Working Group for the Development of Guidance for Culturally Responsive K-12 Outreach by Marine Researchers

Resources for Background and Context

Background/History of Alaska Native Education in Alaska

Barnhardt, C. 2011. A History of Schooling for Alaska Native People. *Journal of American Indian Education* 40(1). http://www.ankn.uaf.edu/Curriculum/Articles/CarolBarnhardt/HistoryofSchooling.html
A review of significant historical events and trends that have helped to shape the policies and practices of education in Alaska, particularly those that have most directly impacted the schooling of Alaska Native people. The following information is provided: (1) an overview of the Alaska context; (2) a review of federal policies that have directly affected education in Alaska; and (3) a historical analysis of the evolution of schooling for Alaska Native people, including the development of a dual federal/territorial system of schools, and the initiation of a range of federal and state reform efforts. The status of schooling in Alaska (as of 1998) is briefly described. (Abstract)

McDowell Group. 2001. Alaska Native Education Study: A study of statewide Alaska Native values and opinions concerning education in Alaska. Report prepared for First Alaskans Foundation.
http://www.alaskool.org/native_ed/McDowell.pdf
The report includes a literature review on Alaska Native and American Indian education and the results of interviews of Alaska Native educational and cultural experts, an Alaska Native Household education survey, and focus groups on issues affecting Alaska Native education. The impacts of an initial federal policy of assimilation of Alaska Native students into mainstream culture has had long-lasting impacts.

Okakok, L. 1989. Serving the Purpose of Education. Originally published in the Harvard Educational Review, 59(4). Reprinted in *Alaska Native Education-Views from Within*. R. Barnhardt, ed. Pp. 99-118.
Analysis of the differences between the Northwest Alaska Inupiat and the Western worldviews with a discussion about the history of Western culture's influence on her own culture. The author explains why the Native school board has taken full control of the educational system and the Inupiat's struggle to preserve their language adapt a foreign educational system to contemporary Inupiat culture (which accommodates both Western institutions and a traditional, subsistence-based lifestyle. (Abstract).

Decolonization of education report

Outcomes of Culturally Responsive Education for Alaska Native Students

Alaska Rural Systemic Initiative (AKRSI). 2006. Final Report, Phase II, 2000-2005. Submitted to the National Science Foundation.
The project activities rotated across Alaska's five cultural regions each year, focusing on particular domains with five crosscutting themes: 1) documenting cultural/scientific knowledge; 2) Indigenous teaching practices; 3) standards/culturally-based curriculum; 4) teacher support systems; and 5) culturally-appropriate assessment practices. The pedagogical approach of the project was place-based,

hands-on and inquiry-based and addressed the issues associated with converging knowledge systems in a comprehensive, in-depth way. New models emerged for culturally responsive science fairs, in partnership with the American Indian Society of Science and Engineering (AISES), for science-culture camps, and for cultural orientations for new teachers. Native educator organizations were formed in each region. Project results demonstrated measurable impacts in the participating districts. Student scores on standardized science and math test scores increased, dropout rates decreased, and the number of Native students attending college and the number of Native students choosing to pursue studies in fields of science, math, and engineering increased.

_____. 2004. Culture, Chaos and Complexity: Catalysts for change in Indigenous education. ***Cultural Survival Quarterly*** **27(4): 59-64.**
Reflections on the AKRSI as a model for culturally responsive, place-based science and math education. In addition to the academic measures of success, the authors reported that: 1) students spent more time out in the community with elders, parents, and local experts; 2) school curricula reflected the knowledge, values, and practices that were a traditional part of life in the local communities; and 3) teachers incorporated a more place-based pedagogy that engaged students in studies associated with the surrounding physical and cultural environment. The authors described a "paradigm shift" underway in which Indigenous knowledge and ways of knowing are recognized as constituting complex knowledge systems with an adaptive integrity of their own.

Boyer, P. 2001. ***Alaska: Rebuilding Native Knowledge in Building Community: Reforming math and science education in rural schools*****. Washington, D.C.: National Science Foundation.**
Report on the AKRSI in the context of other Rural Systemic Initiatives.

McDowell Group. 2001. Alaska Native Education Study, McDowell Group report prepared for First Alaskans Foundation. http://www.alaskool.org/native_ed/McDowell.pdf
A literature review of Alaska Native and American Indian education concluded that "academic programs that honor both Native culture and language appear to be successful in improving academic achievement. . . American Indian/Alaska Native students perform competently and have a better understanding of mathematics and science when the curriculum integrates Native and Western knowledge systems."

Riha, D. 2019. It's time to make a real investment in culturally responsive education. ***Anchorage Daily News*****. 4/30/19.** https://www.adn.com/opinions/2019/04/30/its-time-to-make-a-real-investment-in-culturally-responsive-education/
An opinion piece by a teacher in the Alaska Native Cultural Charter School about "the transformational experience that culturally sensitive curricula can provide for Anchorage's Native students." The author advocates for Alaskans to recognize the importance of investing in education that prioritizes culturally sensitive curricula, preserves Alaska's history and ensures that educational experiences are being provided that speaks to all of Alaska's student populations.

Teaching Strategies and Indigenous Students as Learners

Barnhardt, R. 2007. Creating a Place for Indigenous Knowledge in Education: The Alaska Native Knowledge Network. In ***Place-Based Education in the Global Age: Local Diversity*****. Greg Smith and David Gruenwald, eds. Hillsdale, NJ: Lawrence Erlbaum Associates.**
Review of the AKRSI project as a process of reintegration of Native knowledge into school curricula as a basis for connecting what students learn in school with life out of school. The AKRSI was based on a

"pedagogy of place" that shifted emphasis from teaching about local culture to teaching through the culture. The primary vehicle for promoting experiential, inquiry-based pedagogy was the development of curriculum materials that guided teachers into the use of the local environment and cultural resources as a foundation for all learning. The article also describes the roles of local Elders, cultural atlases, traditional values, cultural immersion camps for new teachers, experiential learning, culturally responsive science fairs, the Alaska Native Knowledge Network as a clearinghouse and database, and cultural standards.

Hammond, Z. 2016. Culturally Responsive Teaching and the Brain. Teacher's Voice blog. Posted October 20, 2016. https://www.teachingchannel.org/blog/2016/10/20/crt-the-brain
The author of the book *Culturally Responsive Teaching and the Brain* compares and contrasts culturally responsive education with multicultural education and social justice education. Culturally responsive education focuses on improving the learning capacity of diverse students who have been marginalized educationally, centers around the affective and cognitive aspects of teaching and learning, and concerns itself with building resilience and academic mindset by pushing back on dominant narratives. The author emphasizes that it is a mindset rather than a program or set of strategies which requires teachers to "de-bias" their intentions (i.e., acknowledge their own unconscious biases), their attention (become aware of triggers of stereotypical responses and assumptions), and to take the time to practice new strategies and break automatic associations.

Jones, A.J. n.d. Research on Motivational Factors Contributing to Alaska Native Student Success in Secondary Schools: The Drop out Issue. PowerPoint presentation uploaded on September 12, 2014. https://www.slideserve.com/fayola/alberta-jones-juneau-school-district-university-of-alaska-southeast-research-project
In addition to the conclusions of the study described below, the author emphasized "real life situation learning and learning about their environment motivates Alaska Native students." She also highlighted rigor, relevance, relationships, and the resilience of the students as important to the academic success of Alaska Native students.

_____. 2006. Research on Motivational Factors That Lead to Success of Alaska Native Students In Middle School and High School Master of Education Final Research Project Ed. 698 Juneau: University of Alaska Southeast Juneau.
http://ankn.uaf.edu/Curriculum/Masters_Projects/AlbertaJones/Jones_MastersThesis.pdf
Results of a survey of Alaska Native middle and high school students. The author concluded that the relationships between teachers and their students were the key factor to success of Alaska Native students. The common, effective teaching strategies that emerged from the interviews were cooperative learning group activities, hands-on activities, visual examples, clarity of instruction when explaining lessons, helping students, and giving student choice and freedom. Another result from the interviews was that students preferred participant structures of small group learning and one-on-one work with teachers and peers. "

Kasun, S.G. and D. López. 2017. Native Science in Practice: Cases for broadening understanding. *Journal of Multicultural Affairs* (2)1: Article 6. Web-published by SFA ScholarWorks.
https://pdfs.semanticscholar.org/71d6/a83dd1c78cbc0b8fa2ca762743e39b181e66.pdf
This case study approach to evaluate the success of various approaches included three Alaska case studies: 1) the Ya Ne Dah Ah School curriculum; 2) a Bioexploratory program focused on local knowledge of medicinal plants and bioassays in multiple sites in Alaska and North Dakota; and 3) the Alaska Onward to Excellence (AOTE) program in seven rural Alaskan communities where the majority of students were Alaska Native. Their conclusions reinforced those of Cajete (2000) that when teaching science in the classroom, the teacher should first introduce concepts through cultural approaches that resonated with Native science and its emphasis on the interconnectedness of all things. The programs

selected as case studies also shared an emphasis on engaging the local community and "meticulously" engaging community resources. Hands-on exploratory learning and intergenerational transfer of knowledge were key aspects of what the authors termed "Native science." Linkage between hands-on methods and the cultural significance engaged students in learning new scientific concepts within the context of their own culture.

McDowell Group. 2001. Alaska Native Education Study: A study of statewide Alaska Native values and opinions concerning education in Alaska Report prepared for First Alaskans Foundation. **http://www.alaskool.org/native_ed/McDowell.pdf**
The literature review on Alaska Native and American Indian education included a focus on the potential incompatibilities between American Indian/Alaska Native learning styles and standard Western educational curriculum and teaching styles. Researchers in this area focused on thinking processes, active learning, and group dynamic issues as potential barriers to academic success of indigenous students. Some researchers, however, researchers cautioned against over-generalization across diverse indigenous cultures that lead to "stereotypic notions" and ignoring individual differences and different cultural norms.

Native Science/Indigenous Ways of Knowing

Cajete, G. 2000. ***Native Science: Natural laws of interdependence.*** **Santa Fe, NM: Clear Light Publishers.** (Referenced in Kasun and Lopez 2017 – see below)

Kawagley, A.O. and R. Barnhardt. 1998. Education Indigenous to Place: Western Science Meets Native Reality. http://www.ankn.uaf.edu/curriculum/Articles/BarnhardtKawagley/EIP.html
Description of Indigenous knowledge systems and a comparison of the characteristics of Indigenous and Western worldviews as well as the common ground between the worldviews. The Indigenous implications to a pedagogy of place are described. Four concepts in the indigenous worldview are highlighted as contributions to ecological understanding with educational applications: long-term perspective, interconnectedness of all things, adaptation to change and commitment to the commons. The article also emphasizes that an examination of educational issues in indigenous settings requires a consideration of the cultural and historical context, particularly in terms of who is determining what the rules of engagement are to be, and how those rules are to be implemented.

_____., D. Norris-Tull, and R.A. Norris-Tull. 1998. The Indigenous Worldview of Yupiaq Culture: Its scientific nature and relevance to the practice and teaching of science. ***J Res Sci Teach*** **35: 133-144.** http://ankn.uaf.edu/Curriculum/Articles/KawagleyNorrisTull/YupiaqCulture.html
Is science an invention of European thought, or have legitimate scientific bodies of knowledge and scientific ways of thinking emerged separately in other cultures? Can Indigenous knowledge systems contribute to contemporary science teaching? Here we describe evidence from the Yupiaq culture in southwestern Alaska that demonstrates a body of scientific knowledge and epistemology that differs from that of Western science. We contend that drawing from Yupiaq culture, knowledge, and epistemology can provide not only a more culturally relevant frame of reference for teaching science concepts to Yupiaq students, but also a potentially valuable context for more effectively addressing many of the recommendations of U.S. science education reform initiatives. (Abstract)

Kim, E-J. A., A. Asghar, and S. Jordan. 2017. A Critical Review of Traditional Ecological Knowledge (TEK) in Science Education. Canadian Journal of Science, Mathematics and Technology Education. DOI: 10.1080/14926156.2017.1380866
https://doi.org/10.1080/14926156.2017.1380866

What is traditional ecological knowledge? In many disciplines, including science education, anthropology, and resource management, it has been conflated with Indigenous knowledges, which has contributed to misunderstandings. This article explores the history of traditional ecological knowledge and examines its contemporary conceptualizations in science education. We argue that traditional ecological knowledge and Indigenous knowledges are distinct, emphasizing that traditional ecological knowledge is a form of cultural and intellectual appropriation that modifies Indigenous knowledges to better fit a conventional Western modern science framework. Our article explores how contemporary understandings of traditional ecological knowledge have shaped the development of science education curricula. (Abstract)

Culturally Responsive Curriculum

North Slope Borough School District. Inupiaq Learning Framework.
https://www.nsbsd.org/Page/4542
Adopted by the Board of Education in 2010, the Iñupiaq Learning Framework (ILF) is the foundation upon which the North Slope Borough School District is articulating the curriculum. They have developed a variety of culture-based educational materials and resources, including books.

Markham, L. 2017. Our School. *Orion Magazine*. https://orionmagazine.org/article/our-school/
The article describes culturally responsive teaching in the North Slope Borough School District. The integration of science activities in the 5th grade interdisciplinary Immiuġnik: Finding Winter Water unit is featured.

Murphy, Bree. Culture Camp: Examining the convergence of Traditional Knowledge and Western Science in Seldovia, Alaska. M.S. Project, UC Davis. M.S. Thesis available through ResearchGate.
Results of a participatory action research project on the type of learning and teaching at the convergence of TK and Western that occurred at a culture camp. The participants identified what was at this convergence as: 1) respect, sharing, and open-mindedness as habits of mind (values); 2) knowledge of medicinal and edible plants and animal habitats and behavior; and 3) the historical, social, and cultural context of Seldovia's history, personal identity, and prior relationships with the scientific community. The author concluded that the culture camp allowed a unique and open environment for scientists, Elders, and community members to share, interact, and share knowledge about the environment.

Stephens, S. 2000. Handbook for Culturally Responsive Science Curriculum. Fairbanks, Alaskan Native Knowledge Network. http://www.ankn.uaf.edu/handbook/.
This handbook is an outcome of the AKRSI project that describes the characteristics of culturally responsive science curricula and the strengths of their use, provides the "Venn diagram" model of overlaps between Traditional Native Knowledge and Western Science, and provides guidance for the development of standards-based curriculum that correlates local knowledge with science standards. The handbook also looks at the relationship between the Learning Cycle Model for science education and Native ways of teaching and learning, particularly at the different methods of sharing knowledge and methods of authentic assessment of knowledge and skills. "In other words, if we truly value student growth and understanding of cultural knowledge, then we must find ways to assess such knowledge and we must resist the temptation to merely treat cultural knowledge as a vehicle for science learning." "Promising assessment strategies" for traditional assessment and inquiry assessment, along with compatible assessment strategies, are highlighted. The handbook includes an ASRSI unit building assessment rubric and a sample primary unit on lure construction and ice fishing with Elder involvement. This sample unit includes activities on "observing locally" and "connecting globally" as well as a rubric

for design of local projects that have subsequently been more fully developed through the approaches of the GLOBE and SIGNs projects to climate change education.

Participation in Research and Monitoring by Indigenous Communities and Indigenous Youth

Davis-Chavez, D.M. and M.C. Gavin. 2018. A global assessment of Indigenous community engagement in climate research. *Environ. Res. Lett.* 13. https://iopscience.iop.org/article/10.1088/1748-9326/aaf300
A comprehensive and systematic review of climate research projects that were inclusive of Indigenous community's participation and decision-making in all stages of the research process and also that accessed Indigenous knowledge. The highest levels of Indigenous community participation reported in the scientific literature were concentrated in northern Canada and Alaska. Despite the quantity of participation, however, the review concluded that climate researchers, in general, were not fully engaging Indigenous communities appropriately in decision-making about the use of their Indigenous knowledge and returning results of the research to the communities. "The vast majority of climate studies (87%) were still practicing an extractive model in which outside researchers use Indigenous knowledge systems with minimal participation or decision-making authority from communities who hold them. Few studies report on outputs that directly serve Indigenous communities, ethical guidelines for research practice, or providing Indigenous community access to findings." Studies that had been initiated *with* (through mutual agreement between outside researchers and Indigenous communities) and *by* Indigenous community members, however, provided examples of more responsible community engagement related to accessing Indigenous knowledge than studies initiated by outside researchers.

Inuit Circumpolar Council (ICC). 2016. Coastal Monitoring Indigenous Knowledge Holders Meeting Report, Ottawa, Canada, February 29, 2016.
Indigenous participants discussed the threats to biodiversity within their given regions, changes occurring; ways that Indigenous Knowledge (IK) directs daily monitoring activities; challenges and potential solutions for the inclusion of IK with the Circumpolar Environmental Monitoring Program (CEMG), monitoring priorities and IK approaches to monitoring. The largest point raised continuously throughout the IK holder and the CEMG workshops is the need for trust and respect. Participants expressed the need to engage youth in monitoring, identify parameters and attributes through both IK and science (i.e. taste, smell, weight, etc.), monitor through a food security lens/approach, and ensure that information addresses community-driven concerns.

Raymond-Yakoubian, B. and J. Raymond-Yakoubian. Research Processes and Indigenous Communities in Western Alaska: Workshop Report. Kawerak, Inc. Social Service Program Report to the National Science Foundation for Award 1624041. https://kawerak.org/wp-content/uploads/2018/04/Research-Processes-and-Indigenous-Communities-in-Western-Alaska-Workshop-Report.pdf
Report on a workshop in Nome to discuss the impacts of research on Indigenous communities in the region and community relationships with researchers. The authors reported that research in western Alaska with community effects has increased dramatically in recent years (e.g. through increased research on climate change, vessel traffic, fisheries, infrastructure needs, and resource development). It appears to have become a significant and regular part of the 'seasonal round' in the region's Indigenous communities. They also noted other aspects of researcher and community relationships: "Communities have increasingly expressed interest in participating in all aspects of the research process, from helping to set research priorities to providing Traditional Knowledge (TK) to contribute independently of and in concert with scientific inquiries. . . . Aspects of the phenomena of 'research fatigue' in communities is also being more broadly recognized as something requiring consideration."

Sigman, M., ed. 2015. *Community-Based Monitoring of Alaska's Coastal and Ocean Environment: Best practices for linking Alaska citizens with science.* Fairbanks: Alaska Sea Grant.
https://seagrant.uaf.edu/bookstore/pubs/SG-ED-78.html
A handbook based on a statewide workshop with participation by more than 100 practitioners of community-based observing and monitoring programs from 34 Alaska communities and in Canada and Kamchatka. One of the "best practices" that emerged was the engagement of youth. Best practices also include ones for projects designed to engage K-12 audience and Alaska Native communities and guidelines for the incorporation of traditional knowledge (adapted from ones developed by the Alaska Native Science Commission and the Inuit Circumpolar Council). The need for two-way communication is emphasized at every stage of the design and implementation of CBM projects and programs.

Spellman, K.V., E.B. Sparrow, M.J. Chase, A. Larsen, and K. Keally. 2018. Connected Climate Change Learning through Citizen Science: An assessment of priorities and needs of formal and informal educators and community members in Alaska. *Connected Science Learning: Linking In-School an Out-of-School STEM Learning*. Issue 6. Diversity and Equity.
csl.nsta.org/2018/05/connected-climate-change-learning-through-citizen-science/
The article links needs assessments for climate change education to be taught and communicated by teachers, informal educators, and community members in Alaska rural and indigenous communities to the design of a "Climate Change in Your Community" workshop that culminates in teacher-community member partnerships to participate in citizen science projects relevant to local community issues. (The compilation of needs assessments includes the one by Anderson and Plude 2010 – see below.)

Culturally Responsive Marine Education

Anderson, A.V. and D. Plude. 2010. Needs Assessment of Alaska Teachers. Web-published report. COSEE Alaska. http://www.coseealaska.net/files/alaska/FinalAKNeedsAssessment.pdf
The results of a large-scale survey study co-sponsored by the COSEE Alaska project and IARC of 151 Alaska teachers to assess what was needed to support teaching about both climate change and marine environments. Teachers expressed their highest needs for instructional materials to be Alaska-specific lessons aligned with standards, issue-oriented curricular units, and media. In terms of teaching support, the highest need was for field trips led by scientists (highest ranked by both urban and rural teachers). The highest priority for online resources needs (listed by all grade levels and across settings of having virtual field trips with scientists in the field or in the lab. Overall, teachers said they needed teaching strategies about climate change and marine education as highest priority, followed by how to integrate Alaska Native knowledge.

Apple, J., S. Pavlik, and J. Green. 2011. Sense of Place and Perspective: Incorporating Native and Western approaches in marine science education. Presentation at the Salish Sea Ecosystem Conference, Vancouver, BC, October 25-17, 2011.
The authors in a partnership between an Indian university and a state university in western Washington State characterized the motives of western marine scientists as multiple and complex. They distinguished between "true collaborations motivated by seeking solutions to common problems or understanding large-scale phenomena for which each group has unique and important insight and an intrinsic, more philanthropic and inclusive approach to education and science, motivated by the fact that Native students are one of the most underrepresented in science. They listed four types of important goals and outcomes that could be achieved by outreach and education for Indigenous students, including the potential benefits to Indigenous communities:

1) **technological** (the promotion of use of tools and technology of Western science useful in addressing culturally important issues or environmental or economic problems that Native communities face);

2) **professional/workforce development** (providing training for students in these tools to enhance their knowledge and skill-set and become an asset to tribal communities).

3) **pedagogical** (two different types of goals: a) the integration of perspectives through content and curriculum based on Native knowledge or b) in a Western-centered context that integrates Native content into existing Western-structured science curriculum);

4) **ecological and cultural preservation** (seeking to understand, mitigate and remedy major environmental problems that threaten communities and healthy ecosystems)

Chugachmiut Heritage Preservation Program. Heritage Kits.
http://spoonfrogclients.com/chugach/index.html
Online resources to support multi-media kits on topics of climate change, food from the sea, weather forecasting, and "our water" are based on Sugpiaq and Eyak TEK and aligned with the Chugachmiut Curriculum Framework and Alaska State Cultural, Science and Geography Standards. The Elders, local scientists, and local education coordinators have been involved in development of the kits, which include curriculum, books, posters, banners, objects, inter-active digital experiences, and equipment for field experiences

Dublin, R., M. Sigman, A. Anderson, R. Barnhardt, and S.A. Topkok. 2014. COSEE-AK Ocean Science Fairs: A Science Fair Model That Grounds Student Projects in Both Western Science and Traditional Native Knowledge. ***Journal of Geosciences Education*** **62(2): 166-176**
https://pdfs.semanticscholar.org/2d58/e8f50a04491500d9f3508018180b3ee307cb.pdf?_ga=2.64806953.760721669.1557872103-900519526.1557872103
The authors developed and evaluated an ocean science fair model based on the culturally responsive science fair design developed during the AKRSI project. The revised model focused on student projects related to theocean, aquatic environments, and climate change. The projects were judged using typical science fair criteria for the validity and presentation of the science and by cultural and community experts using criteria for cultural and/or community relevance. Financial support was provided for teachers to organize local and regional fairs and for student and chaperone travel to an ocean science ''fair within a fair'' at the Alaska statewide science and engineering fair. The results of interviews of students participating in an Ocean Science Fair at the state level suggest learner outcomes of (1) strong, positive feelings of self-efficacy in science; (2) comfort with being identified as a scientist; and (3) feelings of connection to the student's community and support in doing science projects.

Garza, D. 1999. ***Tlingit Moon and Tide Teaching Resource: Elementary Level.*** **Alaska Sea Grant.**
https://seagrant.uaf.edu/bookstore/pubs/SG-ED-33.html

_____. 2011. ***Alaska Native Science: A curriculum guide.*** **Fairbanks, Alaskan Native Knowledge Network. University of Alaska Fairbanks.** https://seagrant.uaf.edu/bookstore/pubs/M-163.html
A resource guide for use with grades 6-9 with examples from around Alaska and across Alaska Native cultures. A radio program series of interviews of Alaska Native scientists done at Sitka Alaska's Raven Radio on a CD is included in the guide. Units include the topics of herring management - traditional and contemporary, and the co-management of walrus harvests.

Sealaska Heritage Institute. *Éek: Beach.* Grades 1-2. Thematic unit featuring Tlingit language, culture

and history. https://www.sealaskaheritage.org/sites/default/files/beach_resources_combined.pdf

_____. *Chaa Salíi: Beach*. Grades 1-2. Thematic unit featuring Haida language, culture and history. https://www.sealaskaheritage.org/sites/default/files/Beach_haida_booklet.pdf

Sigman, M., R. Dublin, A. Anderson, J. Warburton, G.I. Matsumoto, D. Dugan, and J. Harcharek. 2013. Using Large Marine Ecosystems and Cultural Responsiveness as the Context for Professional Development of Teachers and Scientists in Ocean Sciences. *Journal of Geosciences Education* 62(1): 25-40.
Results of five-day professional development workshops that brought together K-12 educators, scientists, and cultural experts in the context of Alaska's three large marine ecosystems (Arctic Ocean, Bering Sea/Aleutian Islands, and the Gulf of Alaska). Key factors that increased the impact of a single professional development workshop on the ability of K-12 educators to produce place-based and culturally responsive STEM lesson plans included: 1) opportunities for scientists and educators to interact with each other and community members and culture bearers on an equal basis, and 2) embedding the training within a longer-term program of curriculum development and professional development for which cultural responsiveness was a high priority.

Topp, R. and S. Okonnen. 2015. *Arctic Currents: A Year in the Life of a Bowhead Whale*. Final Report to the BOEM Coastal Marine Institute, March, 2015.
https://www.boem.gov/ESPIS/5/5498.pdfhttps://www.boem.gov/ESPIS/5/5498.pdf
This outreach project was a collaboration between the UA Museum of the North, the UAF Institute of Marine Science, and Inupiaq Elders and cultural experts to produce a calendar followed by a film. The purpose of the film was to build on the whale's story to demonstrate ecological connectivity and encourage public understanding of the marine ecosystem. Both the calendar and the film incorporated scientific information and traditional knowledge. The calendar text was in both English and Iñupiat and versions of the film sound track were recorded in English and two Iñupiaq dialects.

Culturally Responsive Geoscience Education

Apple, J., J. Lemus, and S. Semken. 2014. Teaching Geoscience in the Culture of Science and Place." *Journal of Geoscience Education* (62)1: 1-4.
https://pdfs.semanticscholar.org/1d93/2ee7376f308c14e42d5dc2ac441063586231.pdf
Introduction to a double issue on this theme to highlight new and ongoing efforts to better define, implement, and assess place-based and culturally infused approaches to geoscience teaching. Describes research on the effectiveness of explicitly place-based teaching of geoscience and environmental science as thus far have limited, with a yield of mixed—though encouraging—results with respect to improved factual and conceptual learning, greater regional and local awareness, enhanced teaching practice, and deeper sense of place (with references to specific studies).

Semken, S., E. Emily G. Ward, S. Moosavi, and P.W.U. Chinn. 2017. Place-Based Education in Geoscience: Theory, Research, Practice, and Assessment. *Journal of Geoscience Education* (65)4: 542-562.
https://pdfs.semanticscholar.org/9682/18f74a7e998fe1f3abfab439b9cbf5f6c2cc.pdf?_ga=2.106660101.760721669.1557872103-900519526.1557872103
Review of place-based education (PBE) as a "situated, context-rich, transdisciplinary teaching and learning modality distinguished by its unequivocal relationship to place, which is any locality that people have imbued with meanings and personal attachments through actual or vicarious experiences." Place-based learning is described as rooted in historic and indigenous teaching philosophies that has also gained

interest in environmental education, sustainability, and diversity in geoscience. The authors survey place-based education as it is currently or recently practiced in communities with indigenous (or largely indigenous) populations in general and in indigenous communities in Alaska and in Hawai'i. They also review the literature in terms of theory and research methods that have informed the development of place-based curriculum, instruction, and the authentic assessment of "sense of place." They also examine virtual geoscience place-based education.

Smythe, W.S., R. C. Hugo and S. McAllister. 2017. Incorporation of Traditional Knowledge into Geoscience Education: An Effective Method of Native American Instruction. Journal of Sustainability Education. June 22, 2017.
http://www.susted.com/wordpress/content/incorporation-of-traditional-knowledge-into-geoscience-education-an-effective-method-of-native-american-instruction_2017_06/
A case study of a culturally relevant, geoscience education program developed for Hydaburg, Alaska, with the participation of a Haida scientist from that community. The program focused on shipworms as indicators of environmental health. Scientific skills gained from involvement in the project led to tribal summer internships for students to continue to monitor marine ecosystems." The most powerful piece of this geoscience research project, however, was the context in which it was developed. Lessons were rooted in the community, in which it was taught, utilizing and recognizing the importance of TEK through involvement of elders. This project was developed to demonstrate that TEK holds equal vales to Western Science."

Watts, N.B. and W. S. Smythe. 2015. Incorporating Traditional Knowledge into Geoscience Education. It Takes a Community to Raise a Scientist: A Case for Community-Inspired Research and Science Education in an Alaskan Native Community. *CLEARING: A Resource Journal of Environmental and Place*. February 23, 2015. http://clearingmagazine.org/archives/11544
A four-year-long K-12 education and community outreach program is described as an outreach initiative for the Center for Coastal Margin Observation and Prediction (CMOP). "This program has three unique characteristics: it introduces coastal margin science as a relevant and viable field of employment; it integrates STEM learning with Traditional Knowledge; and, it invites family and community members to share science experiences." Activities included lesson plan development, field trip activities, and community meetings. The article features ten lessons learned in terms of things to consider when developing a science program with Native communities are featured. In a village where traditionally students did not think about education beyond high school, two students attended college, two students attended trade school, five students received scholarships, and eight Native interns conducted science or science education in the community.

Culturally Responsive Climate Change Education

McFarland, H. 2018. Alaska Students Share Real-Life Climate Change Experiences at International Event. https://uaf-iarc.org/2018/09/06/alaska-students-share-real-life-climate-change-experiences-at-international-event/
Kwethluk's GLOBE Learning Expedition project is featured and Elena Sparrow describes the culturally responsive evolution of the Alaska GLOBE (Global Learning and Observations to Benefit the Environment) program and development of the Arctic and Earth SIGNs (STEM Integration of GLOBE and NASA). The SIGNs program provides support for course courses that combine climate change science and the development of stewardship projects in communities.

Raising Educational Achievement through Cultural Heritage UP (REACH Up). UAF School of Education K-12 Outreach Office. http://k12reach.org/
The program website includes curriculum maps for topics related to climate change-related themes of changing weather and climate, changing landscapes, and changing lifestyles; and curriculum and multi-media resources for each theme and topic at different grade levels. Resources are also provided to support community projects, practicing research, student production of videos and judging criteria, and student science fair projects and judging rubrics. The lesson plans were developed through extended professional development provided to the Bering Sea School District, so many are place-based for that geographic area.

Sommer, L. C., C. E. Talus, M. Bachman, F. Barnes, M. Ebinger, J. Lynch, and A. Maestas. 2004. The Importance of Traditional Knowledge in Science Education: ARM education uses interactive kiosks as outreach tool." Fourteenth ARM Science Team Meeting Proceedings, Albuquerque, New Mexico, March 22-26, 2004.
http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.297.8808&rep=rep1&type=pdf
Description of a collaborative process involving Elders, scientists, and community members to design a kiosk in the Iñupiat Heritage Center that integrates traditional knowledge into climate science education. Teachers reported that while their main interest in using the kiosk was as a teaching tool for their students, they were also interested in increasing their own knowledge. The majority of teachers reported that the kiosk increased their understanding of both climate change and traditional Iñupiaq knowledge. They also reported that they would use the kiosk as a teaching tool for their students and were also more likely to use related curriculum materials on the program website.

Spellman, K.V., E.B. Sparrow, M.J. Chase, A. Larsen, and K. Keally. 2018. Connected Climate Change Learning through Citizen Science: An assessment of priorities and needs of formal and informal educators and community members in Alaska. *Connected Science Learning: Linking In-School an Out-of-School STEM Learning*. Issue 6. Diversity and Equity.
csl.nsta.org/2018/05/connected-climate-change-learning-through-citizen-science/
See description above under Participation in Research.

Teachers' Domain. Alaska Native Perspectives on Earth and Climate. WGBH Boston.
https://alaskapublic.pbslearningmedia.org/collection/ean/
Lesson plans and video resources organized from a holistic indigenous perspective and the Earth Systems approach of the NGSS. The videos include interview of Alaska Native scientists, both male and female.

More Examples of Culturally Responsive Science/STEM Curriculum Resources

Alaska Native Knowledge Network (On-going) Searchable database of lesson plans by topic.
http://ankn.uaf.edu/curriculum/units/

Dick, Alan. 1997. *Village Science*. Teacher's Edition. Fairbanks, Alaskan Native Knowledge Network. University of Alaska Fairbanks. http://www.ankn.uaf.edu/publications/VS/toteacher.html

_____. 2004. *Alaska Science Camps, Fairs and Experiments.* Fairbanks, Alaskan Native Knowledge Network. University of Alaska Fairbanks.
Includes the rubric for judging science fairs from both western science and cultural/community relevance perspectives. http://ankn.uaf.edu/publications/Alaska_Science/

Never Alone: Kisima Ingitchuna. Video game created by a collaboration of Elders, storytellers, and community members. Players become a young Inupiaq girl or an arctic fox on a quest to save the girl's village from an eternal blizzard. Upper One Games, Inc.