

**The Center for
Indigenous Research,
Science, and
Technology**



Mentoring Our Own Native Scientists



**2021 MOONS
workshop report**

The MOONS workshop would not be possible without the institutional and financial support of the National Science Foundation (RCN: Facilitating Indigenous Research, Science, and Technology, PLR-1417767), the University of Kansas, Haskell Indian Nations University, the University of Missouri, and the First Alaskans Institute. We would like to express our gratitude to the people and organizations that have made the MOONS workshop possible. We wish to thank Anna Kerttula de Echave, NSF Arctic Social Sciences Program Director for her assistance and encouragement in planning this workshop; Haskell Indian Nations University President Vendia Chenault and Dr. Dan Wildcat for their for welcoming remarks; Ron Brave for leading the welcome prayer; the Haskell Indian Nations University administration for providing the facilities and IT to host the workshop and staff; Raven Naramore for catering services; Paulette Blanchard, Natasha Chenot, and Stephen Esmond, University of Kansas graduate assistants to Jay T. Johnson, for their help in organizing the workshop; Mandy Frank, Administrative Associate at the Institute for Policy & Social Research, University of Kansas for logistical assistance, travel planning, and the layout and production of this report; our guest speakers for their engaging presentations and the discussion session facilitators for leading challenging discussion sessions, both listed in the workshop agenda found in Appendix B; the five workshop participants who submitted the imaginative and constructive papers found within Appendix D; and to all of the workshop participants who contributed thoughtful ideas in response to the challenges presented throughout the workshop.

Report prepared by: Jay T. Johnson, University of Kansas





Cover Artwork

Our cover art depicts a portion of a mural in Lawrence, KS that was created as part of an effort between the Douglas County Commission and Van Go, Inc. that seeks to capture the essence of the nearby wetlands and Indigenous people of the area. The ribbon design pays homage to the ribbon work of the Wazhazhette Wazhazhe (Osage; the former being an endonym) Nation. The lead artist for the mural the Haskell/Wakarusa Wetlands mural is Mona Cliff, a multidisciplinary indigenous visual artist, she explores the subject of contemporary Native American identity and culture through her use of traditional Native crafting methods such as seed bead embroidery and fabric applique. Mona is an enrolled member of the Gros Ventre tribe (A'aninin/Nakota Nations) of Ft. Belknap, MT.

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The Mentoring Our Own Native Scientists (MOONS) workshop took place from September 19-21, 2018 at Haskell Indian Nations University (HINU), a federally-operated tribal university in Lawrence, Kansas. The purpose of the MOONS workshop was to discuss the many challenges Native students face along the academic path toward advanced STEM degrees, and possible solutions, such as mentorship and alliance building. The goal of the MOONS workshop was to inform the FIRST Network of scholars, and other Native scientists, currently working on these issues with innovative ideas to aid in these efforts. The MOONS workshop was structured through a framework of identified challenges that prevent Native students from applying for, and completing STEM graduate degrees, and discussions that analyze potential solutions.

The MOONS workshop participants identified and engaged in a discussion of four (4) challenge-based questions:

1. How to prepare Native undergraduates for graduate study?
2. What goes into developing and running an Indigenous student mentoring network?
3. How to assist non-Native and Native faculty in becoming advocates and mentors for Native students?
4. How to work with 'gatekeepers' within academia and to build alliances with Native organizations?

This report outlines presentations and discussions of the MOONS participants, emphasizing the

stories and experiences that were shared. This report is organized into five sections in addition to the introduction by Dr. Robin Kimmerer that contextualizes the challenges being faced by Native students and faculty in STEM fields:

Section I addresses the presentations and discussion sessions that focus on the first challenge of preparing Native undergraduates for graduate study in STEM fields.

Section I includes an overview of two presentations: an overview of the Haskell Environmental Research Studies Internship Program by Dr. Joseph Brewer, Katrina McClure, University of Kansas, and Phillip Cody Marshall, Haskell Indian Nations University; and, the Native Environmental Science Program at Northwest Indian College by Dr. Emma Norman and Dr. Victoria Walsey. Section I also includes an overview of the three discussion sessions that followed the presentations. Discussion sessions were led by Dr. Mark Palmer, University of Missouri, Dr. Ed Galindo, University of Idaho, and Phillip Cody Marshall, Haskell Indian Nations University. Participants discussed topics and ideas related to early educational influences, academic and financial barriers, and Native student perceptions of STEM.

Section II addresses the presentations and discussion sessions that focus on the challenge of developing and running an Indigenous student mentoring network.

Section II includes an overview of the Indigenous Student Mentoring Programme in Aotearoa/New Zealand – Te Kupenga o MAI by Dr. Naomi Simmonds, Māori and Indigenous (MAI) Programme, University of Waikato, Aotearoa/New Zealand. Section II

also includes an overview of the three discussion sessions that followed the presentations. Discussion sessions were led by Dr. Joseph Brewer, University of Kansas, Dr. Jay T. Johnson, University of Kansas, and Dr. Robin Kimmerer, SUNY Environmental Science & Forestry. Participants discussed topics and ideas related to establishing mentor networks, and sustaining mentor networks.

Section III addresses the presentations and discussion sessions focused on assisting non-Native and Native faculty in becoming mentors for Native students. Section III includes an overview of one presentation: *Assisting Non-Native and Native Faculty to Become Advocates and Mentors for Native Students* by Gail Makuakāne-Lundin, Dr. Dana-Lynn Ko’omoa-Lange and Dr. Heather Kaluna, University of Hawai’i at Hilo. Section III also includes an overview of the three discussion sessions that followed the presentations. Discussion sessions were led by Dr. Ed Galindo, University of Idaho, Dr. Jay T. Johnson, University of Kansas, and Dr. Kyle Whyte, Michigan State University. Participants discussed topics and ideas related to faculty mentors, both Native and non-Native.

Section IV addresses the presentations and discussion sessions focused on dealing with gatekeepers and building alliances with national organizations. Section IV includes an overview of two presentations: *Working with ‘Gatekeepers’* by Dr. Ed Galindo, University of Idaho, and Dr. Jessica Black, Heritage University; and, *Building Alliances* by Chelsea Chee, American Indian Science & Engineering Society (AISES), Brandon Stevens, Tribal Vice-Chairman of Oneida Nation, and Josh Lucio, American Indian Graduate Center (AIGC). Section IV also includes an overview of the three discussion sessions that followed the presentations. Discussion sessions

were led by Phillip Cody Marshall, Haskell Indian Nations University, Dr. Robin Kimmerer, SUNY Environmental Science & Forestry, and Dr. Joseph Brewer, University of Kansas. Participants discussed topics and ideas related to establishing alliances, and alliances as community healing spaces.

Section V contains key recommendations from our discussion sessions pertaining to the four challenges. This is not an exhaustive list of recommendations, but rather a series of starting points, recommendations that represent key areas of exploration, and merit further discussion. These recommendations are a synthesis of workshop presentations, discussion sessions, educational research, and workshop participants papers submitted prior to the workshop. Key recommendations include are related to:

- Encouraging Native students to pursue STEM
- Design of STEM programs for Native students
- Financial and Academic support for Native students in STEM
- Mentor programs and networks
- Native and Non-Native faculty mentors
- Institutional and Tribal partnerships with Native students

This report begins with relevant background information about the Center for Indigenous Research, Science, and Technology (C-FIRST), and the MOONS workshop and concludes with appendices that list workshop participants, the workshop agenda, bios of the guest speakers, papers submitted by workshop participants, references, and figures. A complete copy of this report is available on the [University of Kansas, C-FIRST, Facilitating Indigenous Research, Science, and Technology Network website](#).

The Center for Indigenous Research, Science, and Technology (C-FIRST) is directed by Dr. Jay T. Johnson, Professor & Associate Chair in the Geography & Atmospheric Science Department at the University of Kansas (KU). C-FIRST seeks to study the continually unfolding relationship between Indigenous peoples and their environment. The goal of C-FIRST is to bridge Indigenous and Western sciences, through appropriate principles, protocols, and practices, in order to better understand the conditions of place-based vulnerability and the best strategies to achieve resilience by facilitating Indigenous-led research initiatives. The C-FIRST vision is to establish an Indigenous science network that emphasizes research activities that contain integrated theory, practice, and dissemination through mentoring and community-based partnerships.

Reflective of burgeoning interests in collaborating on Indigenous-led research initiatives, Dr. Johnson established the Facilitating Indigenous Research, Science, and Technology (FIRST) Network. Formed in 2015, and funded by the National Science Foundation Grant No. OPP-1417767, the FIRST Network seeks to create a network of Indigenous

scientists, researchers, and community organizers who represent communities, organizations, and academic institutions across the United States. The FIRST Network is an interdisciplinary group of Native scholars all working at the intersection of Indigenous and Western scientific traditions to explore how Indigenous communities are utilizing both traditions to meet their research needs, particularly regarding their efforts to sustain resilient ecosystems.

The overall goal of the FIRST Network is to develop strategies for meeting the research needs of Indigenous communities, including the capacity to lead their own research initiatives. Intrinsicly linked to this goal are the barriers that Native students and scholars face within higher education. Under the leadership of Dr. Johnson and the FIRST Network, the MOONS workshop was planned to further the conversation about these barriers, and to discuss strategies that can be used to overcome them.

The MOONS Workshop

The MOONS workshop brought together thirty-seven U.S. and international Indigenous scholars, and three KU graduate student assistants, interested in discussing solutions to the many challenges Native students face along the academic path toward advanced STEM degrees. The MOONS workshop participants identified and engaged in a discussion of four challenge-based questions:

- **How to prepare Native undergraduates for graduate study?**
- **What goes into developing and running an Indigenous student mentoring network?**
- **How to assist non-Native and Native faculty in becoming advocates and mentors for Native students?**
- **How to work with 'gatekeepers' within academia and to build alliances with Native organizations?**

During the MOONS workshop, participants were able to engage with presentations and panels, and with one another during a number of discussion sessions. Presentations were given about each of the challenges. Following each presentation, participants were divided into discussion groups to consider the challenges and potential solutions. Discussion groups changed with each challenge and were led by different discussion session leaders. Each group had a discussion leader, a note taker, and a staff member was responsible for recording the group discussion. Discussion sessions each lasted for approximately an hour and a half. The notes from the discussion sessions were displayed throughout the MOONS workshop for feedback.

Photo: Dr. Jay T. Johnson, Director of C-FIRST, welcomes MOONS participants to the workshop in the Board of Regents Room, Navarre Hall at Haskell Indian Nations University.



The first workshop presenter was Dr. Robin Kimmerer, SUNY-ESF, who contextualized the challenge facing Native students in pursuit of STEM degrees in her presentation titled, “The Challenge Before Us: Reversing the Decline in Native Students Completing Graduate STEM degrees.” Dr. Kimmerer brought forth data showing that, among earned PhDs in STEM fields, other minority groups have been represented in greater numbers over the last fifty years. The share of PhDs earned by Native students, however, has remained at relatively the same low level (Figure 1). According to a National Science Board (2018) report:

- The number of Science & Engineering (S&E) bachelor’s degrees has risen steadily in the United States over the past 15 years, peaking at more than 650,000 in 2015. The share of S&E bachelor’s degrees awarded to American Indians or Alaska Natives dropped from 0.7% to 0.5% of the total degrees in this period.
- The proportion of U.S. S&E master’s degrees earned by underrepresented racial and ethnic minorities increased from 14% to 21% between 2000 and 2015, but American Indians and

Alaska Natives accounted for 0.4%, without any significant increase over the period.

- The number of S&E doctorates conferred annually by U.S. universities increased from nearly 28,000 in 2000 to 45,000 in 2015. In 2015, Blacks earned 1,855 S&E doctorates, Hispanics earned 2,019, and American Indians and Alaska Natives earned 137, altogether accounting for 0.4% of all S&E doctoral degrees awarded that year, similar to the proportion in 2000.

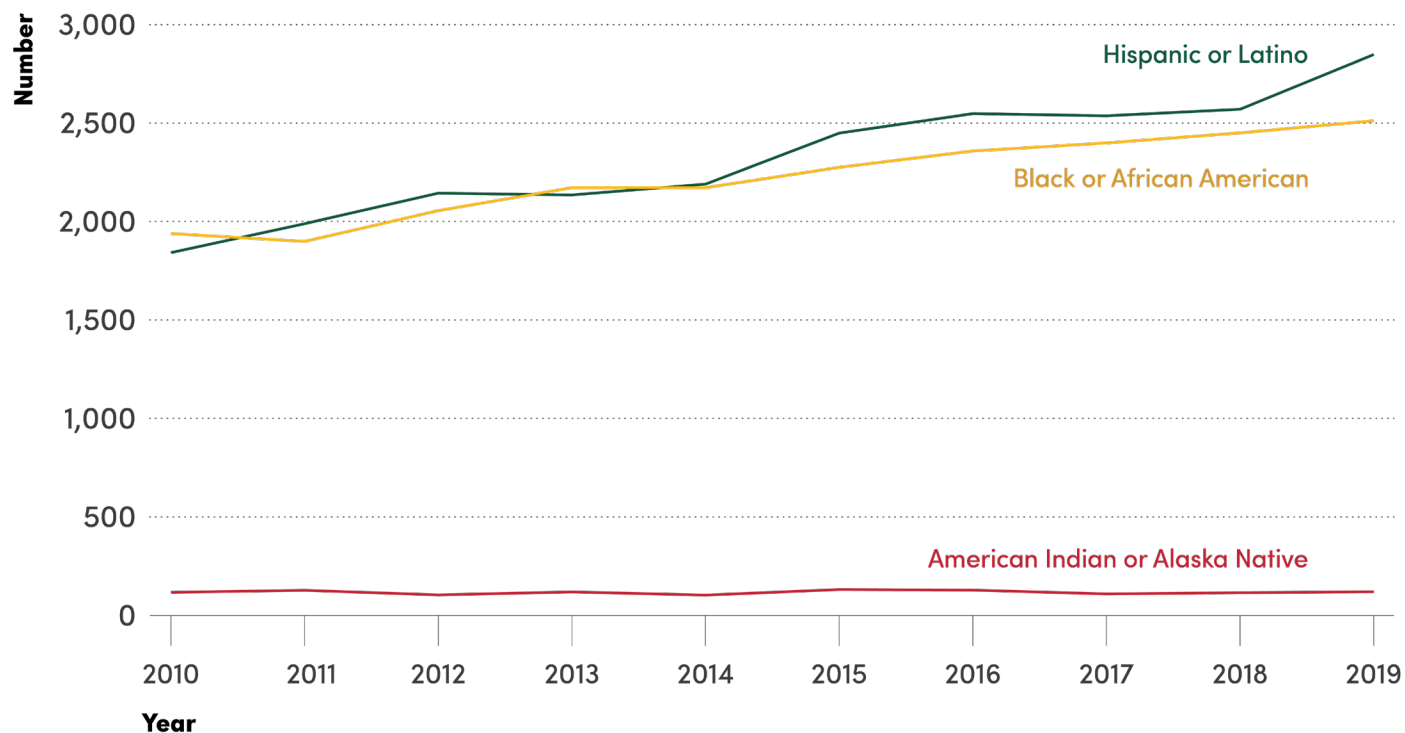
Causes & Consequences. On all levels, Native students are the only ethnic group in the U.S. with flat or declining numbers of students completing advanced STEM degrees. Consequences of this lack of improvement in Native STEM achievement includes impacts to scientific leadership in Native communities, and on self-determination, tribal sustainability, and Nation building, environmental and social justice outcomes, and even health disparities. Without scientific advancement Native people are not as well prepared for the management of their own communities’ health and natural resources. The limited numbers of Natives completing advanced degrees also limits

the number of role models and mentors that new generations of Native students can look up to. Dr. Kimmerer argued that this trend is deeply troubling for this generation, particularly when remembering that our people have always been scientists. Adaptation, resilience, engagement with and understanding the natural world, hypothesis testing peer review among our elders, all of these elements of science are present in our communities. Other potential causes for this lack of improvement in graduate advancement that Dr. Kimmerer identified were lack of educational opportunity, the achievement gap, poverty, historical trauma, technology equity, and funding. The consequences of this failure to advance in STEM fields for Native students are severe. It limits scientific leadership in Native communities, but

the most significant consequence is an absence of Indigenous knowledge from problem-solving, research, and education.

This view of science is built on the idea that Western Science has an exclusive claim on knowledge making. There are academic programs across the country that invite native peoples to join science departments to help make them mainstream scientists. This forces Indigenous students to choose between their own ecological knowledge and their scientific education. Dr. Kimmerer provides the example of how academic study tends to put rigid parameters on how we can scientifically study and understand land. “In Academia, land can be viewed as capital, natural resources, and as a source of ecosystem

Figure 1. Doctorates earned by underrepresented minority U.S. citizens and permanent residents: 2010–2019.



Data from the National Center for Science and Engineering Statistics (NCSES) 2020

services, but not identity, the place that sustains us, where our more than human relatives live, our connection to ancestors, our library, or the source of our knowledge. Crucially, a spiritual connection to land is left out of the discussion. This connection means that indigenous knowledges can be ignored for a long time, as when the forest service ‘discovered’ the value of burning forests, which the Potawatomi had understood for a very long time.” This view is indicative of how, through definitions of valid knowledge and technical language, science can exclude Indigenous groups and their ideas.

There is a confusing disconnect for Indigenous students who hear both that science is important and their communities are in need of scientists, and that science has devalued their way of thinking. Indigenous students might choose not to participate in science as a discipline, because it “does not recognize (their) own knowledge.” Science itself, as the curiosity-driven pursuit of knowledge of the natural world is a fundamental human activity, which is not limited to the confines of the Western worldview. The cultural conflicts experienced by students contribute significantly to this pattern of under-representation of Native students in science graduate education. Some Indigenous students do not want the label of “scientist.” One of Dr. Kimmerer’s Native students once said, “I don’t want to be known in my community as a scientist, but as someone working on the side of the people and the earth.”

Changing the Story. Scientific innovation requires full participation, and complex environmental issues at the interface of culture and nature require a diversity of approaches. Science in its present form has failed to envision optimal outcomes in terms of sustainability. The world’s regions of greatest biodiversity are

generally the regions actively managed by Indigenous communities who have lived in these areas for millenia. Consensus has emerged that educational systems that exclude Indigenous knowledge are among the root causes of the underrepresentation of Indigenous students in science disciplines. The exclusion of Indigenous science and virtual absence of Indigenous students in science means that the dominant research agendas do not have the benefit of input from an Indigenous perspective. Indigenous knowledge is nearly invisible in higher science education, and as a result, so are Indigenous students. Indigenous science allows for an educational philosophy, pedagogy, and system that explicitly explores ways of knowing, and systems of knowledge that have been actively repressed for five centuries (Deloria & Wildcat, 2001). There is room for knowledge from an Indigenous perspective to balance the shortcomings of scientific ecological knowledge, as it already does in various places around the world.

“ I don’t want to be known in my community as a scientist, but as someone working on the side of the people and the earth.”

Presentation: Haskell Environmental Research Studies Internship Program

Presenters: Dr. Joe Brewer & Katrina McClure, KU, Cody Marshall, HINU, & Emma Norman, NWIC via Zoom

The first presentation on preparing Native undergraduates for graduate study focused on the Haskell Environmental Studies Research (HERS) summer internship program. The HERS program helps Indigenous STEM students prepare for graduate school by helping them acquire research skills. The HERS program is an eight-week paid summer internship that focuses on preparing fifteen students for academic research by designing their own project around an environmental issue in their community. In June and July, interns spend the first five weeks on the Haskell Indian Nations University (HINU) campus. During this time interns work in the classroom, visit the Konza Prairie Biological Station, KU campus, and conduct GIS training and fieldwork. HERS interns develop their research questions and create research posters, which they present to the Haskell and KU communities. During week six, interns travel to Boulder, Colorado and spend the week working with staff members from the

University Center for Atmospheric Research (UCAR), where they also present their research posters. Interns then spend the final two weeks of the program in July conducting independent research and finalizing their research papers.

Mentoring in HERS. Interns work closely with University of Kansas graduate students, who help them to design independent research projects on climate and environmental change occurring in a Native community of their choice. Graduate mentors provide one-on-one support to interns to help make sure that they are learning good scholarship practices and help keep track of student well-being. The interns attend daily debriefing sessions to check in on their wellbeing and keep track of the HERS students' progress and challenges. This also serves as a support system for the graduate mentors, who may have difficulty with the time management demands of graduate school and the program. These measures have created an environment of closeness for the HERS staff, interns, and student mentors. Katrina McClure pointed out that she has noticed that Native student mentors have an easier time mentoring native students than non-native mentors do.

Indigenous Knowledge & Skills. Dr. Joseph Brewer, the HERS Assistant Director, talked about the experience that interns have working with the University Corporation for Atmospheric Research (UCAR), where they learn about environmental assessment techniques through mini-research projects.. Interns get training in water quality and streamflow discharge using water sampling techniques, review of historic discharge levels and community surveys. Dr. Brewer said, “One of those uniqueness’ that we really push in the program is ‘how do you incorporate your Traditional Ecological Knowledge, your tribal knowledge?’” The HERS program is meant to help students be able to “venture off of the road” of mainstream science. Throughout these skills development activities, the interns are instructed by a faculty-mentor from UCAR to help facilitate their research. At the end of their week in Boulder, the students present their findings. The goal of promoting these skills is to help prepare students for graduate school research and presentation.

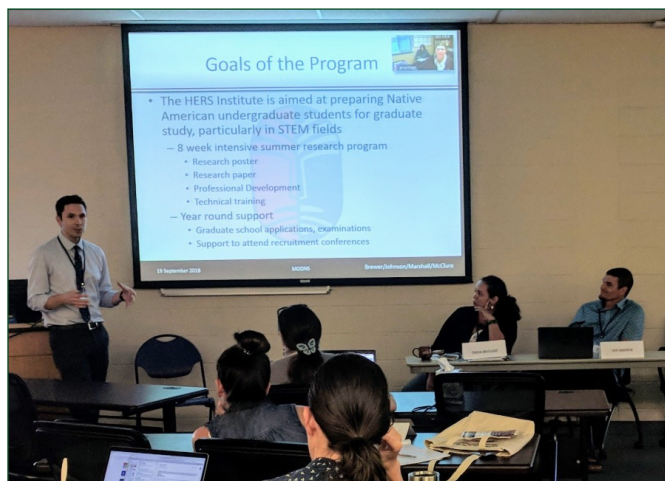


Photo: Phillip Cody Marshall describes the goals of the HERS program to MOONS participants, alongside Katrina McClure and Dr. Joseph Brewer.

Presentation: Native Environmental Science Initiatives at Northwest Indian College

Presenters: Dr. Emma Norman & Dr. Victoria Walsey, Northwest Indian College

Tribal colleges have been making a significant impact on the participation of Indigenous students in the STEM disciplines. Dr. Emma Norman, Chair of the Native Environmental Science Department at Northwest Indian College (NWIC), and Dr. Victoria Walsey, faculty in the Native Environmental Science Department at NWIC and former HERS Curriculum Coordinator, joined virtually to present on their experience preparing Native undergraduates for graduate study. At NWIC, the Native Environmental Science program transitioned from a two-year program to a four-year program in 2009, making it a Bachelors of Science (BSNES). Dr. Norman said, “We’ve had 68 graduates since then, I was trying to count how many of our students went on to graduate school but I would say at least 15, and that number is increasing”

The BSNES program aims to increase students’ self-awareness of their traditional knowledge and open up opportunities for them to succeed with that knowledge in graduate school. The final two years of the BSNES program include a capstone project, a “mini master’s thesis” that helps prepare students for graduate school using their place-based knowledge methods. When BSNES students graduate, they have a firm understanding of relationality, focused on inquiry, and multiple ways of knowing.

Place-based Pedagogy. NWIC has been prioritizing place-based pedagogy for STEM students. Place-based natural science education encompasses pedagogical frameworks centering experiential learning in or about a locality, or

region of interest, and is transdisciplinary and cross-cultural in nature (Semken, 2008). NWIC has around 500 students from 130 different tribal nations, 60 students are enrolled in the BSNE program. With so many different tribal nations represented, some ask how place-based pedagogy can work. Dr. Norman's response to this question is: "It is getting the knowledge from the land, recognizing that, where your feet, your heart and your mind are all in one place, you can learn from the knowledge holders of the community." The different NWIC-campus tailor their curriculum to the problems of local communities through an Indigenous research framework. This idea of focusing on place-based pedagogy has been successful in increasing retention and addressing local issues. Dr. Norman provides the example of the Lummi site, where students learned about the ecology of the Nooksack river, and through interdisciplinary study, how relationships with upstream dairy farmers impact Indigenous rights to the traditional foods from the river. This was a success because it brought together community leaders and partnered with dairy farmers to help voluntarily curb the pollution that washes into the river. Another case study on the effectiveness of this place-based approach was the response to the proposed Cherry Point fishing terminal. Their response was informed by local knowledge holders and scientific investigation of the area. This approach allowed students the chance to present their findings before an audience and participate in conjunction with local knowledge holders.

Native Students Seeing Themselves as Scientists. The Salish Sea Speakers series provides a platform to discuss the role of place-based knowledge in community outcomes and student success. Dr. Norman provided the example of Althea Williams, who listened to a

talk about the Nooksack river, where her family had lived for generations, and decided to major in the Native Environmental Science program the next day. Dr. Norman said that Althea, "had never, in her whole life, known that she was a scientist, but she knew everything about the Nooksack River. She knew that because she lived there, her family was there, her dad and her brothers and her sisters were fisher people." Althea went on to create an oral history of the Nooksack River and present at the Salish Sea Ecosystem Conference. Her work illustrates the importance of an interdisciplinary approach, and the connection between Indigenous science and place. By integrating Indigenous ways of knowing and using a place-based pedagogy, the BSNE program helps Native students see themselves as scientists and excel at graduate school.

Discussion Sessions

MOONS workshop participants worked in three groups to address the challenges related to preventing Native students from applying for and completing STEM graduate degrees. The key challenges that emerged were related to early educational influences, Native student perceptions of STEM, and academic and financial barriers.

Early Educational Influences. Participants discussed early educational influences and the impacts they have on Native STEM students beginning in elementary school. The STEM graduate school pipeline begins when students are first exposed to STEM and how they are encouraged and empowered matters. One participant gave the example of their own experience as a student in elementary school in the 1970's. This student was exceptional at math, and was given a career prediction test. When the results came back, this student was

predicted to have a career that did not require higher education. The results were based on ethnicity data and had not taken into account math aptitude scores. This was a discouraging experience for the student.

Another early educational influence to consider is how students are evaluated, and how those evaluations can miss important student strengths. For example, standardized tests focus on the ability to do (math problems, reading comprehension, etc.), but they infrequently consider creativity. Additionally, test-taking is a skill in and of itself. The format of the test may be standard, but the testing environment is not a standard experience by any means. When a student doesn't score well on a standardized test, they are considered underdeveloped or lagging behind. The empowerment that a student might have had dissipates, and the pressure to perform builds. One participant describes this circumstance as, "The weight of the world becomes so heavy that you can't ..." Math is a STEM subject that students can easily fall behind in and are then channeled into non-math and non-science directions. Native students would benefit from more collaborative approaches to math and a deeper connection. For example, comparing math to a language that explains the natural world, or that a forest manager needs to understand math to calculate horticultural practices, a role that would serve their community.

Native communities face a challenge in attracting teachers with experience teaching in Native communities, particularly teachers with STEM experience. Participants spoke of the rural urban divide or even Native versus non-Native school districts. Rural districts may not be viewed as particularly desirable for teachers since they do not have as much funding and it can be more

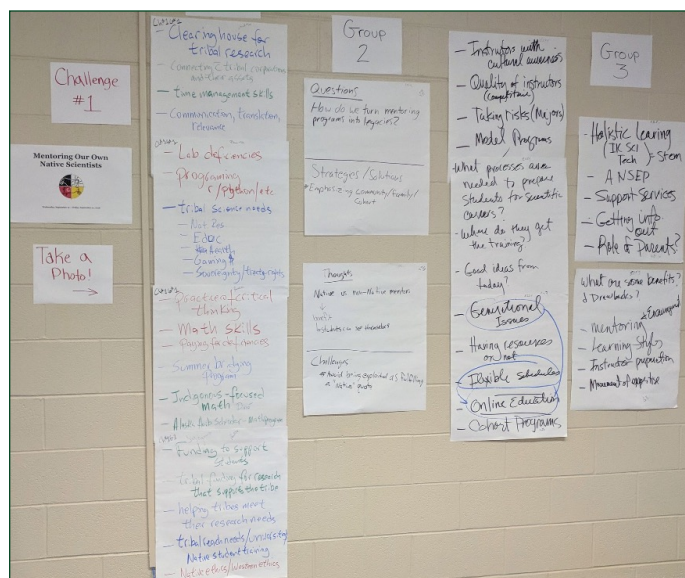


Photo: Notes generated by MOONS workshop participants on addressing the challenges related to preventing Native students from applying for and completing STEM graduate degrees (Challenge # 1).

challenging to work in areas that do not have as much support. Teachers in rural districts may lack the commitment and understanding of working with Native students and local tribes, which can result in missed opportunities for encouragement and empowerment. Furthermore, many Indigenous parents themselves may lack a higher education for a variety of reasons. These parents frequently do not view attaining an education as a major goal or need for their children. If parents do encourage their children to continue their education towards a graduate degree, it is more likely that they guide them towards an easier career rather than a STEM degree.

Native Student Perceptions of STEM. Participants discussed several reasons why Native students may not choose to pursue STEM degrees. First, they may not understand the relevance of science degrees for their communities. It is important that students see how getting a

graduate degree in science, a long and possibly expensive pursuit, translates into a job that is relevant for their communities. One participant provided the example from Alaska, “you can go get your engineering degree, but you can’t really go back to your village because there are no engineering jobs there.” Western scientists may not be able to articulate the relevance or even understand a Native student’s desire to serve their community. Second, the values held by Native students do not always match with those found in Western science education. One participant stated, “Not that they are not competitive people, obviously they are, but they’re not necessarily competitive in the ways that Western society wants people to be competitive to kind of step all over each other to get to the top or put themselves at the center to fight for ...You see this a lot in graduate school, of course where people competing for funding and things like that.” The institutional setting is set up for individual success, not for a community or collective success. A second example surrounds the myth of science as objective versus political and emotional. One participant observed, “It’s not that Indigenous people don’t care about science, it’s just that we’re understanding it in a different way than this very neutral, apolitical, passionless, sterile scientific world view.” Given these significant disconnects between Indigenous values and Western science, scientists have a difficult time recruiting and retaining Indigenous students. They must learn how to understand and incorporate these values and perspectives if they intend to be successful mentors to Indigenous students.

Academic & Financial Barriers. One consequence of not being able to attract qualified teachers with STEM experience, is a lack of STEM co-curricular activities. Teachers with STEM experience are more likely to sponsor

STEM related activities than those without STEM backgrounds, beyond the minimum requirements to teach the subjects. Students who participate in STEM co-curricular activities gain more exposure, interest, experience in concept application, and confidence in their abilities. Additionally, students with STEM co-curricular experience are more likely to be accepted to prestigious programs and be awarded scholarships. Similarly, there are challenges with STEM programs that exist outside school districts, primarily including access and cost. For example, the Alaska Native Science & Engineering Program (ANSEP) is a competitive and expensive program to run. It would be difficult to replicate a program without qualified trainers and substantial funds.

Some co-curricular experiences are crucial to undergraduate student success in pursuing a graduate STEM degree, for example, lab experience. If undergraduates attend a university where faculty have greater teaching loads, faculty are not able to prioritize research, and may not have a research agenda at all. One participant observed, “They can’t have a research agenda so they don’t have labs and the students here don’t get any laboratory experience. And so they’re really at a disadvantage because a lot of other students are getting that experience.” Students with lab experience are more likely to be accepted into a funded STEM graduate program. A second example is computer programming. Most graduate students earning STEM degrees are going to be analyzing data and required to learn a programming language. Computer programming skills benefit students while doing the work to earn their degree, and is a transferable skill to helping their community in the future.

Another challenge that may impact the choice to attend graduate school is completing a bachelor

degree program in four-years. The longer that someone is in school, the greater the outlay of financial aid and scholarships. . It may be beneficial for students to progress in their programs at a slower rate in order to avoid academic overload, or taking multiple courses that require substantially more time and effort than others. Students who take longer to complete their degrees may become exhausted from their studies and desire to finish in order to get a job and to meet the obligations of their family. Often the pressures from communities to be working and earning an income, to then contribute to their own families impacts a graduate student's experience. Family can play a role for Native students beyond their desire to financially contribute. Native students who have children of their own are challenged to fulfill their role as a graduate student alongside their role as a parent.

Native students from low socioeconomic backgrounds have the added burden of facing financial challenges. Some of the financial challenges that participants discussed were the lack of financial support, other financial commitments, and lack of information about scholarships. One participant noted that their institution had shifted away from providing summer academic support because the summer is an important earning period for some Native people. They said, "That's when you need to get jobs. That's when you need to be making money for your family, for yourself." Tribal colleges help Native students financially by providing low tuition rates. However, large research universities charge more for tuition, which makes them a less viable option initially. The information that Native students may not have is that there are tuition waivers, and they may even be paid a stipend, while pursuing a graduate degree in STEM.

The values held by Native students do not always match with those found in Western science education.

“ Not that [Indigenous people] are not competitive people, obviously they are, but they're not necessarily competitive in the ways that Western society wants people to be competitive to kind of step all over each other to get to the top or put themselves at the center to fight for ... You see this a lot in graduate school, of course where people competing for funding and things like that.”

Presentation: Indigenous Student Mentoring in Aotearoa – Te Kupenga o MAI

Presenter: Dr. Naomi Simmonds - MAI program, Aotearoa/New Zealand

Dr. Naomi Simmonds (Raukawa, Ngāti Huri) presented on the topic of developing and running an Indigenous student mentoring network. Dr. Simmonds first provided historical context for Māori students and the education systems in New Zealand. The Māori intellectual tradition was perceived to contrast with a Western tradition, which had incorrectly identified the Māori as a “warrior race.” This persistent warrior myth is part of the reason that Māori students can have a hard time seeing themselves as scientists. Dr. Simmonds stated, “It’s because we’ve been told for generations that we’re not a thinking people, that we don’t have an intellectual tradition. And that we’re capable of being warriors or as that kind of changes over time, we’re only capable of succeeding in particular disciplines.” The colonial education system for Māori was an educational Trojan horse, because it both acted as an assimilatory force and focused on the development of manual rather than mental labor

under the assumptions of the “Warrior Gene” myth (Smith & Smith, 2018). There were movements driven by Māori people in the 1970s and 80s helped to make universities more inclusive to Māori culture and brought Māori language programs into higher education.

Māori enrollments in graduate programs have been increasing significantly over the last few years, but enrollment is predominantly in the humanities, with only 20% of total Māori enrollments in STEM fields (Universities New Zealand, 2016). Importantly, Māori account for only 6% of PhDs earned between 2006 and 2013 (Ministry of Education, 2015). Growth in Māori PhDs has not been matched by growth in Māori faculty. Māori students, particularly at the PhD level, are expected to educate the non-Native faculty advisors about Māori worldview. Many students cite the lack of Māori educators in New Zealand institutions as a challenge.

Māori and Indigenous Program. Under the Māori Centre of Research Excellence, the Māori and Indigenous (MAI) program became a national program in 2002, and has led to a significant increase in Māori applications to

doctoral programs. The aim of the MAI program is for the enhancement of Māori and Indigenous post-graduate students throughout Aotearoa/New Zealand. This national network forms an integral part of Te Pae Whakatairanga Hiranga, the Capability Building program of Ngā Pae o te Māramatanga. The initial goal of the MAI program was to graduate 500 Māori doctoral scholars, which was achieved between 2002–2007. The new benchmark is to develop 1,500 doctoral scholars. This program helps Indigenous graduate students feel supported and validated in their study, and works to shift the discourse surrounding policy and education. There are several key features of the MAI program, including the active support and validation of Māori theories and methodologies, the flexibility of how it is organized by each site to provide for the needs and diverse circumstances of their students, and strong facilitation by Māori faculty who have experienced the doctoral journey and are committed to creating opportunities for students to progress their research, and Māori cultural grounding and approach to supporting doctoral scholars.

Cultural Grounding. The MAI program provides a Māori cultural grounding in approach to supporting our doctoral students. Dr. Simmonds stated, “It’s not just about the academic journey, but it’s also about connecting with who they are and understanding the cultural context.” The cultural significance of Māori investigation of the natural world is evidenced by the story of Māui, who ventured out into the world to find fire for his community. After finding fire, he experimented with it to find out what it was useful for and how it behaved. Māui discovered the trees of New Zealand which were best for making fires, and that knowledge has passed on through generations. Māori intellectual traditions also offer a distinct

way of orienting oneself, as with the story of Māui who caught the North Island of New Zealand in the form of a fish, and so to go “up” would mean to go south, to the head of Māui’s fish. Māori thought, however, teaches that the health of the earth and of Māori communities are intimately related, and it is important to create a space for these connections. Ideologies of control and exploitation of land and people are very similar, and so an interdisciplinary approach to thinking about community and nature is important. A second example is the Kaupapa Māori Approach to research (Figure 2). It is open-ended, ethical, systematic and accountable. It is scientific, open to existing methodologies, informed and critical, neither fixed nor rigid.

Role of Community. Māori traditional pedagogy sees education as lifelong and reciprocal. There is a tradition of mentorship by community members. Dr. Simmonds provided the metaphor of the flax plant, which consists of the middle “baby” shoot, the outer “apprentice” shoot, and shoots that grow up into the air. Only the shoots that grow into the air are used, and the other two are left alone so the plant will stay strong. This shows how traditional ecological knowledge and care for the community can be related. The plants also grow best in clusters, just as people do. Māui was a mentor and taught the Māori, who then passed down that information in a form of mentorship. The MAI program actively creates networking and sharing opportunities through writing retreats specifically for MAI doctoral scholars, and a range of other workshops and professional development opportunities based within Māori pedagogical processes. The MAI National conference serves as a networking space for both doctoral scholars and supervisors to share across tertiary institutions. Māori coordinators maintain ongoing links and share opportunities nationally.

Figure 2. Kaupapa Māori Approach. Presented by Dr. Naomi Simmonds during “Indigenous student mentoring in Aotearoa – Te Kupenga o MAI” presentation. MOONS workshop presentation. (2018 September 20).

Rangatiratanga	Requires that power and control rest within Māori cultural understandings and practices and that the issues and needs of Māori are the focus and outcome of all research. This principle is also situated within Te Tiriti o Waitangi.
Taonga Tuku Iho	Ensuring the validation of tikanga and te reo as cultural frameworks of success.
Tikanga	Relationships where aroha, respect and manaakitanga (care) are a key foundation
Whanaungatanga	Maintaining a focus on relationships to ensure networking and maintaining connections
Ako Māori	Māori pedagogical processes are essential.
Tuakana Teina	Enables culturally defined relationships that provide a means for knowledge transition, the passing on of experiences and the creation of a cultural framework for supportive relationships
Kanohi ki te Kanohi	A key engagement strategy is face-to-face gatherings, which can then be supported through technology.
Ki piki ake i ngā raruraru o te kāinga	Acknowledges that kaupapa Māori practices and values are able to successfully intervene for the well-being of whānau



Photo: Dr. Naomi Simmonds begins her presentation to MOONS participants on Indigenous Student Mentoring.



Photo: Dr. Joe Brewer, University of Kansas, leads MOONS participants in a discussion session about what goes into developing and running an Indigenous student mentoring network.

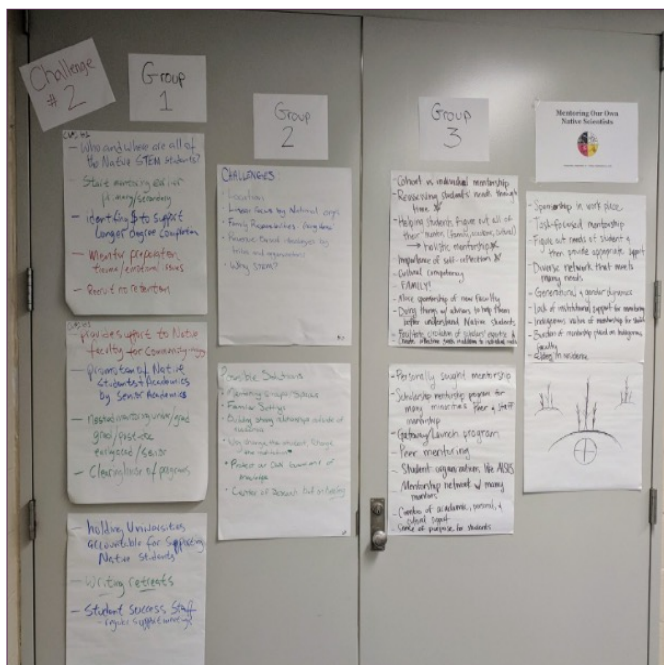


Photo: Notes generated by MOONS workshop participants on addressing the challenges related to developing and running an Indigenous student mentoring network for Challenge #2.

Discussion Sessions

MOONS workshop participants worked in three groups to address the challenges related to developing and running an Indigenous student mentoring network. The key challenges that emerged related to program limitations, establishing mentor networks, and sustaining mentor networks.

Establishing Mentor Networks. There was consensus among the participants that establishing mentor relationships with Native students in STEM is both essential and challenging. Native students in STEM programs are frequently isolated and small in numbers. Some students come from institutions where there is a Native student cohort. However, often Native students experience being the only STEM Native graduate student in their institution or program. Katrina McClure explained how recruiting students to the HERS program poses a challenge. To address this, the HERS program uses in person hand-outs, word of mouth, classroom presentations, and the program website. One of the most important aspects of recruitment for this, or other programs for Indigenous students, is having trusted mentors who can personally vouch for these programs. This highlights the value of networking in an effort to recruit Native students, and also means that keeping in contact with program alumni is important. Katrina expressed the importance of trust in her own experience, “I applied to things because somebody trusted told me about an opportunity, and they were willing to vouch for a program because they knew someone that they trusted that said ‘this is a good program.’” This highlights the value of networking in the effort to recruit native students.

Sustaining Mentor Networks. Sustaining Native student mentor networks requires effort and energy. It is key that the person or organization communicating through an established network is trusted. One participant observed, “I hear about the cohorts of Indigenous students calling each other and talking about grants, or travel opportunities, or a free lunch, or a free trip, which is actually really important.” Sustainable networks create a sense of community, students must feel like they are welcomed and believe in the importance of the network. A sense of community can be created through the development of personal relationships, and through providing opportunities within the communities of the students involved.

Section III. Assisting Non-Native & Native Faculty in Becoming Mentors for Native Students

Presentation: Assisting Non-Native and Native Faculty to Become Advocates and Mentors for Native Students

Gail Makuakāne-Lundin, Dr. Dana-Lynn Ko'omoa-Lange & Dr. Heather Kaluna, University of Hawai'i at Hilo

Gail Makuakāne-Lundin, a long-time administrative leader at the University of Hawaii-Hilo, who has served as the Vice Chancellor for Student Affairs, and Director of Kīpuka Native Hawaiian Student Center and Hawaiian Leadership Development Program, began the presentation by discussing the Native Hawaiian Student Center at the University of Hawai'i at Hilo (UH Hilo). UH-Hilo has one of the most diverse student bodies in the nation with 20.6% Asian students, 20.2% white, and almost 10% Native Hawaiian, and 31% of the student body self-reports as being two or more races (Chronicle of Higher Education Almanac, 2018). Gail discussed her experience working in Student Affairs. Students would often say things like, "I wish my faculty knew how to pronounce my name..." Most of the faculty at UH-Hilo were not from Hawai'i, which meant that they weren't familiar with the place and the culture. Students desire to have examples and references in class

that relate more to their home. One of the goals for Gail and her colleagues was to help non-Native faculty be more culturally sensitive. This was a challenge because Native Hawaiian culture is not necessarily open to teaching outsiders.

Uluākea Program. To engage non-Native faculty, the Student Center at UH Hilo created the Uluākea program, a faculty and curriculum development program that works with teaching faculty in various academic disciplines to gain a practical understanding of Hawaiian ways of knowing the world. One strategy was to invite non-Native faculty to join a hālau, a traditional school of dance. Invitations were given only to those recommended by students, and 50 faculty from various disciplines have now participated. After participating in the program, one faculty member in geography said, "As a non-Native person, I have been able to cultivate a very supportive and meaningful relationship with my students, the larger community, and the place where I now live." Gail noted that the explicit invitation was really important, the faculty saw that as being quite special. Many untenured professors went on to include their participation in their promotion and tenure dossier.

Institute for Scientists and Engineer Educators (ISEE). Dr. Heather Kaluna, who received her PhD in astronomy from the University of Hawai'i at Mānoa's Institute for Astronomy, shared her experiences earning STEM degrees. After an undergraduate degree in physics and math, she was able to study the possible origin of much of the earth's water from asteroids at NASA. This incorporated her personal connection with the ocean in her study as a graduate student. Dr. Kaluna participated in the Institute for Scientists and Engineer Educators (ISEE) summer internship program, which helps students integrate their undergraduate research into graduate research. The program orientation for this internship is run by graduate students. In describing the goals of the ISEE program, Dr. Kaluna said, "The idea is that we actually have the intersection of these two populations of students, all very much from very diverse backgrounds, coming together in such a way that we can actually promote students from undergraduate studies into STEM graduate studies and also promoting the education and success of those students in STEM graduate programs." These students have an 'ohana (community/family) that they can retain through undergraduate and graduate studies. The ISEE program seeks to work with local students to place them in internships with local industries.

The ISEE program also helps graduate students with professional development and while addressing imposter syndrome and stereotype threat. Stereotype threat is a group stereotypes can negatively impact how students think of themselves, and can lead to students conforming to these stereotypes (Steele & Aronson, 1995). "Imposter syndrome creates this unrealistic sense of inadequacy and doubting one's accomplishments and whether or not we should be where we are," said Dr. Kaluna. These issues

can represent serious obstacles for Native Hawaiian scholars. Thinking about how Native Hawaiian students and culture are treated in the classroom is an important part of easing these challenges. "You don't feel like you're some imposter in the classroom, because now the teacher actually recognizes you as an individual and understands the importance of your role in this island." Dr. Kaluna stated that the idea is to promote this idea, giving students a sense of pride in perpetuating science through a cultural lens.

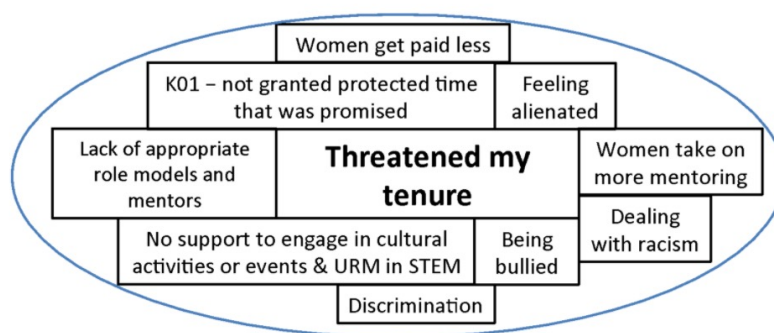
Ho'okahua Program. Dr. Dana-Lynn Ko'omoa-Lange, a Native Hawai'ian biomedical researcher who received her Ph.D. from Brown University in Molecular Pharmacology, Physiology and Biotechnology, discussed intersectional disadvantage in the form of double, triple, and quadruple disadvantaged positions. She, as a Native Hawaiian female from a socioeconomic lower income family and as a first generation college student is quadruple disadvantaged. Most Native Hawaiian students face at least two of these challenges, she felt lucky that in her undergraduate program at San Diego there were other Native Hawaiians present. However, in graduate school at Brown, she almost quit studying science because she felt that the institution was trying to transform her into a predefined role that was counter to her cultural perspective. "I felt just emptiness. I had nobody. There are no Hawaiians there. I had friends, but they had just come from different cultures. I didn't have anybody that had that similar rhythm that I could connect to and then come back to who I was." Even as an assistant professor, she found it difficult to do the Native Hawaiian programming that she wanted to because of push-back from her department chair and the promotion committee, this almost cost her tenure.

Dr. Ko'omoa-Lange discussed challenges to her tenure (Figure 3). The challenges facing those seeking tenure serves as a motivation while working in the Ho'okahua program at UH Hilo. "Ho'okahua aims to increase incoming student preparedness and success in STEM courses and programs, enrollment and completion rates of students in STEM courses and programs, student access to technology and Indigenous knowledge in the STEM disciplines. The Ho'okahua program uses a cohort model where student development is fostered through cultural development courses and activities, personal counseling and workshops designed for specific student needs (Native Hawaiian Student Programs, 2009)." Dr. Ko'omoa-Lange worked in the Ho'okahua program to make UH Hilo an Indigenous campus or Native Hawaiian place of learning. "Part of that was curriculum transformation and developing programs that are sensitive or that utilized some of the Native Hawai'ian culture so that Hawai'ian students can connect to it and engage," Dr. Ko'omoa-Lange said.

Dr. Ko'omoa-Lange discussed the health disparities of Native Hawaiians and the disconnect

for Native people between traditional medicine and Western medicine, which became a topic of interest in the Ho'okahua program. Many students studied traditional Hawaiian medicines and how they interact with prescription drugs. In this case, a sense of community and connection to culture was integral to the ability of scientists to support their local community. Understanding traditional interpretations of health is crucial. A panel of Native Hawai'ian physicians developed the four pillars of native Hawaiian health, which are (1) cultural revitalization, (2) family, (3) neighborhood and community health care, and (4) education and economic stability. Dr. Ko'omoa-Lange discussed the importance of keeping Indigenous ethics at the forefront of research. Dr. Ko'omoa-Lange stressed the importance of recognizing the diversity and uniqueness of Indigenous people, the right of Indigenous people to self-determination, and the right for Indigenous people to their cultural heritage and practices. She said, "Traditional cultural expressions of Indigenous people must be respected, protected and maintained Indigenous knowledge practices and innovations must be respected."

Figure 3. Ko'omoa-Lange, D-L. Challenges to Tenure. Assisting Native and Non-Native Faculty to Become Advocates and Mentors for Native Students. MOONS workshop presentation. (2018 September 20).



Helping non-Native Faculty Mentor Native Students

Many times a difference in cultural perspective colors the discussion over that students are prepared for graduate school. Elaborating, Dr. Ko'omoa-Lange stated, "Our non-Native faculty will say, 'well, I thought they were immature. I thought they're insecure. They're not ready. They're not going to be able to handle a professional program.' It's because they don't value the same values. They don't see the value in the things that we find important." Some of the factors that played a prominent role in helping non-Native faculty mentor Native students were:

- They learned they have to learn a protocol. For example, they learned that they needed to ask permission to enter sacred spaces.
- They learned that Native students enjoyed their research because of their cultural connection to it.
- They learned to communicate information in different ways. For example, one student who was interested in medical school suggested a metaphor of the body as a canoe and all the systems as paddlers. This is a way to use culture-specific knowledge to discuss STEM research via metaphor, and can be extended to other studies.

Discussion Sessions

MOONS workshop participants worked in three groups to address the challenges related to assisting non-Native and Native faculty in becoming advocates and mentors for Native students. The key challenges that emerged were related to Native faculty mentors, non-Native

faculty mentors, and diverse mentors.

Native Faculty Mentors. It is important to understand the experience of Native faculty as mentors, particularly since there are few Native faculty in STEM. Even if students obtain their PhD, they may not actually continue on in academia. Referencing the presentation by Dr. Naomi Simmonds, one participant said, "Talking about all the people who have gone through these PhD programs successfully and how many of them actually went to the professoriate? The number is astonishingly low." Those Native graduate students who continue on to become faculty members frequently are burdened with mentoring most of the Native students, even if they are early in their career. The time and energy it takes to mentor Native students can be great. One Native graduate student is comparable to three non-Native graduate students as far as time commitment due to their needs and unique circumstances. For example, many Native students are dealing with trauma. On this subject, one participant said, "I have never been trained, or received training, nor have any of my scientific colleagues received training in how to deal with trauma, with victims of a lot of different issues. We are not trained social workers. We are not trained counselors. We are not trained in anything, but we're expected to be." Native faculty are given other additional responsibilities such as diversity committees, or organizing events around Native culture. However, there is no institutional incentive for the added student mentoring or additional responsibilities, which often interferes with Native faculty research and promotion. Similar to recruiting Native students, universities do not focus on the retention of Native faculty. It is important to have policies and practices in place that hold universities accountable for supporting, promoting, and retaining Native faculty.

Non-Native Faculty Mentors. Many Native students have experienced negative interactions with non-Native faculty mentors, both intentional and unintentional. Problematic attitudes and behavior include being unfamiliar with the importance of place and culture, being unwilling or unable to engage or relate, biased viewpoints, cultural insensitivity, and cultural disengagement. The interest in learning about and respecting Native culture is important for faculty. One participant shared an experience with their graduate advisor during berry picking season, “I invited her to go berry picking with me. She has never berry picked. I was really enjoying myself and after she berry picked with me, she realized how reflective and connected it could be to Nature and she finally understood why it was hard for me to be away, because that connection that I had with Nature pulls at us as Indigenous people when we go to the university.” It is important to help non-Indigenous faculty better understand Indigenous ways of being.

Presentation: Working with 'Gatekeepers'

Dr. Ed Galindo, University of Idaho & Dr. Jessica Black, Heritage University

Dr. Ed Galindo began this presentation by asking who the gatekeepers in higher education are, or rather what they are. Gatekeepers are people and things that impact students and faculty, and influence their experience and opportunities. Gatekeepers can take the form of teachers, family, friends, elders, students' own expectations, and even technical knowledge. Gatekeepers are in admissions, work in financial aid, and exist in most places where decisions are made on campus.

Dr. Galindo noted that in his research about gatekeepers, he was finding that there was a significant demand for counselors in Indigenous communities because of the high suicide rate. He also noted that gatekeepers can have a positive role in showing students the importance of STEM research. There's a disconnect between the students taking science classes and what they need to do in life, they may not understand what they are doing in school or why it is important outside of school. It is the job of the mentors to

help guide them. High school counselors are gatekeepers, but some don't like science, and can be a barrier for student's interest in STEM. Dr. Galindo had such an experience when his own high school counselor told him, "your people don't go to college. They do two things. They go to the army or they go to welding school." This relates back to the concept of the warrior gene, which was mentioned in several other workshop presentations.

Parents can be gatekeepers as evidenced by the problem of truancy and how that affects achievement. Students themselves can be gatekeepers. For example, they can miss deadlines for important things such as financial aid. Tribal leadership can be gatekeepers. Dr. Galindo related the story of a soil scientist who set out to work for his tribe, but was rejected, because some of the committee members thought he had changed. He lost out on a job application, mainly because of his PhD. "That should not be an issue, but it is a gatekeeper issue," said Dr. Galindo. The attitude about gatekeepers should be to create positive networks, not negative ones. Community is an important aspect for developing Indigenous scholars in STEM.



Photo: Dr. Jessica Black and Dr. Ed Galindo present to MOONs workshop participants on working with gatekeepers.

Dr. Jessica Black continued the presentation by discussing institutional gatekeepers. Dr. Black pointed out that it is important to address student conflicts with advisors, this can be a reason why Native students take a longer time to graduate. Faculty advisors need to be accountable for advising. Administrators can play a key role in making sure that these situations don't escalate and can press the importance of advising without having conflict with faculty. These issues can be lost in institutional hierarchy, and this can be frustrating for students. For example, Dr. Galindo had a Masters student who was a sundancer, and came into conflict with his professor because his professor thought he should be working on his thesis instead of sundancing. Dr. Galindo explained, "The professor, who's non-Indian thought he was square dancing, and said, 'why isn't he working on his work? Why is he square dancing?' He's not square dancing. He's praying even for you. So, I got together in a room that was tense. But this student did something really cool. Had a book. About Native life, slammed it down on the table and said, 'I'm not coming back here until you read that book.'" The professor read the book and apologized. Beyond non-Native faculty, it is valuable to invite university administrators

to cultural events. The more understanding and support from administrators will lead to an increased presence of Indigenous science in academia.

Presentation: Building Alliances with Native Organizations

Chelsea Chee, American Indian Science & Engineering Society (AISES), Brandon Stevens, Tribal Vice-Chairman of Oneida Nation & Josh Lucio, American Indian Graduate Center (AIGC)

The underrepresentation of Native people in STEM is striking, the visibility of Native scientists is important for young people who are considering STEM. In order to increase the visibility of Native scientists, building alliances are key.

Chelsea Chee, who works with the American Indian Science & Engineering Society (AISES), illustrated this point with her own experience, "You can send engineers and professors that do this work and show the career exploration or the options that we could have, especially on the reservations, because I grew up and I only saw a handful of career options." Chelsea created [the Native in STEM website](#) as a tool for finding

Native scientists in order to increase visibility of Indigenous scientists. Networking is important for exposing Native students to different careers in STEM. “So that was one of my really personal experiences of building an alliance and building an alliance at AISES recognizing that I didn’t have all the contacts that I needed to make this project successful,” Chelsea said. AISES provides a connection to other Indigenous scholars, as well as other underrepresented groups in STEM through connections with the coalition such as the National Society of Black Engineers (NSBE) and the Society of Hispanic Professional Engineers (SHPE).

National Alliances. The collective goal of AISES and the coalition is to graduate 15,000 diverse engineers and scientists by 2020. This would mean that future generations are taught by diverse faculty. Chelsea stressed that “two heads are better than one,” drawing knowledge from multiple individuals and groups is more effective. Josh Lucio, a program associate for the American Indian Graduate Center (AIGC), added that alliances can be an important way to coordinate funding opportunities as well as support services

and mentoring. Alliances can also be useful in data sharing and analysis to understand challenges that students are facing. In building alliances, sometimes the most difficult step is just asking an organization for a partnership. Chelsea’s advice is just to ask. Ask the person or organization that you are interested in building a collaboration or alliance with. Focus on improving the existing foundations of your ideas with your partners, rather than starting from scratch or reinventing the wheel. Also, it is important to be energetic and proactive in cooperation with other members of alliances who have different strengths and challenges. Make sure members work with their strengths.

Alliances with Tribal Leaders. Vice-Chairman for the Oneida Nation, Brandon Yellowbird Stevens, spoke of building alliances with tribal leadership to promote STEM education for Native students. An important question that tribal leaders are asking is, how do we utilize scientists within the tribe? Vice-Chairman Stevens pointed to his experience at the National Congress of American Indians (NCAI) policy center, when proposing alliances and programs, hard evidence is key to



Photo: Chelsea Chee speaking with MOONS participants along with Brandon Yellowbird Stevens, and Josh Lucio on building alliances.

illustrating a problem and showing a potential solution at all levels from the practitioner to asking for funds from the federal government. Gathering data on what graduates do after graduation should be a bigger priority. Building alliances with tribal authorities is important to ensure that graduates can contribute upon finishing school. There needs to be better ways of finding resources to make programs more efficient and empower groups to build alliances. There also needs to be more emphasis on broader impacts and how other groups can replicate successes.

Discussion Sessions

MOONS workshop participants worked in three groups to address the challenges related to working with gatekeepers and building alliances. The key ideas that emerged were related to establishing alliances and alliances as community healing spaces.

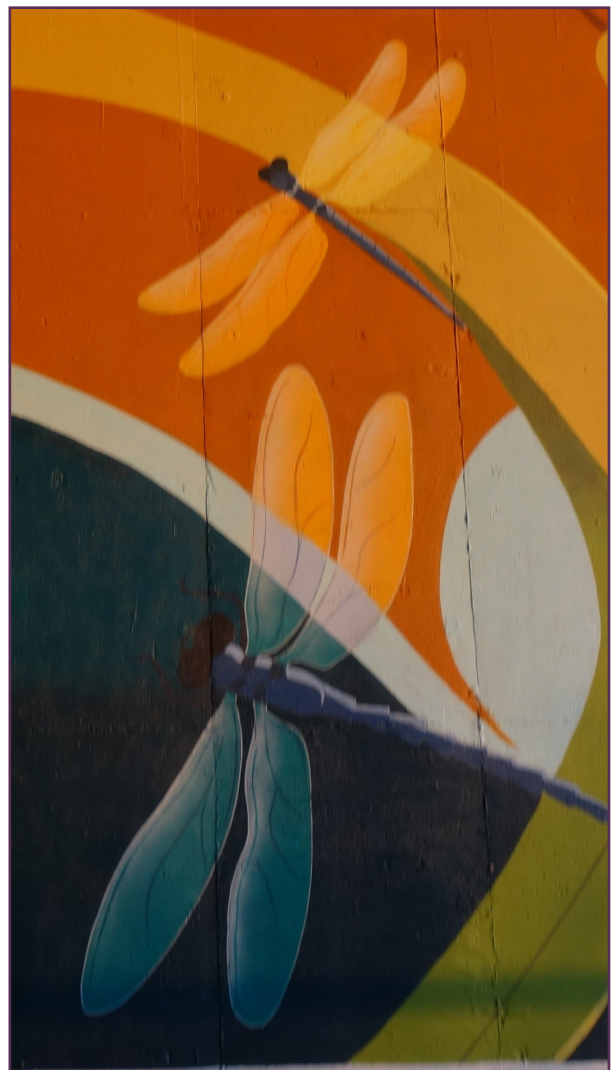
Establishing Alliances. Students in STEM can act as a liaison between tribes and campuses to help address problems that tribes have identified. Talking to students and asking what they are interested in, in their own communities is important for faculty to identify available resources, whether it be in the public or private sector. Faculty advisors and mentors should ask the students, “What could you do? How could you help?” Building alliances with tribal leadership helps to solidify the value of the STEM education that Native students are receiving. It is an opportunity for the tribe to support you emotionally, spiritually, physically, financially, and expect students to come and help out. A key point in rebuilding alliances is having some kind of contract between the partners because then you all know what is essentially expected from each of you.

Alliances as Community Healing Spaces.

Participants discussed the importance of providing a “space for healing,” and getting Native people together to recognize the issues their students face in both their academic journeys and their work to find a job in their communities. Healing is important at the individual level and the collective level, and can be facilitated through research and every day labor. One participant suggested the importance of having programs in place to ensure the opportunity for graduate students to work with their communities. It is important that these mechanisms come from tribes in order to create a welcoming and supportive environment for graduate students who have completed their degrees. The message that these programs would send is, “We understand you. You paid your dues. You still have a responsibility to the nation, to better yourself, and help in building community.” Through the use of transitional programs, Native students could be provided with resources, opportunities to work in their communities, and a connection to the community that is welcoming and supportive.

Based upon MOONS workshop presentations, discussion sessions, applicable educational research, and papers submitted by participants prior to the workshop, the following is a synthesis of the key recommendations. These include:

- 1. Encouraging Native students to pursue STEM**
- 2. Design of STEM programs for Native students**
- 3. Financial and Academic support for Native students in STEM**
- 4. Mentor programs and networks**
- 5. Native and Non-Native faculty mentors**
- 6. Institutional and Tribal partnerships with Native students**



Encourage Native students to pursue STEM programs and careers.

- 1 Encourage Native students to pursue STEM subjects, extracurricular activity, and other opportunities by creating a positive learning environment.** A positive learning environment, which includes building quality relationships, communicating clear expectations, and where a diversity of perspectives are valued, increases student success (Seifert et al., 2014). In order to help prepare Native students be successful as undergraduate and graduates, a clear understanding of early educational experiences, and how those experiences continue to influence students is needed. How young students are introduced to careers in STEM, how conscious or unconscious bias impacts their self-confidence, plays a role in their pursuit of STEM.
- 2 Create connections to STEM by illustrating its relevance to their families and communities. Use real world problems that are facing Native communities to illustrate the importance of scientific study.** One participant provided the example, “From understanding how to make food for a fish if you’re into aquaculture, to understanding how to manage your lumber, or how to manage your grass for a buffalo herd. All that involves knowledge and math.” It is important that students feel that they are learning for a reason. Emphasize active learning, where students have the opportunity to participate in hands-on activities. As one participant explained, “Native people, they learn better by doing, not sitting and listening to how you do it.” Giving students opportunities to connect with what they are learning outside of the classroom is important for their success both inside and outside of the classroom.
- 3 Student engagement is associated with an assortment of educational practices and conditions such as student-faculty contact, collaborative learning, institutional environments that are perceived by students as inclusive and affirming.** (Wolf-Wendel et al., 2009). Increase student engagement by encouraging Native students to direct their research agendas and in designing their own experiments.

Design STEM programs for Native students.

1 STEM programs designed with Native students in mind should seek to develop a curriculum that is culturally responsive and inclusive. Engage with local issues and work with local knowledge holders, facilitate more Indigenous teachers and increase exposure to Indigenous teachers, and having academic role models regularly visit Indigenous communities.

2 STEM programs designed for Native students should seek to integrating Indigenous science and research paradigms, such as:

- Place-based pedagogy helps prepare Native students for graduate school through integrating multiple ways of knowing. As Dr. Norman mentioned in her presentation, the efforts of place-based study are greatly increasing the diversity of STEM.
- Integration of Traditional Ecological Knowledge (TEK) incorporates the historical and contemporary role of human beings in shaping communities and landscapes. Recognition of TEK increases opportunities for productive partnerships between Western scientists and Indigenous communities

3 STEM programs for Native students should be intentional with content and include skill development beyond what is considered strictly STEM. Program curriculum should include critical thinking, writing, and skills that help students navigate their experience in higher education.

- Critical thinking skills include how to develop research questions, how to understand multiple perspectives, and how to engage in community-based research.
- Writing skills should include peer review, writing as Indigenous students, and how to write applications for grants and scholarships.
- Skills that help students navigate their experience in higher education should focus on the student experience broadly. Skills should include transitioning to four-year institutions, time management, self-care, and mental health. STEM specific skills include understanding degrees and careers, how to get involved with research, fieldwork and lab experience, and applying to internships.

4 STEM programs designed for Native students should seek to foster Native scholarship based in community, collaboration, and Indigenous ethics such as:

- Recognition of the diversity and uniqueness of Indigenous peoples.
- The right of Indigenous peoples to self-determination, including their cultural heritage and practices, must be recognized.
- Indigenous knowledge, practices and innovations must be respected, protected and maintained.

5 Increase Native student participation programs that are designed to prepare students for various points in their academic careers. For example, programs that prepare students to begin their graduate programs such as summer bridge programs.

6 Increase Native student programs that target specific knowledge and skills. For example, a graduate writing group that specifically addresses the skill set for writing academic research papers.

7 Programs should be flexible, embrace community responsibilities, and be understanding of the time it takes for degree completion. For example, programs with more online options provide flexibility.

8 Create more opportunities for fieldwork and lab experiences for undergraduate Native students in STEM. High impact practices are those that are intentionally designed to increase student engagement and success. Such practices require students to invest considerable time and effort, facilitate out-of-class-learning, engage students with faculty, encourage interaction with diverse audiences, and provide frequent feedback (McCormick et al., 2013).

9 Ongoing support for Native students in STEM extends beyond recruitment and retention, to persistence. Retention and persistence are often used interchangeably to describe students enrolling, remaining enrolled, and ideally graduating in a timely manner from a university. However, there is an important conceptual framework that distinguishes the two terms. Retention is framed from the perspective of the university. The university retains students, the percentage of retained students is a reflection of the institution's quality, and if a higher percentage of students are retained then the university has accomplished its goal (Reason, 2009). Persistence is framed from the perspective of the individual. Persistence is determined by a student achieving their goal, which allows and encourages differentiating student experiences.

Increase financial support for Native students in STEM.

- 1 Increase graduate student funding for Native students in STEM.**
- 2 Universities should provide a range of scholarships and support for Native students, including funding for tuition, tutoring, textbooks, and other living expenses such as housing or child care.**
- 3 University administrators should work with Native students to help identify funds to support longer degree completion.** Financial aid plays a huge role in non-traditional student education and this particular group of students makes the most use of financial aid to further their education. Most non-traditional students work part-time or full-time and do not have the disposable income to afford their education (Bragg, 2013).
- 4 Offer extensive academic resources in areas that Native students may struggle with as an undergraduate including math and computer programming.** For example, offering a math class free and for credit.
- 5 Provide Native students with access to grant funding.** Grant applications and how they are reviewed is an important example of financial aptitude. Helping Native students prepare for graduate school and life in academia should include an understanding of navigating the necessary processes to be successful, such as grant writing.

Establish and promote undergraduate and graduate mentoring programs for Native students in STEM.

- 1 Provide support for mentorship programs that have undergraduate and graduate Native students working with each other directly, and integrate undergraduate students into graduate students' research.** Undergraduate and graduate mentorship programs allow for students to come together to promote students from undergraduate studies into STEM graduate studies while also promoting the education and success of those students in STEM graduate programs. Graduate student mentor programs also help Native faculty, often expected to mentor Native students. Mentoring is crucial early and throughout the academic careers of Native students.
- 2 Promote undergraduate and graduate student mentor programs that emphasize trust and communication.** An important aspect of a mentor program is having trusted mentors who can personally vouch for programs and departments that respect Indigenous perspectives and individual needs.
- 3 Advocate for undergraduate and graduate student mentorship programs that integrate Indigenous perspectives and methodologies.**
- 4 Include leadership as a component within graduate student mentorship programs where students are taught how to serve as mentors for other students and develop a network.**
- 5 Provide adequate funding to ensure the success of undergraduate and graduate student mentor programs.**
- 6 Establish mentor programs for first year Native students in STEM to help create a sense of community.** Adopt a community model of academic organization that would promote involvement through the use of shared, connected learning experiences among its members, and reorganize the first year of college as a distinct unit with its own underlying logic and pedagogical orientation (Tinton, 1998).
- 7 Engage with national Native networks** such as the American Indigenous Research Association (AIRA), American Indian Science and Engineering Society (AISES), and Society for Advancement of Chicanos/Hispanics and Native Americans in Science (SACNAS).

Encourage Native faculty mentoring and networking with Native students in STEM.

1 Understand and encourage the establishment and sustaining networks of mentor programs and networks that are culturally grounded, and uphold cultural values. For example, the Kaupapa Māori Approach (see Figure 2 in Appendix F).

2 Create networking opportunities that embrace the Indigenous values, such as:

- Community is an important aspect for developing Native scholars in STEM.
- Being part of a network of other Native scientists, especially from one's own culture, is important.
- Fostering mentorship among students within a diverse community leads to educational benefits such as improvements in cognitive abilities, critical thinking, and self-confidence.

Encourage non-Native faculty mentoring and networking with Native students in STEM.

1 Increase the cultural awareness of non-Native faculty. Mentor faculty to become better mentors through training, workshops, or mentoring retreats.

Include topics such as

- Incorporating culture in the classroom
- Promoting a sense of pride for students in perpetuating science through a cultural lens

2 Engage non-Native faculty in cultural events to further their understanding of Native values.

- Provide opportunities for non-Native faculty to understand Indigenous ways of being through experience.
- Set up a system of inviting university members to cultural events to participate in activities rather than just talking about them. This can be a public event, or staying with family in the community.
- Seek permission from Tribal Councils, orient non-Native participants before the event, and debrief after the event.

3 Be supportive of Native Faculty and emphasize that Indigenous advancement is the responsibility of everyone at the university by:

- Recognize time limitations and reduce teaching loads
- Provide more support for Native faculty in leadership roles in academia
- Re-evaluate hiring policies. For example, adding community engaged scholarship to job descriptions, or understanding the relationship between culture and self-promotion.
- Re-evaluate promotion practices taking into account the extra cultural labor that Native faculty are expected to perform for the university.
- Provide recognition that Native faculty that are walking in both worlds, Western academia and Native culture. One participant shared that, "Someone who can walk in both worlds is the type of leader that is needed for the next generation because you have to be able to spiritually handle the responsibilities that being a representative of the Indigenous community but also be able to handle the academic side, the western side and understand where they're coming from."

Strengthen Native faculty mentoring of Native students in STEM.

1 **Using Indigenous approaches to mentorship assists Native students in navigating STEM challenges**

- Creating a culture of listening, and allowing Native students to speak and be heard. This helps deepen the mentee and mentor relationship, and also provides space for Native students to be comfortable in a new and possibly uncomfortable environment. Listen with more than just your ears. Bring your whole self into the space.
- Seek to build trust with students and create a sense of family with students. As one participant explained, “Before we get started, before we do the planting that foundation has to be healthy, which means we have to build that trust, we have to build the ability to understand and be open.”
- Consider a holistic approach when mentoring Native students to help navigate graduate school in a holistic way, rather than just on academics.
- Incorporate self-reflection into feedback, allow students to explore their own stories and be empowered.

2 **Address Native student perceptions of STEM including how they see themselves as scientists, and how they see science in higher education.** It is important to ensure that Native students see themselves as scientists.

3 **Provide Native students with strategies for managing imposter syndrome and stereotype threat.** Stereotypes are especially harmful when students internalize and agonize over them; those who identify most closely with academic achievement are especially vulnerable to stereotype threat (Steele & Aronson, 1995).

4 **Address Native student perceptions of graduate school. Demystifying graduate study is a challenge when working with Native students.**

5 **Seek mentorship from other Native faculty members.** Support the establishment or growth of a system for Native faculty mentorship to gain experience and understanding. Faculty to faculty mentorship helps with future faculty preparation and role modeling.

Establish a supportive environment among institutional gatekeepers working with Native students in STEM.

- 1 Institutions should provide a culturally sensitive and supportive environment.**
There is a critical need for cultural centers on college campuses to support first-generation, marginalized college students, aiding in creating a necessary sense of family away from home (Pérez & McDonough, 2008).
- 2 Encourage Native STEM centers on-campus. Native STEM centers give students a place to be where their identity as a Native student and student of science intersect.**
- 3 Advisors should undertake cultural safety and antiracism training to help foster a culturally safe space for Indigenous peoples, with a sound understanding of the local Indigenous context.**
- 4 Acknowledge and incentivize staff to better meet the needs of Indigenous students, including support and services.** Provide student support services that address various student needs.
- 5 Incorporate Indigenous courses throughout the university curriculum.**
- 6 Encourage Indigenous advisors to support and empower Indigenous students to make well informed decisions and to help manage Indigenous student expectations when entering into university and graduate studies.**

Enhance Tribal partnerships with Native students and academic institutions.

- 1 Tribal partnerships can help drive the research questions and tribal research agenda, identifying issues that the tribe is concerned with and proposing research to address those concerns.**
- 2 Incentivize educational innovation in Native communities and establish Centers for Indigenous Research.**
- 3 Help tribes meet their research needs by funding graduate students that are doing research that benefits the tribe.** Students should present their research to Tribal Councils explaining how the research benefits the tribe.
- 4 Tribes are investing in the future through education.** Uphold Tribal research values in collaborative projects with Native students and institutions.

Appendix A. Workshop Participants

Richard Armenta, California State University San Marcos

Jessica C. Black, University of Alaska Fairbanks

Jessica L. Black, Heritage University

Joe Brewer, University of Kansas

Jocelyn Carter, McMaster University

Chelsea Chee, American Indian Science & Engineering Society (AISES)

Mark Clytus, University of Arizona

Bruce Ervin, University of Alaska Fairbanks

Ed Galindo, University of Idaho

Shawna Greyeyes, Coconino Community College

Agatha John-Shields, First Alaskans Institute

Jay T. Johnson, University of Kansas

Heather Kaluna, University of Hawaii Hilo

Robin Kimmerer, SUNY Environmental Science & Forestry

Dana-Lynn Ko’omoa-Lange, University of Hawaii Hilo

Jamie Lavigne, Nipissing University

John Lee, University of Washington

Josh Lucio, American Indian Graduate Center (AIGC)

Raglan Maddox, Well Living House, Centre for Urban Health Solutions at St. Michael’s Hospital

Gail Makuakāne-Lundin, University of Hawaii Hilo
Phillip Cody Marshall, Haskell Indian Nations University

Katrina McClure, University of Kansas

Elizabeth Medicine Crow, First Alaskans Institute

Heidi Needham, University of Hawai’i Mānoa

Emma Norman, Northwest Indian College

Mark Palmer, University of Missouri

Brett Ramey, University of Washington Conservation Scholars

Naomi Simmonds, University of Waikato

Deondre Smiles, Ohio State University

Lois Stevens, University of Kansas

Ashleigh Thompson, University of Arizona

Hannah Tsingine, Fort Lewis College

Victoria Walsey, Northwest Indian College

Kyle Whyte, Michigan State University

Daniel Wildcat, Haskell Indian Nations University

Brooke Wright, University of Alaska Fairbanks

Brandon Yellowbird-Stevens, Oneida Tribe of Wisconsin

Student Associates

Paulette Blanchard, University of Kansas

Natasha Chenot, University of Kansas

Stephen Esmond, University of Kansas

Appendix B. Workshop Agenda

Mentoring Our Own Native Scientists (MOONS): 18–21 September 2018

Tuesday, 18 September (travel day)

6:30pm – Welcome dinner provided for those who have arrived (Merchant’s restaurant – 746 Massachusetts St.) – meet in lobby at 6:15pm to join walking group

Wednesday, 19 September

Breakfast at hotel (provided, begins serving at 6:30am)

7:45 – 8:15am – Shuttle from hotel to Haskell (meet outside hotel main entrance)

8:00 – 8:30am – Check in and coffee (Board of Regents Room, Navarre Hall)

8:30 – 9:00am – Welcome to Haskell (President Chenault)

9:00 – 10:00am – Introductions

10:00 – 10:15am – Morning break (Board of Regents room, Navarre Hall)

10:15 – 11:15am – Tour of the Cultural Center and Haskell campus

11:15am – 12:30pm – Presentation: The challenge before us – reversing the decline in Native students completing graduate STEM degrees – (Robin Kimmerer)

12:30 – 1:15pm – Lunch catered on site (provided)

1:30 – 3:00pm – Challenge #1: Preparing Native undergraduates for graduate study. (Haskell Environmental Studies Research Institute – Joe Brewer, Cody Marshall, Trina McClure; Northwest Indian College – Emma Norman – via Zoom)

3:00 – 3:15pm – Afternoon break (Board of Regents room, Navarre Hall)

3:15 – 4:30pm – Discussion sessions related to challenge #1 (Discussion facilitators; Mark Palmer, Ed Galindo, Cody Marshall)

4:40 – 5:00pm – Check in and adjourn

5:00 – 5:30pm – Shuttle from Haskell to hotel (dinner on own or small groups downtown)

Thursday, 20 September

Breakfast at hotel (provided, begins serving at 6:30am)

8:15 – 8:45am – Shuttle from hotel to Haskell (meet outside hotel main entrance)

8:30 – 9:00am – Check in and coffee (Board of Regents Room, Navarre Hall)

9:00 – 10:30am – Challenge #2: What goes into developing and running an Indigenous student mentoring network? (Naomi Simmonds – MAI program, Aotearoa/New Zealand)

10:30 – 10:45am – Morning break (Board of Regents room, Navarre Hall)

10:45am – 12:00pm – Discussion sessions related to challenge #2 (Discussion facilitators; Joe Brewer, Jay T. Johnson, Robin Kimmerer)

12:00 – 12:45pm – Lunch catered on site (provided)

1:00 – 2:30pm – Challenge #3: Assisting Non-Native and Native Faculty to Become Advocates and Mentors for Native Students (Gail Makuakāne-Lundin, Dana-Lynn Kōmomoa-Lange, Heather Kaluna – University of Hawaii-Hilo)

2:30 – 2:45pm – Afternoon break (Board of Regents room, Navarre Hall)

2:45 – 4:15pm – Discussion sessions related to challenge #3 (Discussion facilitators; Ed Galindo, Kyle Whyte, Jay T Johnson)

4:15 – 5:00pm – Debrief and adjourn (sign-up for shuttle to campus for presentation at KU)

5:00 – 5:30pm – Shuttle from Haskell to hotel (dinner on own or small groups downtown)

Optional

6:30 – 6:45pm – Shuttle from hotel to KU (meet outside hotel main entrance)

7:00pm – Presentation at KU (Burge Union Forum AB) Setting a Tribal Research Agenda (Ed Galindo: Attendance optional)

Friday, 21 September

Breakfast at hotel (provided, begins serving at 6:30am)

8:15 – 8:45am – Shuttle from hotel to Haskell (meet outside hotel main entrance)

8:30 – 9:00am – Check in and coffee (Board of Regents Room, Navarre Hall)

9:00 – 10:30am – Challenge #4: Working with 'gatekeepers' (Ed Galindo & Jessica Black)

10:30 – 10:45am – Morning break (Board of Regents room, Navarre Hall)

10:45am – 12:00pm – Discussion sessions related to challenge #4 (Discussion facilitators; Cody Marshall, Robin Kimmerer, Joe Brewer)

12:00 – 12:45pm – Lunch catered on site (provided)

1:00 – 2:30pm – Building alliances (Chelsea Chee, AISES; Brandon Stevens, Oneida Tribe of Wisconsin; Josh Lucio, AIGC)

2:30 – 2:45pm – Afternoon break (Board of Regents room, Navarre Hall)

2:45 – 3:30pm – Wrap-up and adjourn

3:30 – 4:00pm – Shuttle from Haskell to hotel

Saturday, 22 September

Breakfast at hotel (provided, begins serving at 7:00am)

All remaining participants depart

Appendix C. Guest Speakers



Dr. Jessica L. Black. Jessica L. Black is an Associate Professor of Environmental Science and Studies and the Director of the Center for Indigenous Health, Culture & the Environment (CIHCE) at Heritage University. Jessica earned a BA in Geology from Wellesley College, a BS in Geography from the University of St Andrews, a MS in Quaternary Studies from the University of Maine, and a PhD in Geological Sciences from the University of Colorado. In her professional career, Jessica has focused her efforts towards the overall goal of supporting diverse undergraduate students in STEM to completion of their degrees so they can transition to graduate programs and the STEM workforce, ultimately diversifying the professoriate and strengthening tribal natural resource departments with skilled indigenous candidates. Jessica continues to work with her colleagues at Heritage to infuse the B.S. Environmental Science and B.A. Environmental Studies degree programs with culturally responsive curricula, respectfully intertwining Traditional Ecological Knowledge, intergenerational learning, and experiential learning methodologies to our classes. Jessica also has a strong commitment to working with indigenous youth from our local high schools, and has established several programs where students conduct community-based environmental research and develop environmental monitoring field skills.



Dr. Joseph Brewer II. Assistant professor in the Environmental Studies program at the University of Kansas. Professor Brewer earned a Ph.D. from the University of Arizona. His research interests lie in working with Indigenous people on community driven land tenure and natural resources initiatives that work towards self-determination. This includes natural resources management for American Indian and Alaskan Natives, energy sovereignty for American Indian tribes and Alaskan Natives, the Federally Recognized Tribal Extension Program (FRTEP), Indian land tenure, and how local/regional Indigenous knowledge informs state/federal natural resources management offices.



Dr. Ed Galindo. Dr. Galindo (Yaqui, American Indian) is a faculty member at the University of Idaho, Associate Director for Education and Diversity for the NASA Idaho Space Grant Consortium, Affiliate faculty member at Idaho State University (Biology Department) and Affiliate faculty member at Utah State University (Physics Department). Dr. Galindo has extensive education and research in working with Native American students. While serving as chairman of the science department on the Shoshone-Bannock Indian Reservation, he was twice elected as the National Indian Teacher of the Year, awarded by the National Indian School Board Association. Dr. Galindo describes himself as “round and brown”, full of curiosity for life and learning. He finds humor in most things on this planet, including himself. Ed is very proud to currently be serving as a board member with the Barry M Goldwater Scholarship and Excellence in Education Foundation. Most recently, Ed was honored to be inducted as a lifetime

(Sequoyah Fellow) member of the American Indian Science and Engineering Society (AISES) for research and educational outreach in the American Indian communities. The Native American Research and Education Foundation was a host of an honoring dinner held at Las Vegas Nevada in April (2016).



Dr. Jay T. Johnson. Dr. Johnson is a Professor in the Department of Geography & Atmospheric Science at the University of Kansas. His research interests are at the intersection of Indigenous and Western approaches to resource and environmental management with a particular focus on sustaining resilient landscapes in the face of environmental change. Dr. Johnson's current research interests concern the broad area of Indigenous peoples' cultural survival with specific regard to the areas of resource management, political activism at the national and international levels and the philosophies and politics of place which underpin the drive for cultural survival. Much of Dr. Johnson's work is comparative in nature and has focused predominantly on New Zealand, the Pacific and North America.



Dr. Heather Kaluna. Dr. Heather Kaluna received her bachelor's degree in Mathematics and Physics from the University of Hawai'i at Hilo (UH Hilo) in 2008 and her Ph.D. in Astronomy from the University of Hawai'i at Mānoa Institute for Astronomy in 2015. She completed her postdoctoral training at the University of Hawai'i Institute for Geophysics and Planetology. Combining her love for science and passion for sharing knowledge, she chose to pursue a career in post-secondary education to share insights gained from astronomical research and to contribute to the field of research. She completed her first year as an Assistant Professor of Astronomy at UH Hilo. A Native Hawaiian woman born and raised on the island of Hawai'i, Dr. Kaluna is keenly aware of the lack of diversity in STEM careers particularly in Hawai'i. Throughout her graduate and postdoctoral career, she actively pursued opportunities to learning about engaging diverse populations in areas of STEM research and learning techniques to become an effective educator. Her participation in the Institute for Science and Engineer Educators has taught her how to incorporate themes such as inquiry, equity and inclusion into her curriculum. Her goal is to employ the knowledge gained from programs such as ISEE to make STEM education and research more accessible to the diverse populations in Hawai'i and most especially at UH Hilo.



Dr. Robin Kimmerer. Dr. Kimmerer is a mother, plant ecologist, writer and SUNY Distinguished Teaching Professor at the SUNY College of Environmental Science and Forestry in Syracuse, New York. She serves as the founding Director of the Center for Native Peoples and the Environment whose mission is to create programs which draw on the wisdom of both indigenous and scientific knowledge for our shared goals of sustainability. Her research interests include

the role of traditional ecological knowledge in ecological restoration and the ecology of mosses. In collaboration with tribal partners, she and her students have an active research program in the ecology and restoration of plants of cultural significance to Native people. She is active in efforts to broaden access to environmental science education for Native students, and to create new models for integration of indigenous philosophy and scientific tools on behalf of land and culture. She is engaged in programs which introduce the benefits of traditional ecological knowledge to the scientific community, in a way that respects and protects indigenous knowledge. Dr. Kimmerer serves as a Senior Fellow for the Center for Nature and Humans. Of European and Anishinaabe ancestry, Robin is an enrolled member of the Citizen Potawatomi Nation. She holds a BS in Botany from SUNY ESF, an MS and PhD in Botany from the University of Wisconsin and is the author of numerous scientific papers on plant ecology, bryophyte ecology, traditional knowledge and restoration ecology. As a writer and a scientist, her interests in restoration include not only restoration of ecological communities, but restoration of our relationships to land. She lives on an old farm in upstate New York, tending gardens both cultivated and wild.



Dr. Dana-Lynn Ko'omoa-Lange. Dr. Dana-Lynn Ko'omoa-Lange, a native Hawaiian biomedical researcher, was born and raised on the island of O'ahu. She received her bachelor's degree from San Diego State University in Cellular and Molecular Biology and her Ph.D. from Brown University in Molecular Pharmacology, Physiology and Biotechnology. She completed her postdoctoral training at the University of Hawai'i Cancer Center and Abramson's Research Center at the University of Pennsylvania. She became a faculty in UH Hilo's Daniel K. Inouye College of Pharmacy in 2011 and currently holds the rank of Associate Professor in the Department of Pharmaceutical Sciences. A recipient of a five-year National Cancer Institute Mentored Research Scientist Development Award to Promote Diversity, her research program focuses on understanding the role calcium and ion channel signaling in promoting metastasis and drug resistance in Neuroblastoma. Dr. Ko'omoa-Lange has dedicated herself to developing outreach programs and curricula that utilize a native Hawaiian cultural based approach to biomedical and pharmaceutical sciences, as well as cancer research. Courses she teaches in the College of Pharmacy include, Culture & Communication in Pharmacy, Complementary Medicine, Pharmacy History, Pathophysiology and Pharmacology for PharmD students and Cancer Biology and Biochemistry in the Pharmaceutical Sciences PhD program. She also offers an indigenous cancer research directed studies course and an indigenous applied science course for undergraduate students. She has served as a mentor in programs that offer unique outreach and research experiences for native Hawaiian high school, undergraduate and graduate students. Her work in indigenous STEM education and biomedical research was published in a chapter titled, "Linking Hawaiian Concepts of Health with Epigenetic Research: Implications in Developing Indigenous Scientists" in the book, "Ho'i Hou Ka Maui Ola: Pathways to Native Hawaiian Health (Hawai'inuiākea, 2017)." She has been a participant in Uluākea, a program to support faculty to incorporate Hawai'i perspectives into their teaching, research and advising and transform UH Hilo

into a Hawaiian Place of Learning.



Josh Lucio. Josh Lucio is Zuni Pueblo from Zuni, New Mexico. He earned his Bachelor of Science degree in Microbiology with two minors in Chemistry and American Indian Studies from the University of Arizona. He is actively pursuing an Executive Master of Business Administration degree at the University of New Mexico. Josh is most passionate about building capacity in Native communities through education. As the Program Associate for the American Indian Graduate Center (AIGC), Josh is responsible for the oversight of AIGC scholarships and fellowships for undergraduate and graduate level students. He assists with the application process, responds to academic inquiries including financial aid issues, and assist with outreach efforts. Josh joined AIGCS in September 2014 having served seven years administering the Zuni Tribal Scholarship program and coordinating various training opportunities for Zuni Tribal Members. During his undergraduate career, he was an active member of the American Indian Science & Engineering Society (AISES) and Beta Sigma Epsilon, an American Indian Fraternity. In his professional career, Josh served a few years as a Reader for the Gates Millennium Scholars Program, an Adjunct Instructor for the University of New Mexico-Gallup branch campus, a board member of College Horizons and Graduate Horizons, Inc., and former Chairman with the New Mexico Tribal Higher Education Commission. He currently volunteers his time serving as the board President for the Colorado Plateau Foundation. Outside of work, Josh enjoys hiking, traveling, and spending time with his family. His most memorable place to travel was last year when he traveled with his family to watch his daughter run in the National Junior Olympics Cross Country Championships in Tallahassee, Florida. Afterwards, they celebrated at Universal Studios in Orlando.



Gail Makuakāne-Lundin. Gail Makuakāne-Lundin has served in leadership roles at UH Hilo for nearly 34 years including Vice Chancellor for Student Affairs, Director of Kīpuka Native Hawaiian Student Center and Hawaiian Leadership Development Program. She currently serves as the Executive Assistant to the Chancellor of UH Hilo and was appointed in January 2018 to establish the UH System Office of Hawai'i Papa O Ke Ao to develop, implement and assess strategic actions to make the University of Hawai'i a foremost Indigenous-serving institution. Makuakāne-Lundin has successfully obtained more than \$25 million dollars in funding from the U.S. Department of Education, National Science Foundation, National Institutes of Health, Kamehameha Schools and the Office of Hawaiian Affairs to develop innovative initiatives to orient faculty and staff to Hawai'i Life Ways to be able to better support native Hawaiian student retention and graduation at UH Hilo: Uluākea, supporting faculty to incorporate Hawai'i perspectives into their teaching, research and advising and transform UH Hilo into a Hawaiian Place of Learning; Ho'okama'āina, introducing new faculty and staff to Hawai'i Island cultural geographies; and Kuku'ena, a community of learners (administrators, faculty, staff and students) through the

foundation of Hawaiian traditional dance (hula). Makuakāne-Lundin serves as an advisor to Keaholoa, a program dedicated to increasing the representation of native Hawaiian and other underrepresented students in STEM disciplines at UH Hilo through research and internship experiences and The Hawai'i Island New Knowledge Fund to provide opportunities for Hawai'i Island students to study STEM.



Phillip Cody Marshall. Mr. Marshall is an instructor in the Indigenous and American Indian Studies Department at Haskell Indian Nations University in the College of Natural and Social Sciences. His research interests include Indigenous environmental protection and justice, and modern perceptions of Native Americans. He resides in Lawrence, Kansas.



Katrina McClure. Ms. McClure is a PhD student in the geography department at the University of Kansas. She received an Associate of Arts degree from HINU and a Master of Arts degree in human geography from KU. She has been a National Science Foundation IGERT (Integrated Graduate Education and Research Training) Fellow under the C-Change (Climate Change Humans and Nature in the Global Environment) program. Her research focuses on how Native American tribes use the concept of food sovereignty to address community food security. My name is Katrina McClure and I am a Phd student in the Department of Geography at the University of Kansas. I am a member of the Muscogee Creek Nation and the program coordinator for the Haskell Environmental Research Studies internship program. My research focuses on how Native American tribes use the concept of food sovereignty to address community food security.



Dr. Naomi Simmonds. Dr Naomi Simmonds (Raukawa, Ngāti Huri) is a lecturer with the Faculty of Māori and Indigenous Studies, and senior researcher with Te Kōtahi Research Institute, at the University of Waikato. She is engaged in a range of Kaupapa Māori research projects pertaining to whānau (family) wellbeing, decolonising emotions, Māori and Indigenous feminisms, land-based learning, and tribal environmental management. Most recently, Naomi has been awarded a Marsden Fast-Start Grant for research that.



Brandon Yellowbird Stevens. Vice-Chairman Brandon Yellowbird Stevens, a member Oneida Business Committee for the Oneida Nation. Elected in 2008, and currently serving his fourth consecutive term to the Oneida Business Committee. Serving 9 years as a Councilman and his first term as the Vice-Chairman for the Nation. The Vice-Chairman has spent this term focused on increasing communication to the general membership and bringing in more opportunities for our the youth through education and experience. Nationally he serves as the President of the National Haskell Board of Regents for Haskell

Indian University, Midwest Delegate for the National Indian Gaming Association Executive Board and serves on the Advisory Council of the My Brother's Keeper Alliance. He earned his Associates Degree from the United Tribes Technical College in Bismarck, North Dakota and then to Haskell Indian Nations University where he earned his Bachelor of Science in Business Administration and received his Masters of Business Administration at Lakeland University with a major in Finance.

Appendix D. Workshop Paper Submissions

Author: Raglan Maddox, Centre for Urban Health Solutions at St. Michael's Hospital

This paper recognises and explores some challenges to indigenous students completing graduate degrees at universities, specifically in Science, Technology, Engineering and Mathematics (STEM). As an indigenous (Modewa Clan, Papua New Guinea) academic and health professional, this paper draws on the literature and my lived experience as a student, teacher, lecturer and researcher across Australia, Poland, the United Kingdom and Canada. I acknowledge that while there are many differences across these countries, there are numerous similarities from which we can share and learn. I humbly acknowledge and respect that indigenous peoples are diverse and constitute many nations, language groups, cultures and experiences, including experiences with and across the education system. Indigenous students have unique and diverse needs, and many indigenous peoples pursue postsecondary and graduate education at different life stages (Battiste, 2002; Behrendt, Larkin, Griew, & Kelly, 2012; Mendelson, 2006). As a result, it is important that indigenous students are supported throughout our studies to graduate, and to thrive in academic settings. However, barriers to university are varied, complex, interlinked and dynamic (Behrendt et al., 2012).

Challenges to indigenous student success in completing graduate degrees. Firstly, too few indigenous students apply to STEM at universities, including graduate studies, partly due to bad experiences and “low school attainment”. The attainment gap starts early as indigenous students progress through school, and continues to the point at which students usually apply to university. The graduate attainment gap between indigenous and non-indigenous students is affected by numerous factors including quality of schooling, school type and “streaming”, parental education and more broadly, various social determinants of health (Figure 1). Further, I think the challenges to indigenous student success in completing graduate degrees stem from our experiences with the education system. Therefore, this paper reflects various challenges, which ultimately manifest in an underrepresentation of successful indigenous graduate degrees.

There is substantial work required to address these issues and universities cannot tackle this in isolation. It is well documented that social justice principles require the rejection of paternalistic and racist foundations of assimilation systems (Bell & Adams, 2016; Human Rights and Equal Opportunity Commission, 1997; Truth and Reconciliation Commission of Canada, 2015). Essentially, reconciliation requires a commitment and foundation of mutual respect. It also requires an understanding that some of the most harmful impacts of assimilation policies include the lack of respect that our non-indigenous counterparts have been raised with for their indigenous siblings. These societal norms permeate across society and the education system (Lau, 2017; Truth and Reconciliation Commission of Canada, 2015). As a result, it is worth noting that indigenous student success in completing graduate degrees, including in STEM fields, starts early.

Early life: pre-school, primary and secondary school. Low socioeconomic status (SES) is too frequently experienced by indigenous peoples (Australian Bureau of Statistics, 2016; Calma, 2015; Firestone et al., 2018; Xavier, O'Brien, Maddox, Muse, & Smylie, 2018). This is generally an outcome that has impacted generations through the mechanics of colonisation that has eroded power, social structures and indigenous community resources (Ministry of Health & University of Otago, 2006; Truth and Reconciliation Commission of Canada, 2015; D. R. Williams, 1999). The erosion of social structures, added stressors

and other associated impacts resulting from colonisation is well documented (Truth and Reconciliation Commission of Canada, 2015).

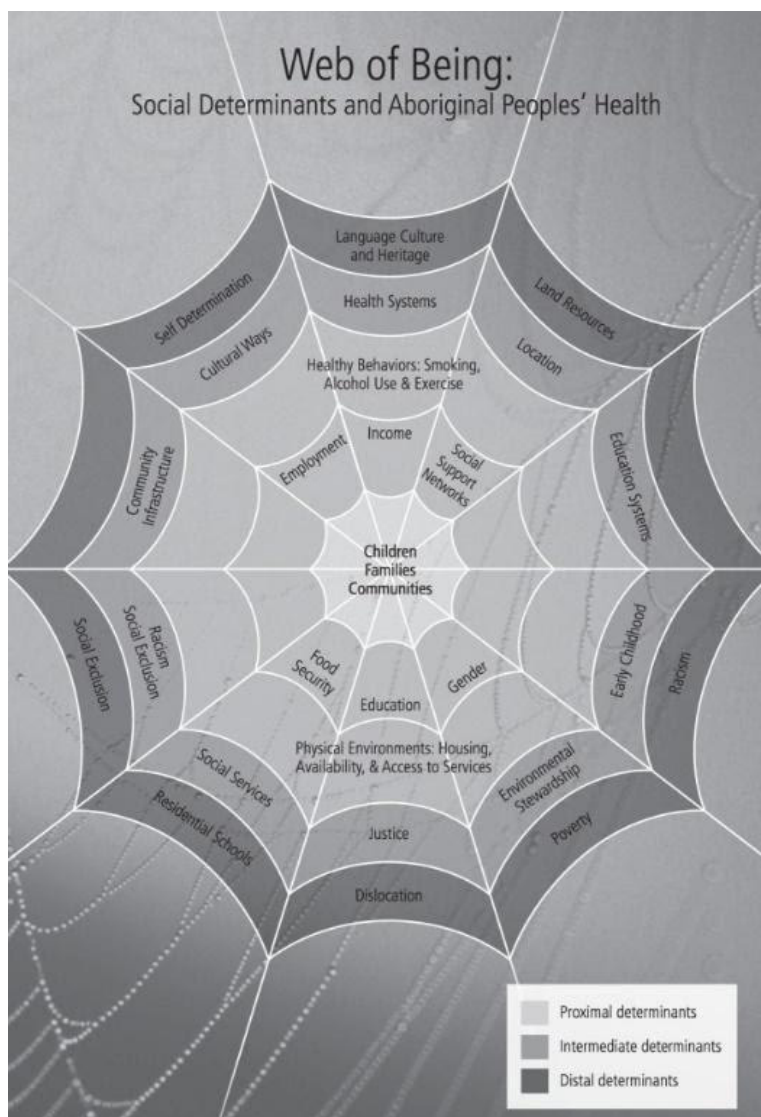


Figure 1. Web of being. Social determinants and Aboriginal Peoples' Health. Greenwood, M. L., & de Leeuw, S. N. (2012). Social determinants of health and the future well-being of Aboriginal children in Canada.

These realities directly and indirectly impact SES, and educational experiences of children, young people, families and students. Further, evidence suggests that infants from low SES backgrounds who achieved promising early test scores are less likely to continue along this trajectory (Sindall, Sturgis, Steele, Leckie, & French, 2015). Pre-school can provide an important foundation, with evidence indicating pre-school as a predictor of positive grades and academic achievement (Taggart, Sylva, Melhuish, Sammons, & Siraj, 2015). However, commonly those at the highest risk of poverty are least likely to take up entitlement to "free early learning and childcare places", facing barriers to accessing such programming (Ferguson, Bovaird, & Mueller, 2007; T. P. Williams, Abbott, & Mupenzi, 2015). Barriers for indigenous peoples could include poor current and historical experiences with the education system, such as a underrepresentation

of indigenous students, indigenous teachers and indigenous role models within schools, experiences of racism and discrimination, negative portrayals of indigenous peoples in the curriculum, for example, curriculum whitewashing (Gibbs, 2006), etc., as well as transport, time challenges, limited awareness of programs and other indirect costs (Behrendt et al., 2012). Further, inequalities continue in primary and secondary school, so that the high performing students in families experiencing low SES in primary school are not among the top performers by the time they reach secondary school; then even less go on to university. Clearly, some of our brightest indigenous students do not achieve their full academic potential. Consequently, school achievement and therefore entry to university and graduate school is substantially impacted.

Recommendation 1: that education departments, pre-school, primary and secondary schools, and universities should work with local indigenous communities to develop locally tailored reconciliation action plans (RAP) where possible. This should provide a locally tailored framework to support reconciliation movements, such as:

- Fostering a culturally safe environment for indigenous students to thrive, including staff undertaking indigenous cultural safety and anti-racism training
- Facilitating more indigenous teachers and increasing exposure to indigenous teachers
- Facilitating more indigenous academic role models and increasing exposure to indigenous academic role models, including stem role models
- Having academic role models regularly visit indigenous communities
- Fostering a curriculum that incorporates strength based indigenous representation
- Developing indigenous curriculum, including respective stem curriculum

University experiences. In relation to university experiences, there is a strong relationship between quality of teaching and the attainment levels achieved by students (REF). Expectations matter. Soft skills matter. In the “best performing” schools and universities, there is often a culture among students and teachers to expect the best academic achievement and opportunities for all students. However, schools’ commonly lower their expectations and/or feed into indigenous stereotypes regarding academic achievement and opportunities. For example, indigenous health science students at university, including medical students too frequently detail harmful stereotyping and microaggressions of teachers, administration and enrollment staff, lectures and others suggesting they expect them to be a good sportsperson, artist or musician, for example, as opposed to an academic scholar.

Too commonly teachers’ assistants, teachers, lecturers, school and university administration, including enrollment staff and the university system fall short of adopting a supportive culture. Further, it is important to highlight that indigenous peoples have been undertaking “academic work” since time immemorial – while noting it is not necessarily documented the same way. For example, it is often purported that quantitative sciences, such as statistics and epidemiology, is a colonised field. However, indigenous peoples have used statistics, quantitative skills and science more broadly in our way of life since time immemorial, including but not limited to ensuring sustainable food for our communities, land stewardship and ensuring the environment is in balance. Our stories and teachings are commonly underpinned by science, “The intellectual and practical activity encompassing the systematic study of the structure and behaviour of the physical and natural world through observation and experiment” (Dictionary, 2008).

Furthermore, my experience suggests that universities are generally Western knowledge centric,

consequently minimising or excluding indigenous knowledges, values, beliefs and ways of knowing and being. Generally, the university system incentivises research funding and publications, over tailoring supports for our indigenous students. This often makes it challenging for indigenous academics (i.e. – role models) to compete with non-indigenous academics for funding and/or tenor track positions, as they are commonly required to undertake tasks that are not always recognised when competing for funding or tenor track positions. Such tasks could include resource intensive mentoring and tailoring of supports for indigenous students, sitting on the research ethics board as an indigenous representative, and teaching various indigenous specific courses or providing indigenous specific lectures.

Recommendation 2: Incorporate indigenous courses throughout university and include strength and asset based indigenous examples into all courses. Such courses and examples should be tailored for indigenous students to help foster advanced indigenous conversations.

Recommendation 3: Incorporate indigenous courses throughout university and include strength and asset based indigenous examples into all courses. Such courses and examples should be tailored for indigenous and non-indigenous students to promote positive indigenous values and knowledges.

Recommendation 4: Acknowledge and incentivise staff to better meet the needs of indigenous students, including tailoring supports and services that may be resource (such as time, talent and funding) intensive.

Recommendation 5: incentivise and formally recognise the roles of indigenous academics, including sitting on the research ethics boards, indigenous representation on diversity groups, and teaching indigenous specific courses or indigenous specific lectures.

Making informed decisions. Decisions on courses, subjects, universities and scholarships, particularly at advanced levels can substantially impact opportunities available to indigenous students when it comes to applying to a competitive course, university or scholarship. This will also impact our students' experiences. Too frequently, indigenous students are not getting the right advice and guidance on the subjects or qualifications to study, as well as university expectations (both the students' expectations of the university, and vice versa). This can result in students not gaining the qualifications they need for their choice of course, scholarship, university or having a suboptimal experience, consequently impacting a student's interest in applying and completing graduate studies. Further, we find the first six weeks of a semester is instrumental in our students' experience. Therefore, it is essential that indigenous students are well supported by our academic community, including our indigenous academic community in the first six weeks of every semester.

Recommendation 6: Course and career advisors with lived indigenous experience are required to support and empower indigenous students to make well informed decisions and to help manage indigenous student expectations when entering into university and graduate studies, include STEM.

Recommendation 7: Course and career advisors should undertake cultural safety and antiracism training to help foster a culturally safe space for indigenous peoples, with a sound understanding of the local indigenous context.

Recommendation 8: The academic community, including our indigenous academic community should be appropriately resourced to provide tailored support for indigenous students, particularly in the first six weeks of a semester. This should include:

- Personal mentoring
- Personal tutoring

Recommendation 9: Establish and promote Mentorship Programs, similar to the Summer Mentorship Program or the Indigenous Science and Engineering Camp, which provide indigenous high school students and indigenous university students with opportunities to explore and gain experience in university studies.

Recommendation 10: Establish and promote Mentorship Programs in universities, similar to SAGE (Supporting Aboriginal Graduate Enhancement) to provide inter-institutional, peer-support/faculty-mentoring education programs, including support for graduate studies in STEM.

Better information, advice, guidance and application support is needed. There are good examples of effective information, advice, guidance and application support throughout schools and universities, but there are substantial opportunities for improvement (Behrendt et al., 2012). This includes increased support for indigenous applications and enrollment at universities. For example, an indigenous liaison officer or a similar position could support indigenous peoples to apply for university and graduate studies, assisting to understand the enrollment process and manage expectations, including a comprehensive understanding of indigenous supports. Further, while grades are an excellent and reliable indicator of a student's academic ability, numerous factors are considered in determining ability and potential in the admissions process (Lau, 2017; Mendelson, 2006). These include personal statements, teacher references and contextual information. An indigenous liaison officer could support indigenous peoples to understand and complete these components of an application, particularly given that some indigenous peoples' teachings and values are based on humility, which can be counterproductive to the university enrollment and scholarship application process. In addition, while there are numerous pros and cons to international study, increasing awareness of international opportunities for indigenous students can also prove beneficial. For example, international study can potentially mitigate the impact of some of the indigenous stereotypes that may have become entrenched within local society due to colonial processes. In addition, international study and exchange programs, particularly across Aotearoa (New Zealand), Australia, Canada and the United States of America could prove beneficial, as there are many opportunities to learn from our indigenous siblings.

Recommendation 11: Universities should provide indigenous specific supports for potential applicants.

Recommendation 12: Universities should provide a range of scholarships and supports for indigenous students, including a range of scholarship to explore opportunities to attend university and to undertake university studies:

- Tuition
- Tutoring,
- Textbooks
- Travel and accommodation

- Child care supports
- Other incidentals

Recommendation 13: Universities should include quotas or identified positions for indigenous students to help account for current and historical barriers to university education.

Recommendation 14: Universities should include quotas or identified positions for indigenous lecturers and academics to help account for current and historical barriers to university appointments.

Recommendation 15: Universities should provide opportunities to study abroad for indigenous students, particularly across Aotearoa, Australia, Canada and the United States of America.

Conclusion. This paper is not a complete list of barriers to the under-representation of indigenous students and their success in graduate degrees. However, this paper touches upon a number of barriers and tangible recommendations to assist address or mitigate such barriers. Further, there is single solution to supporting indigenous students at university and a multifaceted approach is required. Addressing these barriers will take time, commitment and sustained action to ensure indigenous student complete and thrive in graduate degrees, particularly in STEM fields.

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My analysis of the challenge to Indigenous student success in completing graduate degrees, particularly in STEM fields is the importance of all Native American and Indigenous students to have overwhelming engaged network of support (mentorship) from university administrators, faculty, and staff and provide financial means of support that budgets for all expenses for these students especially coming from low socio-economic backgrounds. The college and/or university should provide a culturally sensitive environment and consistent encouragement that will embrace Native American and Indigenous students not just for statistical purposes of enrollment but for more of family-oriented success for these students' lively hood to excel in life by obtaining their personal goals of completing graduate degrees. The other challenge is the right mentorship of university personnel who have comprehensive knowledge of American Indian History, Tribal culture and beliefs, American Indian Policy and Law, and Indigenous Research Paradigms. The common thread through all challenges to Indigenous students' success are about Indigenous education perspective especially the opportunity of the Indigenous Research Paradigm be implemented in Science, Technology, Engineering, Math (STEM) fields. The importance of STEM education in America is major priority for the Western civilization education system at all levels, however, Indigenous education should be also be a priority as well at all levels, especially for Native American students and International Indigenous students pursuing STEM degrees in America.

The discussion about an evolution of American Indian and/or Indigenous education of and for these students while incorporating Indigenous – STEM knowledge into their education matriculation should be allowed at the graduate level. Especially, through a Western civilization science views of doing research

and application of projects on Indigenous lands in these STEM subjects matters a lot for some of these students. The experiences I've had in STEM education and as a professional associated well with the curiosity of Indigenous education I had; that led my affinity toward American Indian Communities which growing up in Oklahoma going to events was some exposure to Native American culture, however especially when I met my wife who is Navajo and her family embrace me by participating in ceremonies which is still an educational journey. My travels across the United States at the collegiate and professional level working with American Indian Science and Engineering Society (AISES), University Grant Consortiums focus on recruitment and retention mentorship of Native American students obtaining graduate level degrees, being an employee for the Navajo Nation, and being adjunct assistant professor teaching at Navajo Technical University a Tribal College and University has also really enlighten me more about the ongoing education struggles of Native American students in obtaining doctoral degrees through Western civilization science unless the research is something the student can relate to helping their native people.

If we had more Indigenous education introduced in our educational system in America as major subject curriculum taught early in elementary and secondary levels of American history subject on consistent basis and allow the contributions for Native American students to present tribal cultural and beliefs at school, then more Native American students would be more comfortable in school and better pride of their Native culture, instead of acknowledging one month of the year only known as a holiday in American history. In *Power and Place Indian Education in America* by Vine Deloria Jr., he argues about "Indigenization" the perspective of Indian education at all levels of education. The concept by "Indigenization", he means an act of making own educational philosophy, pedagogy, and system our own, making the effort to explicitly explore ways of knowing and systems of knowledge that have been actively repressed for five centuries. (Deloria Jr. & Wildcat, 2001) He gives a good depiction of issues facing the diminishing indigenous cultural knowledge of Native American students at all levels of formal education who come different backgrounds from reservations and the urban Native American students who whom try to keep their indigenous heritage by visiting the reservation. He discusses two distinct value systems and worldviews especially the Native American traditional sacred view, and material and pragmatic focus of the larger American Society. This statement by author Peter Iverson also adds to education issues for American Indians historically, "The start of 19th Century began demise of Native Tribes. The Feds "The Great Father" cast a long shadow over Native people and communities." However, the history of American Indians since 1890, then, should include the story of tribal governments and tribal leaders. It should also ponder how Indian communities have carried on and redefined "tradition". (Iverson & Davies, 2015) Therefore, Native American students should embrace their Indigenous knowledge and use it for their benefit of their education pursuit in Western Civilization STEM education disciplines.

If the Western civilization STEM research perspective had more research and application using an Indigenous Research Paradigm in STEM education in America, then significant perspectives would possibly change at all levels of STEM education and not just at the collegiate level for having an American Indian Studies programs educating Indigenous history, Law and Policy, Indigenous traditional cultural values. In *Research Is Ceremony Indigenous Research Methods* by Shawn Wilson, he argues the importance of Indigenous Research Paradigm (Wilson, 2008). This is changing perspective in STEM Education by Indigenous Educators whom especially participate in American Indigenous Research Association meetings (AIRA). The comprehension of the shift or incorporating in Indigenous research methodology perspective in western civilization science education at all levels of education focuses the positive effects of maintaining, transmitting and clarifying and Indigenous way of doing and being in the research process – the basis of an Indigenous research paradigm. The need to examine the paradigm can lead to better understanding of, and provision for, the needs of Indigenous people. Therefore, there must be an appreciation of the differences Indigenous people have in terms of their ontology, epistemology, methodology and axiology

that can lead to research methods that are more fully integrated with an Indigenous worldview (Wilson, 2008). This Indigenous worldview is associated with the same concept “Indigenization” in education. (Deloria Jr. & Wildcat, 2001) These are well distinguished published authors in their respective fields and all have the compassion for advocacy in American Indian education in America to change at all levels of education. I have had the pleasure to meet Dr. Shawn Wilson and Professor Angelique EagleWoman¹ to hear and share conversation on this education topic. I believe the concepts and information presented in these few literary works and challenges previously mention should be always considered especially in comparison views of the western world; who either still think American Indian and/or global Indigenous communities are extinct or very primitive and have no knowledge to contribute to Western science ontologies, epistemology, methodology and axiology in research to an education system. I am motivated for more advanced graduate studies at University of Arizona for a PhD degree, to enhance my knowledge of American Indian Studies and how to work more toward enhancing Indigenous-STEM education into western civilization STEM education as a professor and consultant. I plan on doing this with my research which integrates systems thinking to design Food, Energy, Water Security, Sovereignty (FEWSS) nexus for Indigenous theory and methods of practice to better understanding of Indigenous issues, cultures and values within Indigenous communities.

¹ Angelique W. EagleWoman is a Professor of Law at the Mitchell Hamline School of Law in Saint Paul, Minnesota.

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Challenges to Indigenous Student Success in Completing Graduate Degrees in STEM.

Indigenous students face many different challenges in academia, particularly in STEM programs and more so than their non-Indigenous counterparts. The prosperity of Indigenous students in completing these graduate degrees is not merely dependent on the completion of the difficult course content of that chosen area of study, but rather their success is dependent on a variety of challenges that they must face and successfully overcome along the way. For the prospective Indigenous student, there are issues that they encounter from both within their own community in addition to issues from outside the community among the non-Indigenous population.

For some Indigenous students, this challenge begins the moment they walk into a classroom for the first time. From the onset, these students must bear the brunt of an education that is of poorer quality than that of a non-Indigenous population. Within the Indigenous community, the quality of education delivered to these children is often inferior since schools located within a reservation generally struggle to attract and keep qualified teachers and principals. The available funding to these schools also cause restraints where purchasing basic necessities such as textbooks, computers and school lunches a challenge. Many of these schools lack the much needed funding for building repairs, therefore students and teachers alike endure

a learning environment riddled with leaking roofs, asbestos and mold. Furthermore, many Indigenous parents themselves lack a higher education for a variety of reasons. These parents frequently do not view attaining an education as a major goal or need for their children. If parents do encourage their children to continue their education towards a graduate degree, it is more likely that they guide them towards an easier career other than that of a STEM focused degree. All of these conditions within the Indigenous students' community make fostering a higher education, particularly a STEM degree, less likely.

A students' early years within the educational system really set the stage for their future learning potential. In general, STEM programs are well known to be difficult and they require good grades to get accepted into a particular program. For students that do acquire the grades, this now means that they must leave the comfort of their families and community behind. Because of the unavailability of nearby schools, Indigenous students must move to more urbanized centres where some of these students may be leaving home for the first time. For the most part, these students are placed in non-Indigenous households where their mother-tongue is not spoken and the traditional ways of living everyday life are not practiced, known or understood by their fostering parents. A student's success in STEM can be greatly hindered by the loneliness of being away from home as well as being placed in a non-Indigenous setting. The pressure of living outside the Indigenous community gets magnified and added on top of the difficulties and high demands of learning a STEM focused program. These factors can cause an overwhelmingly stressful situation for a young adult causing some to drop out and return home to seek the security of their families and community.

Outside of the community, there also exists an inherent cultural gap between Indigenous and non-Indigenous students. Non-indigenous populations frequently lack a clear understanding of the history and traditional values of Indigenous people which can leave an already vulnerable student feeling segregated amongst their peers. Depending on their childhood upbringing and what perceptions they have been taught by their parents, non-Indigenous students are often taught to see Indigenous people in a negative light. More often than not, Indigenous students are subject to racism and negative stereotyping from their non-Indigenous peers. These primitive views almost always hinder any type of meaningful relationship between students. Unfortunately, this gap between students is not solely subject to STEM graduate degrees but rather this gap exists throughout the educational system as a whole.

With all things considered, it is not difficult to imagine how a graduate level education, let alone a career in STEM can seem unattainable. Sadly most Indigenous students do not succeed to a graduate level. The number of students that do succeed are far and few between. It is no wonder since Indigenous students can begin to experience negativity from the educational system at an early age or be persuaded by parents to choose an easier path other than that of a STEM focus. The loneliness of being away from family and being excluded from peers can halt the desire to obtain an education all together. Choosing to complete a STEM focused degree is much more than just choosing, it is part of the Indigenous students' environmental surroundings. Choosing a STEM degree is something that must be harnessed from an early age and encouraged to flourish throughout a students' academic career and personal life. Without a positive learning environment, encouragement from parents and educators, as well as acceptance from peers, Indigenous students' prognosis towards obtaining a STEM degree is bleak.

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The challenges that are presented to indigenous students entering graduate school are numerous. Barriers, both intentionally and unintentionally constructed, can make it difficult for indigenous students to complete their degrees or move on to more terminal degrees. These barriers can close in on an indigenous graduate student quickly. Sometimes, they may manifest in offhand comments regarding the 'outsider' status of the indigenous graduate student in the academy. Another barrier can manifest in the very real divide that students must try to gap between staying connected with their home communities yet furthering the settler colonial project through their support and work for the modern American university. I wish to focus on one barrier that can often be the most difficult to overcome—finding a community of fellow Native/Indigenous graduate students at a college/university.

I have found that finding such a community is vitally important for ensuring mental well-being and can provide both intellectual and ontological support for indigenous students. However, such a community can be small or even non-existent. For example, an institution of higher learning may be located in an area that does not have a strong indigenous presence. When I entered my doctoral program at The Ohio State University, I entered a space that was distant from recognized tribal sovereign territories—0.8% of Ohio's 11.6 million people reported themselves as at least part Native American/Native Hawaiian/Pacific Islander (U.S. Census Bureau, 2018). As a result, Ohio State was home to approximately 17 Native American and Native Hawaiian/Pacific Islander graduate students in the fall of 2017 out of nearly 60,000 students on its flagship Columbus campus (Ohio State University Enrollment Services, 2017). Similar small numbers exist at other nearby research universities; 21 Native American/Pacific Islander graduate students were enrolled at Indiana University–Bloomington and 50 graduate students were enrolled at the University of Michigan–Ann Arbor during in fall of 2017 (Indiana University, 2017; University of Michigan Office of the Registrar, 2018). In contrast, during this same time period, the University of Minnesota enrolled 208 Native American/Hawaiian graduate students (University of Minnesota Office of Institutional Research, 2018.), 71 Native American/Hawaiian graduate students were enrolled at the University of California, Berkeley (University of California, 2018), 130 were enrolled at the University of Arizona (University of Arizona, 2018), and 769 were enrolled at the University of Hawaii–Manoa (University of Hawai'i, 2017).

This variety of numbers can be caused by demographic and geographical factors; In Ohio and the East in general, the history of settler colonialism led to the forced relocation of indigenous peoples has led to lower indigenous population numbers in these states. In contrast, places like Minnesota, California, Arizona, and Hawai'i are home to and in closer proximity to larger population clusters of indigenous peoples. Additionally, specific programs at a university will attract different students; I was drawn to Ohio State due to its highly regarded geography program, and other universities will have signature programs that attract indigenous students to attend. Low indigenous graduate student enrollment can therefore be considered a 'unintentionally constructed' barrier; I do not intend to criticize the recruiting practices of universities, their graduate schools, and their individual programs. However, at a large university, with a very small number of indigenous graduate students who are likely enrolled in a variety of disciplines across the academy (I am the only Native American graduate student in my program, for example) combined with the typical struggles that new graduate students face such as imposter syndrome and coordinating a research project, the experience for an indigenous grad student can be one of isolation, especially for those who have moved cross-country and/or left their tribal communities to go to school. This experience is one that I struggled with during my first year. A graduate degree requires enough mental energy and hard work as it is to complete, loneliness and cultural isolation are unnecessary impediments.

So, what is to be done to combat this isolation? I again draw from my own personal experience and point to one small step that we as indigenous graduate students have taken at Ohio State, alongside other Native graduate students at other institutions in the United States—building community through organizing ourselves. Our group at Ohio State University, the Indigenous Community of Graduate and Professional Students (ICGPS) represents a small but growing community of indigenous graduate students who have come together to provide fellowship and support to one another as we go through our individual programs (Ohio State University Student Activities, 2018). Other organizations at institutions across the United States include the Indigenous Graduate Student Association and Native American Law Student Association at Cornell University (Cornell University Student Life, 2018), and the Indigenous Graduate Students Collective at Michigan State University (Michigan State University, 2018). These university specific organization exist alongside more national and international organizations, such as the Indigenous Peoples Specialty Group of the American Association of Geographers (Indigenous Peoples Specialty Group of the American Association of Geographers, 2018). It is important to note that community building does not necessarily mean building a homogenous group of ‘indigenous people’. Rather, I argue that recognizing the diversity of tribal backgrounds and academic fields that are represented in a group of indigenous graduate students will allow these students to generate unique solutions to the common barriers that they all face and will encourage them to be proud in their individual uniqueness.

According to the U.S. Census Bureau, there are approximately 6.5 million U.S. citizens who identify at least in part as Native American or Native Hawaiian/Pacific Islander, approximately 2 percent of the country’s population. This may mean that there will always be a smaller proportion of indigenous graduate students at universities, although I emphasize that this may not be uniformly so across institutions. However, a smaller population need not mean that indigenous graduate students must exist in isolation. By seeking out each other at their institutions, or even across institutions, communities can be built that provide an open and welcoming environment for indigenous graduate students to live by their own cultural values and to support one another as they pursue their degrees and pursue research that can be of benefit to their individual tribes and indigenous peoples across North America, and around the world.

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All of the often-noted challenges to Indigenous people participating in and completing graduate STEM degrees, ranging from financial barriers to lack of preparation during undergraduate experience (and throughout K-12) and family obligations, have been real to me. Though what has been more challenging is not something that excluded entry to, or would have limited success within a program, necessarily, if my work were otherwise in full alignment with the basic premises of the field.

As someone who has worked directly within or immediately adjacent to STEM fields for 15 years without a graduate degree, I would like to offer my conceptions of challenges and barriers within STEM that preclude Indigenous participation generally, followed by what an Indigenized STEM could (and often already does!) look like. Both of these will be offered through ways varied story is highlighted or minimized and surface ways to vision beyond challenges within STEM, as it exists now, and transition the discourse around STEM to focus on ways we might embed Indigenous continuance and survivance into an Indigenized STEM.

Challenges to STEM participation. A challenge to Indigenous participation in STEM graduate programs lies with how knowledge is conceptualized within and across institutions, both academic and organizational, in contrast to where and how knowledge and wisdom is derived within Indigenous communities. At its most basic, a challenge to Indigenous participation in STEM fields, graduate school or beyond, is illustrated by the lack of a letter in STEM that represents Spirituality. In addition to beginning the conversation from a baseline of western materialism, this effectively removes Indigenous story from the dominant narrative, or single story, of STEM-based education.

Without discussion of ways that spiritual dimensions can be integrated into the dominant discourse of the STEM field, it will remain stuck in a materialist perspective of the world, thus rendering itself irrelevant to the shifts in thinking and doing needed most in the fields we hope to engage Indigenous students into. Encouraging willful, uncritical entry into a field that has Indigenous erasure embedded within its acronym is not the sell we should be trying to make to Indigenous students. Instead, how can we support students

who may seek to prepare the world for those to come, rather than merely reinforce the world as it is, through leveraging their access to power structures through their participation in STEM fields?

Story within STEM. Conceptions of STEM, as played out in the dominant narrative, presume a world separated into disciplines, in particular those that exist exclusively in the material world of STEM-related careers. Entrance into these occupations are often presented, particularly to Indigenous and communities of color, as an apolitical intervention towards being “productive” within a capitalist framework, rather than promoted as a way towards expanding and repositioning relationships with STEM to be in service of community life and resurgence of story. In order to excel in this production-based paradigm, individual pursuits, competition and “innovation” are rewarded and knowledge itself is rendered devoid of context—either in place and time. Presenting itself as objective, it serves to minimize and otherwise erase other(ed) stories that hold essential understandings of how to be in reciprocal relationship with place and the knowledges emergent from and generated within them.

A STEM conceived outside of community contexts shifts understandings of how we relate to place (and time) away from seasons and political moments, thus clearing space to further present itself as objective and unquestionably relevant. Institutions become the home-base for knowledge generation and application instead of our communities. As entrance into these spaces can be disorienting and jarring it can be difficult to stay grounded, and the places we love and the stories that emerge from them lose relevance within institutional timeframes. The values and instructions embedded within story become something we are required to check at the door in order to “succeed”, rather than guiding principles and ethics through which we conduct our work. When story is removed from the foundation of work, or otherwise circumvented, our spiritual foundation will easily follow.

An Indigenized STEM in contrast, is grounded in story and reaffirms ways we understand/enact our spiritual roles, responsibilities and relationships to life. Competition is supplanted by collaboration, innovation means contributing to the continuity of community knowledge/values and western-based science is considered just one of many tools we employ to make meaning in place and time. An Indigenized STEM is attuned to the ecological and political realities we exist within, and strategically employs a multitude of understandings derived from experiences and dreams of our ancestors past, present and future to address the challenges faced within our own communities— and by extension all communities. It operates from a baseline assumption of the importance of the collective over the individual. Stories are shared and co-created, offering regular reminders of how we came to be, and how we can continue to be good relatives.

STEAM as a potential way forward. Pragmatically, an Indigenized STEM explicitly integrates arts, which is increasingly common practice and often referred to as “STEAM” (though a truly Indigenized version might opt to go with MEATS!) This allows space to integrate spiritual dimensions, through storytelling/making, while also being recognizable to those currently wed to the dominant conceptualization of STEM. For example, a summer camp for urban Native youth in Coast Salish territories recently completed its 5th year under the moniker of STEAM Camp. Based out of two large parks in Seattle (one secured through struggle by and for the Seattle Native community in the 1970s), young people learn skills and tools recognizable as STEM-related, though always accompanied with additional framings that integrate concepts such as seasonality, relational reciprocity and responsibility to human and non-human communities alike. Each day begins and ends with song.

Within the dominant discourse of STEM, and political moment at this time generally, proposing to incorporate Spirituality into STEM would not be productive towards full integration of the type of story-based spirituality suggested here. Perhaps, then, Art could serve as proxy, given that story has always been integral to Indigenous survivance, and in most instances inextricably linked with spirituality. In doing so we would reinstate Indigenous story into STE(A)M- and do so not for the sake of acquiescing or seeking inclusion from or within the dominant notions of STEM as they exist. Instead it would be a mechanism to bring forward into STEM the power of story held within our communities in ways that is consistent with Indigenous value systems. Doing so not only makes use of STEM as a tool to uphold stories and our relationships to place, but also transforms the field for the betterment of everyone and everything. If prospective (or current) graduate students knew these questions could be foundational to a graduate program I believe we would see more initial interest, and subsequently greater retention and success.

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