they are trying to engage
• Individuals lacking cultural competency or cultural humility
• Research findings or benefits not shared with community participants
• Insufficient research co-production mentorship and/or training opportunities for students and early-career researchers

Diversity, Equity, Inclusion, & Belonging

Many systemic institutional and societal barriers prevent and disrupt diversity, equity, inclusion, and belonging progress in Arctic research. From institutionalized racial discrimination in higher education admissions, to meritocracy norms that exclude the 98% of the world's population without PhDs from filling certain types of research functions or roles, huge challenges persist even within organizations and teams strongly committed to the advancement of diversity, equity, inclusion, and belonging. Research support organizations have an important role to play in identifying these barriers and working across multiple scales—individual, team, institutional, societal—to call out and correct discrimination and injustice in both current and historic practice, at the same time creating positive and constructive spaces for new norms to emerge and flourish.

Additional Challenges Related to Diversity, Equity, Inclusion, & Belonging

- Institutionalized inequities
- Power imbalances
- Bias blind spots
- Uncertainty around who has the responsibility to try to ensure equitable outcomes within a group
- Gender roles and other "social lenses" that presume which role(s) a person will play
- PhDs as implicit or explicit exclusionary criteria for collaborative research participation or leadership
- Feeling separate from others due to personal history or experiences
- The complex role personal identity plays in conflicting worldviews
- Different culture-based values and/or perceptions of morality

4.   COMMITTEE RECOMMENDATIONS

This section of the report outlines the ARCUS Interdisciplinary Research Committee member recommendations for addressing collaborative research challenges. In Table 4, general recommendations have been grouped by challenge types (e.g., Individual, Institutional, etc.) that also identify the audience or actor to which the recommendation might apply. Table 5 provides a synthesized list of actions that the committee specifically encourages ARCUS and other Arctic research support organizations to take as a way to help improve the practice of Arctic research collaboration. Finally—because management and facilitation are both viewed as critical components of collaborative work—an outline of some of the management and facilitation techniques employed with the ARCUS Interdisciplinary Research Committee is shared to provide practical examples of tools and techniques that might be employed with future teams.

TABLE 4: Recommendations for Overcoming Collaborative Research Challenges

Challenge Type	Recommendations
Individual Examples of where challenges might be experienced: • Project leaders • PIs or CoPIs • Facilitators • Students • Science team managers • Local Arctic community members • Arctic Indigenous community members • Liaisons between non-Indigenous and Indigenous collaborators/communities • Volunteers • Research participants	• Use regular reflection processes during & at the end of activities to help improve & refine future plans. • Think of the research space critically & work with others to advocate for the values, norms, or systemic changes needed to support & sustain a more inclusive & collaborative Arctic research community. • Identify your own biases and "lenses" ahead of time. Recognize them, and work on not letting them control your actions or those of the group. • Include a few sentences on your own background & experience within papers. • Be aware of & sensitive to the impact or potential impact of your Arctic research on others.

Interpersonal	• Create a collaboration plan &/or terms of reference document that outlines how collaborators will work together & ensure it is followed consistently.
Examples of where challenges might be experienced:	• Be explicit about the different motivations driving the research collaboration & the potential impact of motivational differences on project outcomes & results.
• Teams	• Include guidance for diversity, equity, inclusion, & belonging in the collaboration plan.
• Partners	• Build listening sessions into meetings that give participants equal space to contribute.
• Consortia	• Within papers and before presentations, explain the roles that different people played in the research process.
• Networks	• Clearly identify & articulate participant roles, responsibility, & authorities.
• Associations	• Rely on & make use of effective facilitators from the beginning & ensure facilitators are skilled with:
• Local Arctic communities	- a deep understanding of people
• Arctic Indigenous communities	- experience & skill in nurturing conversations across knowledge systems
	- the ability to balance egos & ensure everyone has an equal voice
	- the diplomacy skills to support the representation of all parties in the development of the collaboration
	• Define goals for project groups & provide monitoring & measure progress toward results.
	• Address simpler problems first to help establish trust & develop communications before tackling larger & more complex problems.
	• Build teams between partners who are capable of seeing each other as equals.
	• For project leaders, resist the urge to "take over" and make decisions on behalf of the group; help promote group co-facilitation instead.
	• Ask questions.
	• Ensure staffing & tools exist to help improve communications across disciplines & knowledge systems.

Intercultural	• Use a co-production framework in the design of collaborative research (e.g., Ellam Yua et al. 2021).
Examples of where challenges might be experienced: • Working across knowledge systems • Working with Indigenous communities • Working with partners from other cultural backgrounds • Working with international partners NOTE: The recommendations included here are largely focused on intercultural collaborations between non-Indigenous and Arctic Indigenous collaborators. The committee did not focus on developing additional recommendations for other types of intercultural collaboration.	• Consult resources developed by Indigenous organizations such as Kawerak & the Inuit Circumpolar Council on appropriate ways to conduct research in Indigenous communities. (e.g., Inuit Circumpolar Council. 2021c, Kawerak Inc. 2021). • Support the creation/certified training of more facilitators. • Help researchers find Alaska Native consultants/ facilitators. • Focus on developing relationships to a sufficient level of trust & understanding—including cultural understanding—to support strong collaborative projects. • Encourage respectful long-term relationship development between graduate students & Arctic Indigenous community members. • Respect the time & contributions of Indigenous experts & community partners & pay them appropriately for their contributions. • Involve communities in both the development of research questions & in the writing & distribution of research products. • Cease the tokenization of Indigenous individuals involved in research efforts. • Center research around Indigenous people & the needs of Arctic communities. • Build time and training into research grant proposals to allow Arctic communities to participate in meaningful ways & give feedback that can be acted upon. • Call attention to research that has been funded that isn't appropriate (e.g., Indigenous knowledge projects without Indigenous knowledge holders on their teams). • Go beyond academic voices when communicating about Arctic research.

Interdisciplinary Examples of where challenges might be experienced: • Working across disciplines	• Help identify individuals with different disciplinary & collaborative skills & promote activities that bring potential collaborators together with the right mix of expertise. • Be open to approaching questions, research challenges, & ideas from different perspectives. • Encourage a flat hierarchy among the disciplines. • Use examples, illustrations, & more plain language to help others learn and understand about issues. • Support efforts to identify & help overcome the unique challenges of working across social & natural science disciplines.
Institutional Examples of where challenges might be experienced: • Universities • Secretariats • Institutes • Non-Profits • Businesses • Funders • Indigenous organizations • K-12 Schools • Other types of organizations involved in research	• Discourage "parachute science" (e.g., science conducted by non-local researchers who visit field sites solely to gather data & then depart without engaging with local community members). • Recognize the importance & value of funding people's time to establish & maintain collaborative relationships. • Carefully consider how context and institutional structures shape the construction of knowledge. (e.g., how does a funder's call for proposals prioritize academic vs. local community concerns). • Create more opportunities for people with similar interests to come together to talk, learn, & listen without already having a research topic or proposal idea in hand. • Make Arctic research funding processes more accessible for less established organizations, individuals, & tribes. • Consider the benefit that "Science of Team Science" programs within organizations like the NSF might bring (National Research Council 2015). • Encourage research that solves problems & helps people. • Despite a growing focus on collaborative projects, continue to make room for focused disciplinary research, when appropriate.

Infrastructure & Data Examples of where challenges might be experienced: • Technology • Data management • Data use • Collaboration workspaces	• Help teams with the identification of existing data. • Provide accessible platforms & virtual collaboration tools for team members to interact. • Make research products more accessible, open, & discoverable.

Suggested Actions to Build Arctic Research Collaboration Capacity

The ARCUS Interdisciplinary Research Committee also developed recommendations for practical actions in four key areas: Resource Development, Training, Facilitation, and Information Exchange. These investment areas represent a core set of practical activities that can be undertaken by research support organizations over the next 3–5 year period to enact the broader recommendations described above.

TABLE 5: Suggested Actions to Build Arctic Research Collaboration Capacity

Action Type	Suggested Actions
Resource Development	• Develop and/or compile "how to" guides for interdisciplinary workshops & conference panels. • Develop and/or compile "how to" guides to help collaborators overcome the challenges of project conceptualization (e.g., collaboration plan templates, tools for developing shared conceptual models, sample agendas for research collaboration workshops, etc). • Develop &/or compile guides for embedding diversity, equity, and inclusion principles in collaborative research. • Create a reference library of example collaboration contracts, and group conduct agreements. • Compile successful collaborative research examples.

Training	• Feature talks/lectures from accomplished team science researchers & practitioners. • Host workshops on working with Arctic Indigenous communities. • Promote trainings with residency or visitor exchange components to help build relationships. • Help people access guidance for data sharing & use (e.g., FAIR & CARE data principles). • Host trainings for Arctic communities wanting to start & lead their own research projects. • Host trainings on collaborative research proposal development. • Provide coaching on collaborative & co-produced research for early career researcher cohorts.
Facilitation	• Support the development & use of more Indigenous facilitators. • Compile a directory of facilitators who can assist with Arctic community engagement. • Foster an Arctic research facilitator network. • Assist with introductions between different kinds of experts.
Information Exchange	• Communicate to funders and other relevant partners the collaborative research challenges expressed by the Arctic research community & recommendations for addressing them. • Host interdisciplinary Arctic research conferences, workshops, & networking events. • Develop accessible virtual communication platforms to help people connect.

Management & Facilitation: ARCUS Interdisciplinary Committee Examples

The management and facilitation of the ARCUS Interdisciplinary Research Committee provides a small case study of research collaboration in practice. Outlined below are examples of various techniques employed to help the group successfully and collegially work together to achieve its goals.

Collaborative Leadership Structure & Focus: ARCUS leadership approved the formation of the ad-hoc ARCUS Interdisciplinary Research Collaboration committee based on ongoing discussions and outcomes from the 2020 ARCUS Annual Meeting, where the majority of meeting attendees elected to join breakout group discussions focused on the theme of interdisciplinary collaboration. A charge for the committee was developed and approved by the ARCUS Board of Directors outlining the committee's goals, timeline, leadership structure, and criteria for member participation (including eligibility to serve and criteria for remaining in good standing). A Co-Chair leadership structure was adopted that brought together an established ARCUS Board

Member and another volunteer researcher who expressed interest in staying engaged with ARCUS around this topic at the ARCUS Annual Meeting. Committee Co-Chairs were supported in their collaborative leadership and facilitation of the group by the ARCUS Executive Director and two project support staff. Regular planning meetings were held by the Co-Chairs and staff 1–2 weeks prior to each committee meeting to set the committee agenda, prepare meeting documents/materials, and discuss facilitation plans. These planning discussions focused on making sure meeting agendas aligned with desired committee outcomes, ensuring committee efforts progressed from one meeting to the next, utilizing activities that engaged different learning and communication styles, addressing issues of dissent or uncertainty, identifying when check-ins with individual members prior to full committee discussions were needed, and exploring other opportunities to be adaptive and responsive to committee feedback.

Member Nominations & Selection: ARCUS staff released an open call for committee member nominations (including self-nominations), advertising the opportunity through channels regularly used by ARCUS for other Arctic research community news and outreach efforts. The primary audience for the call for nominations was ARCUS individual members, those based at ARCUS institutional member organizations, and key partner organizations. A total of 24 nominations were received and reviewed by committee staff and co-chairs. A total of eleven committee members from the applicant pool were selected to balance diverse disciplinary focus areas, institutional affiliations, and career levels. Because many strong nominations were received and the ad-hoc committee scope was constrained to only 5–6 meetings total, the committee staff and co-leads agreed to constrain membership invitations to those who were self-nominated. Only one Arctic Indigenous community member and one non-Native employee of an Arctic Indigenous organization were represented in the applicant pool and both were invited to join. The committee leadership team recognizes and acknowledges that greater racial and ethnic diversity should have been pursued through a more targeted committee nomination or outreach process.

Stipends: All invited committee members were informed that stipends of $500 were available upon request to support their active participation in the committee. Contracts outlining conditions of payment and providing payment method details were reviewed and signed by each committee member who made this request.

Dialogue Agreements: The committee agreed to the adoption and use of the First Alaskans Institute Dialogue Agreements to help set the tone and guidelines for the conversations the group hoped to stimulate and encourage.

Virtual Meeting Facilitation: The committee co-chairs led facilitation, with support from ARCUS staff. Committee meetings were held via Zoom. Use of video in the meetings was not required, however, co-chairs and ARCUS staff modeled the use of video and did rely on it to read participant expressions and other cues, such as raised

hands. Having multiple people tasked with watching for and responding to these kinds of signals, as well as monitoring Zoom chat comments, gave the main facilitator more flexibility to focus on discussion content. Liberal use of participant chat was encouraged, with facilitators inviting committee members to provide further verbal comment on important or complex ideas. This technique worked well as a way to help bring more members of the small group into the conversation. The Zoom meetings were recorded for the sole purpose of note-taking. The intention to record and its purpose was articulated at the beginning of each meeting.

Writing Prompts: Recognizing the role that different personalities and communication styles play in the dynamics of group conversation, intentional time was built into each committee meeting agenda to allow time for individual written reflection. Question prompts were introduced briefly by committee co-chairs and participants were then asked to take 5–10 minutes to provide a written response. At the end of the timed period, typed responses were shared with other participants via Zoom chat. A few minutes were then allotted to each participant to provide further verbal comments or explanation around their remarks. This exercise helped establish a comfortable and predictable routine that allowed for all committee voices and perspectives to be heard from at each meeting. Prompted by a desire to ensure that the valuable group meeting time was being maximized, the co-chairs and staff also experimented with inviting committee members to provide written input to question prompts via email or in shared google docs between groups meeting. However, these requests typically resulted in fewer responses, which worked against the intended outcome of providing space for all group members to contribute.

End-of-Meeting Reflections: Time was reserved at the end of each committee meeting for round-robin reflections. Each meeting participant was called on by a committee co-chair to offer a few personal thoughts or reflections on their experience during the day's conversation. These reflections offered guidance on how to improve future meetings, provided additional insight into an individual's personal experience or response to an issue or topic, and helped to identify questions that needed additional input or clarification. This exercise became a helpful tool for informing the adaptive management of the committee.

Small Group Work: Small group breakouts were regularly employed during committee meetings, with group sizes of 5–6 people. Groups were pre-assigned in early committee meetings as committee members were still getting to know one another and group discussions were focused on the same topics. Pre-assignments were focused on bringing a balance of perspectives and communication styles to each of the smaller groups. In later meetings, committee members were invited to choose their own small group assignment based on an individual's discussion topic preferences. Committee co-chairs and staff members were also present to facilitate, encourage, and document each small group's efforts.

Concept Mapping: The committee utilized Google Jamboard (https://jamboard.google.com) to help visualize and organize ideas. The suggestion to develop the visual as well as the proposed use of the Jamboard tool were provided by two different small group members during a breakout session and was not planned in advance. Because the individual who suggested using Jamboard was also willing to set up a workspace and guide others around its use, the tool was quickly put to use in the middle of a small group discussion. Committee staff members were then able to help refine the Jamboard design and framework between committee meetings, drawing in additional ideas from prior committee meeting discussion notes. The concept map became a useful reference tool for the full committee in future meetings, helping to provide added focus and a shared sense of progress.

Figure 2: Jamboard concept map used by the ARCUS Interdisciplinary Research Committee to capture and organize collaborative research challenges.

Committee Wrap-Up & Launch of New Efforts: The ARCUS Interdisciplinary Committee was intentionally designed to have a limited duration. After accomplishing the set of goals outlined in the committee charge, the committee as a whole concluded its efforts. This was done to help make the initial volunteer commitment to serve on the committee more manageable for the busy professionals involved. It also anticipated the likelihood that some committee members would be more interested than others in continuing to develop certain ideas or implementing different committee recommendations. In this way, the end of the initial committee's work now serves as a launch point for new projects and products catalyzed by the ongoing interest, energy, and leadership efforts of individual committee members. These new efforts will, in turn, help to expand opportunities for collaboration within the wider Arctic research community.

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Additional Resources

Collaborative Arctic Research Bibliography: This bibliography includes references initially compiled for a workshop on interdisciplinary Arctic change research hosted by UC Irvine in 2019. The bibliography was expanded further and used for an Arctic research collaboration workshop co-hosted by UC Irvine, the Arctic Research Consortium of the U.S. (ARCUS), and Interagency Arctic Research Policy Committee (IARPC) in 2021: https://www.arcus.org/files/meeting/presentations/arctic_change_workshop-list_of_resources-august_2021.pdf