

**Recognizing and removing barriers to STEM careers for Native
Hawaiians and Pacific Islanders:
report on a workshop at the University of Hawai‘i at Mānoa
June 1 – 2, 2016**

Prepared by:

Michael G. Hadfield, Research Professor, Pacific Biosciences Research Center,
and Professor of Biology Emeritus, University of Hawai‘i at Mānoa,

JoNita Q. Kerr, Associate Professor, Guam Community College,

Donald J. Hess, former Vice President of Academic and Student Affairs, College
of the Marshall Islands, Majuro, Republic of the Marshall Islands

and

Celia M. Smith, Professor of Botany, University of Hawai‘i at Mānoa,

assisted by

Nancy L. Marker, Educational Specialist, Social Science Research Institute,
University of Hawai‘i at Mānoa

Executive Summary

To better understand the reasons behind the low numbers of Native Hawaiians and Pacific Islanders entering colleges, enrolling in STEM courses if in college, and going into STEM-relevant careers, the National Science Foundation supported a two-day workshop at the University of Hawai‘i at Mānoa (UHM) on June 1 - 2, 2016. Invited to participate were individuals drawn from colleges in Hawai‘i, the U.S.-affiliated islands of American Samoa, Guam and the Commonwealth of the Northern Mariana Islands, and the Compact-of-Free-Association Pacific-Island countries: Republic of the Marshall Islands, Federated States of Micronesia and Republic of Palau. Many of the participants are members of the indigenous peoples of their islands, as well as science teachers in their colleges. Three of the participants, now in STEM careers, were also former interns in a NSF minority-training program for undergraduate students at the UHM.

The participants were charged to consider: why are Pacific Islanders not seeking professional education in STEM fields and entering STEM fields for careers? They were asked to consider issues such as: (1) lack of awareness or opportunities even to learn what scientists and mathematicians do; (2) lack of opportunity due to geography; (3) cultural barriers, wherein value is placed more on other careers and activities; (4) lack of access to college-level training in the sciences; (5) money, that is, seeking the education required for STEM careers is financially impossible; (6) residual colonialism across the islands imposes western approaches, values and examples on education, e.g., educational planning doesn’t take into account the cultural values and approaches of the Islanders; and, (5) continuing U.S. military activities on the islands that restrict islanders to home lands and access to education.

The participants found that similar barriers to STEM education are present in both Hawai‘i and the Pacific Islands. Cultural barriers run deeply and include: strong family, tradition and religious restrictions against leaving home or entering STEM careers; lack of secondary schools on scattered small islands requiring relocation from home to a distant island for high school without financial support; the impacts of the U.S. military presence in the Marshall Islands that forces citizens to live on a small cramped islet without employment opportunities except through the military; poor primary and secondary schools with undertrained teachers and lack of facilities; and, lack of STEM majors and lab facilities at many of the island colleges. Overall, inadequate funding impacts nearly all of these issues: K-12 teachers cannot afford to be additionally trained; K-12 schools cannot afford to build modern classrooms and laboratories; students cannot afford to travel for high school or college education; and, especially, students cannot afford to travel beyond their island states/countries for advanced training or to earn baccalaureate degrees.

On the second day of the workshop, the participants were charged to propose mechanisms to overcome major barriers to entry to STEM careers by NHPI students. The recommendations are summarized below.

Recommendations for overcoming cultural barriers:

- Frame pre-college science and math courses within the appropriate cultural context.
- Engage families in students’ education with opportunities for sharing experiences.

- Improve training in cultural sensitivity such that non-native teachers understand their students' family obligations and sensibilities.
- Provide middle and high school science teachers with professional development that integrates local history, culture and language into science and math courses.
- At the college level, provide safe spaces for students far from home, where they can escape stereotypic threats and find social and emotional support amongst each other.
- Connect college STEM courses to careers other than the traditional medical, engineering or academic pathways.
- Train mentors to be knowledgeable about and sensitive to the cultural backgrounds of their Island students.

Recommendations for reducing teaching and faculty-training problems:

- Bring in qualified substitute teachers from the outside to teach in the classes while the current teachers complete their degrees full time.
- Expand the concept of summer camps for teachers as well as students, to teach teachers a "place and project based" curriculum incorporating cultural sensitivity.
- Employ specially-trained tutors at the schools to help students in STEM curriculum.
- Conduct teachers' "Brown Bag" meetings where they can meet and discuss techniques, curriculum and methodology.
- Provide funding for teachers to attend regional or international workshops/trainings with the goal of building capacity for teaching.
- Ensure that teachers can work within their environment, using not only their schools and classrooms, and redesign or realign the curriculum to accomplish these ideas of working in their environment.

Recommendations for coping with geographical barriers:

- Island high schools must be subsidized to support residences for students who are away from home, as well as travel costs to get to the islands where the high schools are located.

Recommendations for reducing financial barriers to STEM training and careers:

- Most especially, support programs that provide financial assistance for mentorships in research-educational centers.
- Foster multiple communities of interested, motivated students who identify themselves as scientists yet retain their cultural identities and members of their families. Funding will be necessary for mentoring and coordination of services for the students.
- Provide residential tuition rates at colleges across the Pacific and take steps to increasing articulation and communication so that students can easily move from one campus to another.
- Implement a minority program across US-affiliated Pacific Islands with the capacity to loan funds to qualified NHPI students to cover expenses while waiting for federal funds to arrive
- Raise stipends to meet true costs on the family for participation in internships for NHPI students.
- Assist promising students who lack adequate preparation by providing tutoring services during summer internships and after enrollment in 4-year colleges, and allow extra time to make up course deficiencies.
- Form and organize a NHPI Society to encourage networking between NHPI scientists and students, and provide a clearinghouse for scholarship and grant opportunities.

I. Introduction

The islands of Oceania are at the forefront of the impacts of climate change, especially rising sea level. Yet most of the citizens of these islands are little prepared to understand or to mitigate what climate change is doing to their homelands. Similarly, the Pacific Islands are plagued by issues of maintaining sustainable fisheries, the 21st century environmental problems of pollution, providing sufficient water for growing populations, and coping with increasing numbers of visitors. Small colleges across the U.S. flag territories (American Samoa, Guam, Commonwealth of the Northern Mariana Islands) and the Compact of Free Association States (Republic of the Marshall Islands, Federated States of Micronesia, Republic of Palau, whose citizens have the same rights as U.S. citizens to live, work and be educated in the U.S.) work valiantly to educate their students to participate in 21st century discussions and planning relative to climate-change impacts, but lack the capacity – or the time in a two-year curriculum – to equip their students with the in-depth training and experience in research necessary to devise immediate and long-term solutions to the environmental crises they face. Similarly, most students of Hawaiian descent are undertrained in hands-on research necessary to participate in efforts to conserve the unique biological elements in their “extinction capitol of the world.” It is important to note that, outside of Hawai‘i, there is only one four-year college, the University of Guam, with the remaining six colleges all two-year community colleges. A branch of Fiji’s University of the South Pacific located in the Marshall Islands offers a few degrees by “distance learning,” but without critical laboratory classes available for students in the Marshalls.

Native Hawaiians and Pacific Islanders (NHPI) are perhaps the least acknowledged of four ethnic groups recognized by the U.S. government agencies as underrepresented in the fields of science, technology, engineering and mathematics (STEM). In fact, the inclusion of Pacific Islanders (including Hawaiians) with Asians in most federal agency initiatives (e.g., Fact Sheet: What You Should Know About Native Hawaiians and Pacific Islanders; White House Initiative on Asian Americans and Pacific Islanders. <https://www.whitehouse.gov/aapi>) makes it difficult-to-impossible to obtain precise and up-to-date statistics on the severity of the situation with reference to Pacific Islanders in STEM careers.

However, we can determine that Samoans, Chamorros, Marshallese, Micronesians and Palauans are rarely found in STEM careers for a broad variety of reasons, beginning with training as indicated by data in many recent documents (e.g., Lee and Kumashiro, 2005). One of the most telling is a recent report, “Education in Pacific Island States: Reflections on the Failure of ‘Grand Remedies,’” (Levine, 2015), whose very table of contents suggests a multiplicity of causes for the lack of islanders in STEM careers: “Inadequate funding; Do Pacific Islanders Value Education?; Mismatch with Pacific Culture; Lack of Technical Capacity; Education as a Source of Public Employment; Weak Governance; No Incentives to Improve Efficiency; Weak Civil Society.” Data in this report reveal that the problems for many Pacific Islanders begin far before college admittance: “Around 40% of school children in Pacific Island Countries do not complete primary school, and only 20% graduate from secondary school.” STEM careers will be far from the minds of young people who have not even achieved high-school diplomas.

For students of Hawaiian ancestry, it is well documented that there are definite economic barriers to education for many native Hawaiians (e.g., Hawai‘i Papa O KeAo, a report presented to the

UH Board of Regents, 2012, <https://www.hawaii.edu/offices/op/hpokeao.pdf>; Tran et al., 2010). Unfortunately, the situation of the Hawaiians in their homeland becomes essentially one of class, where they have found themselves near the bottom since annexation of the islands put most land in the hands of powerful Caucasian families and, eventually, corporations. Additionally, the population of Hawaiians was decimated by common diseases brought to the islands by Westerners. Two-hundred-plus years later, Hawaiians living in outlying communities and the smaller islands are still struggling economically. With low incomes, these people find access to STEM careers through higher education nearly impossible to obtain. We find statistics such as these in the White House Initiative on Asian Americans and Pacific Islanders (AAPI) (Tran et al., 2010):

- Almost 20% of Native Hawaiians and Pacific Islanders live in poverty (U.S. average living below poverty: 12%) over 16% lack health coverage.
- Pacific Islanders have a per capita income 27% below the national average.
- 15% of Native Hawaiians and other Pacific Islanders hold at least a bachelor's degree compared to 28% for the entire population; 5% hold a graduate or professional degree compared to 10% of the entire population.
- Pacific Islanders are half as likely to have a bachelor's degree in comparison with 27% for the total population and 49% of the Asian American population.
- Only 29% of Pacific Islanders between the ages of 18 and 24 are enrolled in a college or university, which is comparable to African Americans. In contrast, 39% of non-Hispanic whites and 57% of Asians in the age range are enrolled in college.
- Research has found that AAPI's with higher socio-economic status (SES) were three times more likely to begin college at a selective institution than those in lower SES, with Southeast Asian and Pacific Islanders less likely than Chinese, Japanese, and Koreans to begin college at a selective institution.
- The importance of disaggregation of data within the AAPI community can be seen in bachelor degree attainment rates among ethnic subgroups from a high of 69.2% for Asian Indians to a low of 9.4% for Samoans.

In an article entitled, "A systematic review of barriers and facilitators to minority research participation among African Americans, Latinos, Asian American, and Pacific Islanders," George et al. (2014) concluded: "Our review of literature points to the need to learn more about and refine our understanding of barriers and facilitators to research participation among African Americans, Latinos, Asian American, and Pacific Islander groups."

II. The Participants

To better understand the reasons behind the low numbers of Native Hawaiians and Pacific Islanders entering colleges, enrolling in STEM courses if in college, and going into STEM-relevant careers, the National Science Foundation funded a grant to support a two-day workshop at the University of Hawai'i at Mānoa (UHM) on June 1 - 2, 2016. Invited to participate were the following individuals, drawn from colleges in Hawai'i, the U.S.-affiliated islands of American Samoa, Guam and the Commonwealth of the Northern Mariana Islands, and the Compact-of-Free-Association Pacific-Island countries: Republic of the Marshall Islands, Federated States of

Micronesia and Republic of Palau. Many of these participants are members of the indigenous peoples of their islands (as indicated), as well as science teachers in their colleges. Three of the participants (Cockett, Kimokeo and Pelep) were also former interns in a NSF minority-training program for undergraduate students at the UHM. Drs. Mica Estrada, University of California San Francisco, and John Matsui, UC Berkeley, were invited to speak to the group and participated in all discussions. Drs. Sally O'Connor and Amanda Wilcox of the Division of Biology Infrastructure at the National Science Foundation were present as observers.

Pacific Islands

Camacho, Frank, Associate Professor, Biology, University of Guam (Chamorro)
Hess, Donald, former Professor and Vice President, College of the Marshall Islands
Kerr, Jonita, Associate Professor, Biology, Guam Community College (Chamorro)
Macduff, Sean, graduate student, Saipan, CNMI (Chamorro)
Miller, Ross, LSAMP Coordinator, University of Guam
Ngirmeriil, Sherry, Instructor, Biology, Palau Community College (Palauan)
Pelep, Peltin, Instructor, Biology, College of Micronesia (Micronesian)
Sunga, Anthony Jay, Associate Professor, Biology, Guam Community College (Guamanian)
Savu, Vasemaca, Instructor, Education, College of the Marshall Islands (Fijian)
Tagarino, Alden, Instructor, Biology, American Samoa Community College (Filipino)
Yuzi, Vernice, Instructor, Biology, Palau Community College (Palauan)

Hawai'i

Cockett, Patricia, Ph.D. candidate, Texas A & M University (Native Hawaiian.)
Grabowsky, Gail, Associate Professor, Environmental Studies, Chaminade University
Hadfield, Michael G., Professor, Biology, University of Hawai'i at Mānoa
Hosoda, Kelsea – Minority Program Coordinator, College of Engineering, University of Hawai'i at Mānoa (Native Hawaiian)
Kaakua, Joshua, STEM Diversity Specialist, Office of STEM coordination, University of Hawai'i at Mānoa (Native Hawaiian)
Kanahele-Mossman, Huihui, Associate Director, Kipuka Native Hawaiian Students Services, University of Hawai'i at Hilo (Native Hawaiian)
Kimokeo, Bethany, Instructor, Kamehameha Schools, Honolulu, HI (Native Hawaiian)
Manning, Makenzie, Associate Professor, Biology, Kapiolani Community College, Honolulu
Marker, Nancy, Program Evaluator, Social Science Research Institute, University of Hawai'i at Mānoa
McFall-Ngai, Margaret, Director, Pacific Biosciences Research Center, University of Hawai'i at Mānoa
Richmond, Robert, Research Professor, Kewalo Marine Lab, University of Hawai'i at Mānoa
Smith, Celia, Professor, Dept. of Botany, University of Hawai'i at Mānoa
Takabayashi, Misaki, Professor, Marine Science, University of Hawai'i at Hilo
Unabia, Catherine, Associate Professor, Biology, Hawaii Pacific University

III. The Charge to the Participants

The workshop began with a presentation by the organizer, Michael G. Hadfield, who stressed the two major challenges the group had assembled to address, and urged the participants to be very broad in considering what STEM careers may include: science teachers at all levels; college science and math teachers; people working in governmental agencies involved with the environment, fisheries, etc.; many people working for NGOs on social and environmental issues; basic research by lab and field scientists; and the health sciences.

Hadfield asked the participants to consider the following on the first day:

Why are Pacific Islanders not seeking professional education in STEM fields and entering STEM fields for careers? That is, what are the barriers? And, are they truly barriers – i.e., things that stand in the way of individuals who want to enter STEM education and careers – or is the lack of participation something different, such as lack of awareness or lack of cultural value in STEM careers? The group was challenged to consider the term “barriers to STEM” very broadly, including at least the following factors:

- Lack of awareness, opportunity to even learn what scientists and mathematicians do. This may be mainly because of limitations in primary and secondary schools.
- Lack of opportunity due to geography: your island is too far away from the centers of learning in your islands.
- Cultural barriers: value is placed more on other careers and activities, e.g., farming, fishing, etc. Some cultural groups may even place a negative value on science training and careers. Absence of a culturally relevant approach to math and science education, both topically and methodologically.
- Lack of access to college-level training in the sciences, or even lack of quality education in science and math.
- Money: seeking the education required for STEM careers is simply financially impossible for many young islanders.
- Residual colonialism across the islands imposes western approaches, values and examples on education; for example, educational planning doesn't take into account the cultural values and 'approaches' of the Marshallese (Kupfermann, 2008).
- All of the above: e.g., the Marshallese of Kwajalein Atoll are forced to live on the single islet of Ebeye by the U.S. military that uses the atoll lagoon as a target for missile practice from California and is the sole source of income for the islanders. Very few Ebeye high-school students even graduate (<http://hellomarshallislands.weebly.com/education.html>).

Hadfield next asked the participants to spend the second day of the workshop considering:

What solutions to these problems exposed on day 1 can we envision? Can barriers be removed? Can awareness be increased? Can “value” in STEM careers be increased for Pacific Islanders? How? As a group of academics, we recognize that most of our solutions will be academic, but additional approaches should be envisioned and discussed.

IV. The Program, Day 1: Identifying the barriers to STEM education and careers.

A. Expert Presentations

In a successful effort to launch the workshop's discussion, two experts in the area of expanding participation by underrepresented minority students in college science programs were invited to address the workshop. The following talks were given and discussed:

Dr. Mica Estrada, University of California San Francisco, "Creating a Successful Assessment of STEM Initiatives."

Dr. John Matsui, University of California Berkeley, "Diversity Lessons from UC Berkeley's Biology Scholars Program (BSP)."

B. The Panel Discussion

Before they traveled to Hawai'i, seven of the participants, one representing each island group, were asked to form a panel to briefly present the barriers to STEM education and career-participation as they understood them from the perspective of their own islands. The discussants were: Sean Macduff (Northern Mariana Islands), JoNita Kerr (Guam), Vernice Yuzi (Republic of Palau), Peltin Pelep (Micronesia), Donald Hess (Marshall Islands), Alden Tagarino (American Samoa) and Huihui Kanahale-Mossman (Hawai'i). The 7 – 10 minute presentations made by each person in this group deeply influenced the depth of the discussions during the remainder of the workshop. The panel presentations included both personal comments, i.e., the ways in which growing up in their islands inhibited or retarded individual panelists' own development as scientists, as well as specific data relating to educational, financial and cultural limitations to local STEM training in their islands. The major points made by the panelists, were:

- Public schools are poorly equipped to prepare students for STEM courses and majors in colleges. This problem includes lack of teacher training as well as the absence of science laboratories. Several panelists voiced the feeling that, "if a student's interest in science is not captured before she or he enters college, it is too late."
- A pervasive culture of "science is too hard" for island students makes college-bound students unwilling to enroll in STEM courses. Undoubtedly, this point is related to the first one above.
- Family obligations loom large for young people in all of the island cultures, though perhaps less so in modern Hawai'i. As such, family plans and needs take precedence over entering college, college course requirements, and choices of careers. Many students choose college majors that promise jobs "close to home."
- Financial obstacles are often overwhelming for students from most of the islands. Wages are low and 'subsistence living' is still common. While providing comfortable housing and sufficient food, subsistence living does not provide funds for college tuition and books, nor, especially for travel and enrollment at colleges far from home, e.g., within the U.S. states.
- Language is a problem for many students from Palau, Micronesia, the Marshall Islands, American Samoa and even Guam and the Northern Marianas. English is a second

language for most of these young people, which injects an added obstacle when attempting to master college-level courses in STEM fields.

- Geography presents a major barrier to education in several island groups, especially the Marshall Islands and the Federated States of Micronesia. Distances between islands are great, schools are limited, and interisland travel for, e.g., high school, is undependable or nonexistent.
- There is a general feeling that there are few jobs in the home islands in STEM fields, which has some reality when compared to major U.S. population centers.
- Once students are enrolled in the island colleges, many of the problems noted above persist, and additional resistances to STEM enrollment arises, because, for example, faculties include a predominance of western-trained instructors who have little understanding of island cultural values and lack appreciation for the importance of family in the decision processes of their students.
- Most of the island colleges outside Hawaii and Guam do not offer majors in most STEM fields, and, for this reason lack up-to-date science labs and instructors to teach the STEM courses.

C. All-participant Workshop Activities

During the remaining one and a half days of the workshop, all of the participants engaged in in-depth discussions of (day 1) the challenges and (day 2) potential solutions to the problem of under-participation of NHPIs in STEM education and STEM careers. These discussions were led by experienced professional facilitators who functioned to keep the group focused and moving forward on the challenges. Trained individuals also worked with the facilitators to record the verbal discussions. To increase individual interactions, the entire participant group was separated into three break-out groups each day to consider the challenges and solutions. Again, facilitators and recorders assured active interactions by all of the participants and a good account of the proceedings. The all-participants discussions were video recorded, in addition to the typed records.

The following sections summarize the major points that arose during the break-out and all-group discussions of barriers to STEM careers for NHPIs. All of the participants contributed information from local data sets and from their personal experiences to clarifying four major areas that encompassed the reasons why more NHPI students do not pursue STEM fields and enter STEM careers: A. cultural barriers; B. pre-college educational barriers; C. geographical barriers; and D. financial barriers. Each is presented in more detail below.

D. What are the barriers?

(1) Cultural barriers to STEM education and careers

To understand why there are low numbers of Pacific Island students in STEM programs and careers, it is necessary to understand how various socio-cultural factors such as religion, colonialism, a chief system, and family might influence students' attitudes or career choices. Also, we need to understand what it is about STEM programs or courses that might prevent

Pacific Islander students from pursuing them. For example, issues such as relevance to the culture, language barriers, and lack of cultural sensitivity of non-native teachers.

Introduced religions and colonialism

Traditional culture, past and present colonial rule, and introduced religions combine to produce many distinct cultures in the islands of Oceania. The effects of colonial rule and introduced religions are indelibly woven into the mindset and day-to-day living of native Pacific Islanders. Starting in 1521, when Magellan claimed Guam and the Mariana Islands for Spain, other colonial powers followed including France, Great Britain, Germany, Japan, and the United States. Missionaries introduced religions such as Roman Catholicism, Protestant denominations such as Lutheran, Presbyterian, Methodist, Baptist, and smaller groups such as Assemblies of God, Seventh Day Adventists, Jehovah's Witnesses, The Church of Christ of Latter-day Saints or Mormons (Swain and Trompf, 1995).

While colonialism was barely mentioned during the workshop, it cannot be ignored as all of the islands represented in the workshop bear a common history of being a colony of a conquering nation. This report will not attempt to dissect or analyze the effects of colonialism on the different Pacific Island cultures, as island groups were ruled by different nations for various lengths of time and in varying degrees. However, much has been written about colonialism to allow that it does shape or modify the sensibilities, behavior and attitudes of a people. (Aguon, 2006; Hattori, 2009; Hezel, 1982; de Frutos, 2012; Diaz, 2010 and 1994). Indeed, a participant from Hawai'i stated that some students pursuing STEM degrees have developed a 'rebelliousness' against situations caused by colonialism. For example, students pursuing environmental science, biology, and ecology see the need for native perspective in resource protection.

Respect for parents, elders, chiefs and others in authority is a dominant feature of the Pacific cultures (Hezel, 2013). With the arrival of conquering nations, respect had to be extended to the colonizers including soldiers, governors, and missionaries. On Guam, during the Spanish, Japanese and U.S. colonial eras, respect required being silent and not questioning authority. Depending on the era, silence helped one to avoid a beating, getting killed, or fined. Further, the Spanish-Chamorro War (1669-1695) and European diseases severely reduced the native population to 3,436 in 1710 - about one tenth that of the pre-missionary era (Hezel, 1982). Nearly 200 years of efforts by Jesuit missionaries and Spanish military leaders to convert and subjugate the Chamorros included a *reducción* policy that concentrated the people into manageable village areas surrounding a church. Although wars and disease, decimated most of the male population, fortunately the matriarchal nature of Chamorro society helped to retain most of the native language and the customs of reciprocity and respect for elders (Hattori, 2009; Diaz, 1994). While Roman Catholicism and religious practices pervaded daily life, according to Diaz (1994), it is not necessarily so that the religion subjugated Chamorro culture, rather Chamorros appropriated the religion as a means to continue their most valuable societal and familial customs and obligations. This interweaving of culture and religion would later prove problematic for U.S. Naval governors. After the Spanish-American War ended in 1898, Guam was ceded to America for \$20 million. Under the directive of President McKinley, U.S. Navy officers were to demonstrate to the Chamorros that the mission of the U.S. was one of 'benevolent assimilation'.

This involved a succession of U.S. Naval governors who “exercised complete executive, legislative and judicial authority” (Hattori 2009). Part of this effort included discouraging use of the language and even banning fiestas that celebrated a village’s patron saint. The fiestas were viewed as a waste of time and resources, particularly since they diverted food resources away from the military; vastly unpopular, this edict was removed by the next governor (Hattori, 2009). During WWII, Japan invaded Guam in 1941 and for three years, the Chamorros endured yet another attempt to subjugate their language and culture (Higuchi 2001). When the U.S. liberated the island in 1944, a grateful Chamorro populace embraced American rule with a fervor that was not seen prior to the war (Diaz 1994). The Naval governors continued the assimilation policy that still forbade speaking the native language in public places. Many natives became convinced that speaking Chamorro was backward and that speaking English would greatly benefit their children. This created a generation of native Chamorros who speak only English, or speak very little Chamorro. Currently, a renaissance seems to be occurring in which more natives are appreciating their culture and learning the language, no doubt precipitated by nationalistic leaders, more people attending college, and the creation of the Chamorro Language Commission (Diaz, 1994), but, it took decades to happen.

Barriers posed by chief systems, family, religion, and stereotypic threats

Despite colonization and introduced religion, features of traditional culture persisted in the islands, such as the chief system and close family relationships. American Samoa, Yap, the Marshalls, Pohnpei, and Chuuk still have chief systems with varying degrees of power and influence.

During this workshop, with regard to students who pursue STEM, or other courses of study that require them to leave their islands, only one example was heard in which a chief system imposed cultural obligations. This involved a student from American Samoa who was preparing to transfer to University of Hawaii at Hilo. She was unable to do so when her father was bestowed a high chief title and commanded his daughter to stay on-island to fulfill her duties as a princess, which usually involves at least a two-year commitment. American Samoa has a Polynesian patriarchal chief system that forms the basis of “*fa’a samoa*, the Samoan way of life”. The *matai*, or titled ones, are responsible for the welfare and holdings of their clan, or extended family. Together, all the *matai* comprise the *fono*, which is governed by the chief of the highest level, or *ali’i*. The *matai* system is all about the family and ensuring that the needs of the family members are met. The system has adapted to accommodate members who go off-island by allowing a *matai* to rule by proxy. As long as the absent *matai* continues to support the family at home, he is allowed to retain his title (Johnston 2010).

Another concern voiced during the workshop is that politics associated with the chief system in American Samoa often discourages college graduates from returning home. This reduces the number of native role models and mentors. While it is possible that other islands have chief systems that could impose obligations as barriers to STEM students, since no other examples were provided, we are limited to American Samoa as an example.

Although there is great cultural heterogeneity in Micronesia and Polynesia, a consistently common topic that emerged during the workshop was ‘family’. Close relationships and

obligations to immediate and extended family are not merely very important amongst Pacific Islanders, indeed, Hezel (2013) describes the family as “the heart of the identity of an islander.” Obligations and tending to family matters takes priority over school and was cited as a reason many Pacific Island students find it difficult to succeed in STEM programs. Such obligations range from staying at home to care for younger siblings to fulfilling duties if a title is bestowed such as chief or princess. Often, family obligations are related to religious or traditional practices, such as when a relative dies or is getting married and the family requires all-hands-on-deck to assist with preparations for the funeral or wedding. Further, seeking higher degrees in science or other fields forces the student to travel hundreds to thousands of miles away. This is a difficult prospect for both the student and the family. The student faces culture shock, homesickness, loneliness, and loss of a financial and social safety net, and as a participant stated, “Families just do not want the student to leave.”

Additionally, perceived conflicts can arise with religious beliefs, particularly as religion and culture are so interconnected. Stereotypic threats present another barrier that involves prejudice and even racist attitudes encountered by Pacific Island students as they try to maneuver a different culture.

Participants provided these supporting comments:

- In Palau when a family member dies, kids are taken out of school for a week and they fall behind.
- On Guam, family is very important and the main religion is Catholicism. When a family member passes away, obligations include assisting with the nine-day rosary (*lisåyu*), the funeral itself, and the *finakpo*, or the conclusion of the rosary and funeral. The *finakpo* traditionally involves much site and food preparation, Family members are obligated to be available to help with other duties such as preparing the home for visitors, cleaning the church, or watching young children or older relatives. (also, see de Frutos 2012).
- When one of my family members passed away, I got hit pretty hard and started skipping school and weekly meetings with my advisor. I slacked off, not because I was losing interest, but because my family member had died and I couldn't be there to do the work (for the funeral), it felt bad being far away.
- I experienced cultural shock; the tallest building in Pohnpei is only four stories, but when I came to Hawaii, it was like in the movies.
- Besides being far away, living on our own is not a major part of our island lifestyle. Here in the Western lifestyle, once you reach 18, you're independent, you need to leave your parents and go live on your own. Back home we don't do that, parents don't tell their kids to move away; they'd rather keep their kids with them. We grow up with a family-oriented mentality. One thing that might affect students that are traveling from smaller islands just to pursue higher degrees, the fact that they're leaving their family can affect their learning skills. I had aunties and uncles here, but I missed my family for the whole duration of time.

- There is a lack of buy-in with science in general, as it is viewed with suspicion and not to be trusted since it goes along with the topic of evolution, which runs contrary to several belief systems.
- If a parent or elder does not agree with a topic, they will not talk about it.
- Challenging cultural values can lead to disrespecting elders, (or) questioning cultural norms and traditions while pursuing research.
- One thing that got me was the stereotype (sic) threat. It doesn't just happen within the institution (college). I experienced stereotype threat outside of the institution, within the community; in some cases, hearing the word 'Micronesian' is not the friendliest word. That's basically a stereotype. I experienced it myself on the airplane traveling from Honolulu to Hilo. It is one of the major barriers if you're coming to Hawai'i, or if the student is going to Guam. A lot of things are happening in the community that are targeting the students with that ethnicity (Micronesian) and it can actually affect their learning experiences.

Language, relevance, and connecting methodology to island sensibilities

A common statement amongst participants was that, "Students say science is hard." This attitude is likely related to inadequate preparation in grade school, but language also poses a barrier.

The Micronesian region includes Palau, the Commonwealth of the Northern Marianas, Guam, Federated States of Micronesia (FSM), Republic of the Marshall Islands, Nauru and Kiribati. These politically defined areas include islands that are home to populations that speak distinctly different native languages. For instance, the FSM covers an area of one million square miles, dotted with 607 small islands that are divided amongst four states: Chuuk, Yap, Pohnpei, and Kosrae. Although English is the official language, eight major native languages are also spoken - Chuukese, Kosraean, Pohnpeian, Yapese, Ulithian, Woleaian, Nukuoro, Kapingamarangi (<http://www.visit-micronesia.fm/index.html>); additionally, smaller groups of islanders speak Ngatikese, Satawalese, Puluwatese, Mortlockese, and Mokilese. These languages reflect a rich cultural heterogeneity across an area that is just over four times the size of Texas. It is no surprise that language can be a barrier, particularly when courses are taught by non-native teachers. If a teacher asks a question, students might not respond because they have problems interpreting the question.

Another issue that workshop participants cited was the lack of intersection between science and culture. This statement could be examined in two ways:

1. 'Western' science curriculum has little relevance to the local culture and environment. Improving or modifying the curriculum could be as simple as providing problems or scenarios in an island context. As pointed out by panelist Donald Hess, a book that talks about snow is not relevant on a tropical island. Teaching relevant science to Pacific Islanders requires more place-based texts that explain the rainy and dry seasons, phases of the moon and what that means in

terms of fishing, or the king tides, and how they are connected to climate change. Teachers who are both educated in the culture and possess great proficiency in their topic would provide more relevant and effective delivery. This issue is more fully addressed in the section dealing with curriculum.

2. There is little intersection between Western science and indigenous ways of knowing. Western science is based on Aristotle's scientific method of observation, inquiry and conclusions, yet clearly traditional medicine, celestial navigation, and knowledge of seasonal phenomena, such as sea turtle nesting or timing of harvesting certain reef species, are examples of observation-based science – they are just not usually framed as such by scientists and educators (Johannes, 1992; Miller, 2000; Kelson *et al.*, 2003; see also, Alessa, 2016, “*The Other Way of Knowing*, Schooling the World.” <http://schoolingtheworld.org/resources/essays/the-other-way-of-knowing/>). Examples of local science such as these can be easily incorporated into a curriculum that is culturally relevant, recognizes the importance of indigenous knowledge, and demonstrates that observation-based science is universal. What Western science does not recognize or explain are supernatural or religious phenomena that are not falsifiable or testable, or deducible from accepted scientific knowledge. The scientific method cannot test indigenous beliefs, nor can it test Western religious beliefs, and as such, one of its most important theories, evolution, is a conundrum debated in state legislatures and school boards in the U.S.A. As many Pacific Island groups have appropriated various Western religions and retain local beliefs, it is not surprising to find similar misunderstanding of, and even resistance to, Western science. Also, there is a perception that indigenous ways of knowing are inferior to Western science. This must be addressed in the training of STEM teachers at all levels.

3. The methodology used to present science is incompatible with the sensibilities of Pacific Islanders, and many non-native teachers lack cultural sensitivity. Lectures and labs are traditionally used to teach science courses. Teachers expect students to take responsibility for their learning process by asking questions and seeking help if they find that the material is difficult. This approach is fine if the student has been raised in that type of classroom or cultural atmosphere. An explanation of why this type of exchange might not work with islanders is provided by Hezel in his chapter, *Deciphering the Unspoken*. Hezel discusses how Micronesians will agree with a statement, or say ‘Yes’ to a request, not necessarily because they agree, or intend to comply with the request, but because they do not want to disappoint that person (Hezel, 2013). One can imagine this familiar scenario when a teacher pauses a lecture and asks, “Do you understand?”, or, “Are there any questions?” All heads nod in agreement as they do not want to disappoint the teacher. Also, replying to a question calls attention to oneself, and others would interpret this as trying to ‘stand out’. Volunteering an answer that could be wrong also risks ridicule by others. (Hezel, 2013)

Participants provided these comments:

- Language can be a major barrier for Pacific Islanders; when I was at the college, I saw that trying to speak English can inhibit or restrict students’ learning. A lot of the foreign instructors don’t see this. Language is a main issue for Pohnpeians, Marshallese, and other islanders and ethnic groups whose first language is not English.

- The science is felt as not Hawaiian enough, while in Hawaiian culture is felt as not science enough
- Strong native Hawai’ian students are coming up. But there is a double standard in Hawai’i of culture vs. science. Students feel, if I want to be a professor, I have to be good at both, and thus have to work twice as hard.
- Survival on a Pacific island requires cultural knowledge, which is based on science. (A student) needs to learn both, but it takes more time.
- Integration of culture and science – there is an intrinsic bias and value system attached to it.
- Science is a human endeavor and is a cultural practice.
- There is a tendency to see the local cultures as “less than” (Western science).
- Make science relevant and real in our whole lives, but there is a false perception of a separation of science and culture.
- Religion sometimes conflicts with science learning.
- The way STEM is taught is in a manner that is “western” or linear and hard to connect with culture
- Institutions are not culturally responsive – (they) skim talent.
- Once, I went to an instructor for help, but he told me to come back during office hours. I never went back to that instructor, or any other, after that.
- Native students look to their families first for help. If confronted with academic or financial difficulties, Pacific Island students would rather seek help from family and friends, or even drop out and fail, to avoid approaching a teacher.
- Native Hawaiian and local students will not ask for help – it is perceived as a sign of weakness or buying into the colonial administration. They don’t know how to ask or are afraid to appear stupid.
- Young children do not talk so much, they just listen; they do not speak in front of elders, so they do not speak in class. They only speak when asked to speak, otherwise they are disrespectful; they do not ask questions (in class) when they really need to do so.

Opportunities in STEM-related careers – awareness and availability

In Oceania, a large disparity exists with regard to the type of development that includes industry, infrastructure, and services. In Honolulu, concrete and steel high-rises, traffic, government

agencies, private businesses, highly accessible technology, and the associated support services, are vastly different from the less developed, less crowded, tranquil villages of Pingelap or Majuro. Such differences can influence a population's perceptions and attitudes toward STEM and STEM-related jobs. Islands with a more western infrastructure like Hawai'i and Guam provide a wider variety and number of STEM-related occupations compared to less developed islands. By no means does this imply that less developed islands do not require such occupations, perhaps the issue is that few resident people are trained to fill such positions. Indeed, island nations comprised of scattered islands separated by miles of ocean must need at least a minimum number of medical personnel, environmentalists, biologists, Information Technology (IT) specialists, STEM educators, disaster managers, engineers, and planners to meet the needs of these populations, particularly as the effects of climate change become more apparent. If such positions are held primarily by non-native personnel, this only increases the perception that only non-natives qualify for these positions. Or, islanders are unaware that learning science and math is the path to such positions.

Participants provided these comments:

- Students do not take science because they are not familiar with it.
- Students do not think they can succeed in science because they did not do well in lower courses.
- On Guam, students might not be aware that STEM degrees can lead to other careers besides medicine, engineering, law or academia.
- There is so little opportunity to pursue a career locally with integrated knowledge. There is a lack of local STEM diversity for jobs, which are currently mostly military.
- There is a need for more support: teachers, family, government financing and all levels of the whole process.
- There is a lack of role models (of native descent).

(2) The K-12 education dilemma as a barrier to STEM education and careers

A major barrier to students entering into STEM disciplines in many island groups is the lack of foundation of math, science and technology in their K – 12 classes. This is largely due to several reasons: lack of capacity of the teachers, lack of relevant curriculum, lack of adequate facilities and lack of resources. Students need early exposure to science and math to pique their interest so that they may pursue STEM education and careers in the future. There is a need to show STEM relevance to students, to make it connect to their lives. This is not being done in K – 12 in many of the Pacific Islands and probably in parts of Hawai'i in regards to the indigenous people.

Inadequate teacher capacity is a big issue for NHPIs. A majority of the teachers do not have proper training in teaching in the STEM areas. In Palau, nearly 40% of the teachers have only high-school diplomas. (www.palaumoe.net/phs/) In the Marshall Islands according to the Public

School System (formerly the Ministry of Education), as of school year 2015 – 2016, 158 out of 840 teachers, or 19%, have only high school degrees (<http://www.rmiembassyus.org/Education.htm>). This is true throughout many of the Pacific Islands. A result is exemplified by this anecdote of an experience related by a faculty member from the College of the Marshall Islands: an eighth grade math teacher in the RMI school system who is still earning his AS degree is enrolled at the College of the Marshall Islands in remedial math, casting doubt that he has sufficient understanding of the basic concepts of math to teach math to eighth graders.

How can island teachers build their capacities in these areas? In order for the teachers with only high school degrees to further their education, they need to either attend intensive workshops or return to school/college. For a teacher to return to school full time, a replacement teacher would be required to take their classes, and there is no known group of qualified people to do that. Teachers might attend college during the summer but would require financial support and could take only a maximum of two classes per summer. It would take a very long time and a lot of support for such individuals to earn even an AS degree. Some of the teachers with only a high school diploma have been teaching for many years. It is extremely unlikely that they would leave their home islands for many successive summers to get at least an AS degree, even if financial support was available.

Another issue in the Pacific Islands is that there are few grade levels that have teachers teaching only math and science in their classes. Most of the K – 9 classes are self-contained, meaning that the teachers teach all subjects for a given grade group of students (English, social science, math, science, etc.). Clearly, they are not specifically trained for most of these pedagogies. If they are uninformed in many areas, it will be reflected in the accomplishments of their students.

It is axiomatic that teachers must be creative. Resources and technology can be scarce especially in outer and remote islands. Power outages are frequent, and some island villages have no electricity at all. Fresh water can be scarce especially in times of drought. However, teachers are not being trained how to use the resources that are available and could serve them well. Labs for science do not have to be in furnished, high tech labs. Teachers have good opportunities to take students into the environment and use the resources available for science. But to do this effectively requires more and better teacher training.

Part of the problem of lack of STEM training from the public schools is absence of a relevant curriculum. Although the schools have benchmarks and standards, they are often not truly relevant. Many of the education benchmarks have been adopted from a Western curriculum and not altered to be locally relevant. The textbooks, if the schools even have them, are not something students can identify with. If students cannot identify with what they are being taught, they probably will not develop an interest in that subject.

There is also a lack of adequate facilities especially in the outer islands of the countries. In the Marshall Islands and other island countries that have schools on outer islands, the classrooms often consist of only thatched open air huts, and students of different grade levels are often combined and taught by one teacher. (<http://hellomarshallislands.weebly.com/education.html>).

Participants provided these comments:

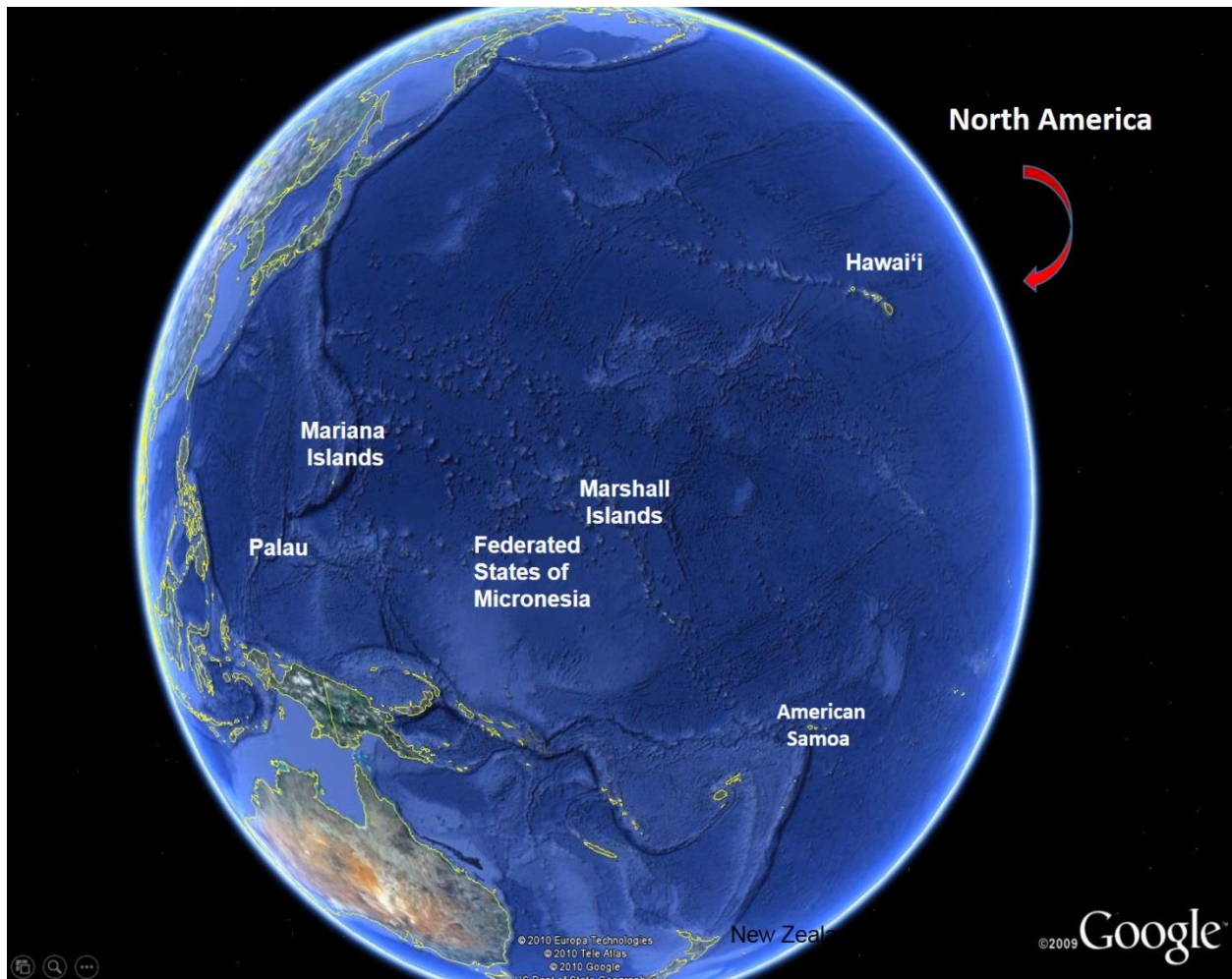
- Students are afraid of STEM courses, because they do not see any relevance. Maybe they are not aware or think there is a lack of jobs available with just a bachelor's degree.
- Lack of awareness or understanding of the values of STEM education in the community leads young people away from interest in STEM careers.
- Students' limited exposure to structured education and pre-college STEM reduces their experiences and interests in science.
- Limited exposure for students to STEM pre-college and a structured education reduces students' experiences with science.
- STEM is not relevant to students – they don't see the connection to their lives.
- Poor teachers are a barrier. The ones who stand out are the ones that help you. As an instructor, I do my own method. I don't teach the scientific method. I ask the students: what do they do to prepare for this class? Often, what they were doing is the scientific method. Give them science in a way they do not know they are learning it. Connect to grandparents, this is the reason why something happened, or why culture is the way it is.”
- Teachers are averse to math.
- In Guam, the larger policy limits what teachers can teach (e.g., they “teach to the test”).
- Native Hawaiian and other Pacific Islanders do not ask for help because they see it as a sign of weakness (they don't know how to ask or feel afraid to appear stupid).
- In Palau, access to technology is harder in some areas.

(3) Geographical barriers to STEM education

A significant barrier to students entering into STEM disciplines is the sheer enormity of the geographical area of the Pacific Islands and Hawaii. The Marshall Islands includes 23 inhabited atolls ranging over 750,000 square miles, with villages and elementary schools on all of them. However, there are only five high schools across 23 inhabited islands (prism.spc.int/images/census_reports/Marshall_Islands_Census_2011-Full.pdf). This means that most students have to leave home to attend high school on a distant island, and there are many factors that impede a student from doing this. The student has to rely on travel either by ship or local airlines, but in the Marshall Islands, there is no regular schedule for ships to travel between islands, and they can be days or even weeks later than they are scheduled. The result is a student will not be able to attend school on time or maybe not at all during a semester.

The Federated States of Micronesia (FSM) is comprised of four different states that were originally different countries (Pohnpei, Kosrae, Chuuk, and Yap) that have been incorporated

into a single country made up of more than 600 islands. Each state includes a major high island and many atolls scattered across wide expanses of ocean. Most of the inhabited islands have elementary schools (164 across the FSM), but few have high schools (total public high schools, 24), again meaning that all students from the small atolls or islands must leave home, travel significant distances and live with relatives or in a boarding arrangement to attend high school (<http://www.fsmed.fm/index.php/public-info/education-statistics1>; <http://www.micsem.org/pubs/articles/education/frames/edstatsfr.htm>).



In the Republic of Palau, some of the inhabited islands are connected by roads, so that students finishing eleven elementary schools can travel by bus to the single public high school located in the town of Koror. However, students from five other islands not connected by road to Koror must move to Koror and live away from their families to attend high school. (see <http://www.micsem.org/schools/palau.htm>). There is no possibility for students to commute these distances by boat. Private, parochial high schools are also available, but are, again located only on the main islands.

In the Marshall Islands, only one local airline provides service. The airline does not go to all of the atolls and more frequently than not, its planes are not operating due to maintenance issues.

Schedules are also subject to change without notice. There are no airlines that travel to the outer islands in the FSM and therefore travel has to be by ship. Most of these ships do not have regular schedules. Travel between the states is only provided by United and their flights are three times a week in one direction and three times a week in the opposite direction. For Kosrae it is only two times per week. Students have a very difficult time in getting to high school by the time school begins. Cost is definitely an issue when a student has to travel to another island to attend high school. Costs include travel, uniforms for school and room and board. Many islanders simply cannot afford this and therefore will not send their child off island to high school.

Travel between Pacific Island countries and even within a country is not as simple as travel within the United States. And, it is extremely expensive; e.g., round-trip airfare between the Marshall Islands and Hawai'i is currently more than \$1,400, and airfare from the Marshall Islands to their closest neighboring population center in Pohnpei (FSM) costs approximately \$1,000 (<http://www.united.com/us>).

Geography is a great barrier to STEM education for the students. The island countries in the Pacific are spread out over thousands of miles. Due to this and the reasons cited above, it is very difficult for students to receive a good STEM background to continue in these fields. For most of them, college is the first time they have had any formal education in the STEM disciplines. In the RMI, although there are only 70 square miles of land, the land is spread out over 750,000 square miles of ocean (www.worldatlas.com/webimage/countrys/oceania/mh.htm). FSM consists of approximately 270 square miles of land spread over one million square miles of water (<http://www.fsmgov.org/info/geog.html>). Palau has 177 square miles of land and 241,000 square miles of ocean. (www.infoplease.com/country/palau.html). The number of islands in these countries is several thousand. The logistics to provide education and in particular STEM education in these areas is extremely challenging.

(4) Financial barriers to STEM education

Decades without funding for K-16 programs that bring NHPI students into STEM fields has left us with enormous and costly barriers. While some minority groups in the U.S. have benefitted from federal funding programs for decades (e.g. Historically Black Colleges and Universities, HBCUs), financing the costs of STEM participation for NHPI students is ultimately a costly process of trying to develop talent in geographic regions where enrichment programs have rarely been run, mentors are unidentified and federal funding for STEM training and assessment has been minimal.

Financial Causes of the K-12 Education Dilemma

The majority of issues raised in Section B, above, reflect failures at many levels to fund programs that bring high quality standards, funding and accomplishments to STEM education for NHPI students in K-12 classes. With little funding, no real progress can be made to bring the NHPI population to federal standards for student accomplishment. The talent pool among these children is high because at this age, students are, by nature, keen observers of the natural world. Yet, lack of trained teachers as discussed above, limits all children's futures. Thus, the major financial barriers for K-12 STEM programs are: (i) a lack of funding to make teacher

development consistently available in the home institutions for NHPI students in kindergarten thru high school education, and (ii) a lack of funding for student support or mentoring for NHPI students in STEM areas.

Financial Barriers for College Students

The financial barriers that exist for NHPI college students began with their subpar K-12 education. These barriers can be considered ‘longitudinal deficits’ because of poor funding across their educational timelines and pathways to college and their careers. The critical barrier then is the systemic infrastructural deficiencies in STEM support at any level, from K-12, college and post-graduate studies. This critical barrier to STEM success is geographically biased, institution-wide and hampers students throughout their education. As a result of little funding, other dependent situations arise such as: 1) a lack of consistently available teacher development in the home institutions for NHPI students; 2) a lack of consistently available student support or mentoring for NHPI students; 3) a failure to demonstrate how STEM professions are relevant and to allow career planning for NHPI students via internships; and, 4) a lack of coordination across STEM programs to facilitate training and nurturing of all students.

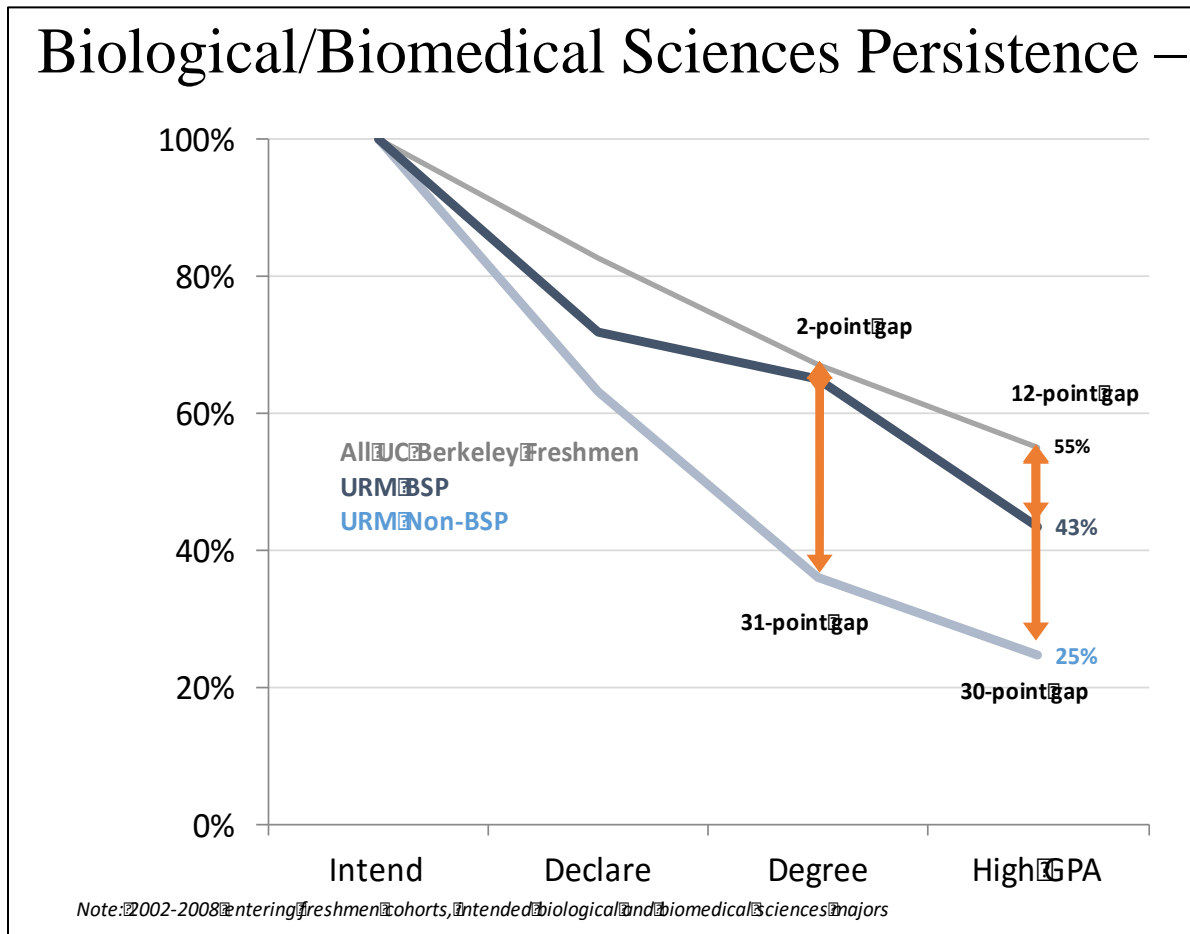
It became clear during the workshop that individual faculty and students have been able to make differences, but this is work of a few, rather than a broad-based program geared to system-wide changes across the educational framework of Pacific institutions from kindergarten to higher education at colleges and universities.

A closer look at dependent situations impacted by drastically inadequate STEM funding.

A first gap is the lack of funding to make teacher development consistently available in the home institutions for NHPI students. In past years, NHPI students who participated in a previously-funded NSF-URM program (Undergraduate Research Mentoring in the Biological Sciences) came to the University of Hawai‘i with backgrounds that prepared those students to teach in K-12 schools. Few knew the approach to framing hypothesis-driven research, had the tools to develop place-based research, nor were readied for STEM jobs in their home economies.

Second, a lack of funding for consistent financial student support for STEM mentoring is a fundamental barrier; students are not given the opportunity to identify themselves as scientists. That identity is one of the best predictors of long-term success. During the workshop, Dr. John Matsui provided an insightful overview of the Biological Scholars Program (BSP) at UC Berkeley (bsp.berkeley.edu). The BSP shows the positive impact by providing an interface between the educational community and those minority students who want to explore STEM for a bachelor’s degree. The students accepted into the program are given stipends for work in research labs and internships and are financially supported for attending conferences. Along with this financial assistance, programs like BSP work because they allow students to see that STEM is interesting, relevant to their lives, and that they are capable of competing in that world as well as their own culture.

The underlying strategy of developing a critical mass and building long-lived institution-funded communities of mentors and mentees has not even been attempted by any 4-year undergraduate-serving institution with NHPI in their student body.



Data presented in the figure above reveal the value of funded mentorship in the Berkeley Scholars Program. Thirty percent fewer students from underrepresented minority groups who were not in the BSP completed compared to those minority students who joined and remained in the program until graduation. Financial support is a most important factor in retaining minority students in STEM majors.

Information presented to the Workshop participants by Drs. Matsui and Estrada revealed that establishing a personal identity as a scientist is critically important to long-term success in undergraduate programs. Data from the BSP mentoring program underscores that those students who view themselves as scientists have the greatest likelihood to succeed.

Despite the presence of programs such as UC Berkeley's BSP, income inequality - low levels of incomes for NHPI students- is a real threat to their STEM success because low family income can prevent students from being able to take advantage of programs that are available in select locations such as existing REU opportunities. Many NHPI students work to support their

families. Even a program that pays a stipend may not cover lost wages during an REU, leaving a lasting negative impact for their families.

A third financial deficiency is the lack of funding for programs that highlight STEM professions as relevant careers for NHPI students, their families and communities. We have no clearinghouse for general information or internships in STEM across these minority groups. Internship clearinghouses are often run by student centers, home departments or other student-oriented programs on major campuses. Not having a specialized internship program for NHPI means that students are not recruited nor placed in federal or agency offices across the Pacific region.

This lack of professional development is only acceptable if you dismiss the possibility of STEM careers in the Pacific Islands. However, the numbers of STEM jobs with fisheries, weather and reef health increases yearly and their importance has jumped proportionally with global change challenges. Pacific region-based scientists are needed now more than ever to ensure the best management decisions are made to preserve cultural practices and islanders' ways of life, if at all possible. For example, decision makers at the United Nations and elsewhere are trying to put legal frameworks together such as floating oil-rig like structures or "lily pads" to replace islands that will be inundated with rising sea levels (<http://vincent.callebaut.org/page1-img-lilypad.html>). Plans for lily pads make no provision to sustain the fishing culture known throughout the Pacific. The voices of these island peoples need strong scientific content for their responses to be heard over the well-intended, but out of touch planning by dominant political groups. Having substantial upgrades in the quality of professional development among teachers in the K-12, colleges and universities among NHPI serving institutions is essential.

A final, fourth, financial gap is the lack of funding for a system-wide infrastructure from college and post-graduate studies in large parts of the US Pacific region. In reality, there is no facilitation for across-institution exchanges that could lead to networking for Pacific-region educators and students. Such disconnects are profound and lead to students not getting scholarship funds in time to make payments at other institutions, and they then face academic probation. There is a lack of travel funds or programs to facilitate taking courses at other institutions. Records are full of students who transfer from the island community colleges to the University of Hawai'i at Mānoa and find that their course credits that count towards their majors, are not accepted. Thus, to finish with a BA or BS in a STEM major at UHM means that a transfer student from Palau or Federated States of Micronesia faces three to four additional years of coursework and the associated costs. This lack of Pacific-wide integration creates a second-class tier of college students when those students attempt to compete in national programs.

In sum, during discussions and panel presentation, it became very clear that there are consistent and potentially nearly insurmountable financial barriers to STEM education for minority students across the Pacific Islands and in Hawai'i.

Participants provided these comments:

- I am from Pohnpei. The University of Hawai'i requires tuition payment tuition in timely manner, but scholarship funds come in late. Our government meets in late

August - September, but it doesn't get scholarship info to University of Hawai'i in time for the deadline.

- Financial aid changes—scholarships vary from year-to-year.
- Financial support/ benefits because minority faculty are rare and get headhunted by other universities. Local faculty should be offered higher salary by universities or better packages than international faculties.
- Provide scholarships with incentives for students to give back to their communities or pay back the scholarship funds.
- Needs for more support: teachers, family, governments (financing) and all levels of the whole process.
- Financial difficulties - can't go to conferences.
- Lack of coordination across Pacific institutions continues to limit students' access to funds, opportunities.
- It is time to invest in all aspects of STEM research and education in this critical part of the Pacific region, to overcome 1950's policies that aim to keep residents under-educated, to use electronic technologies to link like-minded institutions to nurture this next generation of STEM leaders who will help us all by raising the standards, asking the correct questions for resource management and finally putting policies and best practices in place, to protect their island communities in the face of global change.
- A Micronesian participant, now teaching at an Island college, related that he had been a student who participated in the NSF-UMEB and URM internship programs at the University of Hawai'i. He said that when he left his home island he faced difficulties that included insufficient financial support, long distance travel away from family, reticence to seek assistance, and threats based on being stereotypically characterized in definitely negative terms.
- A participant from the Commonwealth of the Northern Mariana Islands related very similar experiences when he left Saipan to further his education in Hawai'i. Both participants gained focus and direction from individual mentoring in the U.S. with financial assistance that was critical to their success.

IV. Day 2: Identifying Solutions – how to remove the barriers to STEM education and careers for Native Hawaiians and Pacific Islanders.

A. Overcoming or reducing cultural barriers.

As noted above, participants in the workshop found that bridging the gap between science and culture is a major issue. Until more indigenous islanders become science instructors and return

to their islands, non-native teachers will be needed to teach STEM courses. Further, indigenous students who leave their islands to seek STEM degrees experience culture shock, stereotypic threats, loneliness and loss of a family support net.

Recommendations from participants for overcoming cultural barriers:

- Frame science and math courses within the appropriate cultural context would help increase awareness of the importance and relevance of STEM fields. This would involve creating place-based textbooks and other curriculum material.
- Engage families in students' education with "talk-story opportunities and sharing experiences." This could involve native mentors or role models who successfully navigated STEM programs.
- Improve training in cultural sensitivity such that non-native teachers understand their students' family obligations and sensibilities. For example, encouraging an 'open-door' policy that recognizes how much effort it took for a student to just ask for assistance.
- Provide middle and high school science teachers with training or professional development that integrates the local history, culture and language into science and math courses.
- Provide safe spaces on campuses for students far from home and family, where they can escape stereotypic threats by meeting and finding social and emotional support amongst each other. Such spaces could also provide access to advising, mentoring, and tutoring.
- Connect STEM courses to careers other than the traditional medical, engineering or academic pathways; introduce students to options such as forestry, agriculture, disaster management, community or urban planning, environmental consulting, and technical positions in local and federal agencies.
- Train mentors to be knowledgeable about and sensitive to the cultural backgrounds of their Island students. Clearly, any efforts to increase the participation of Pacific Island students in STEM fields must involve both supportive mentors and sufficient financial assistance to students.

B. Improving K -12 Education: reducing the K-12 dilemma.

As was stated above (section IV.D.(2)), above, one of the main barriers responsible for greatly reducing the numbers of NHPI students attending college and taking STEM courses is the lack of capacity of K-12 faculty to teach most STEM disciplines to pre-college students, especially in the lower grades. At the current time there is training for teachers, but it is in only English and math. These trainings need to be expanded to science and technology. Teachers that do not have the proper credentials need to complete their college education. This requires time and funding. At this time, teachers who are not near a college can only take courses in the summer and only two at a time. At that rate, it takes too long for them to complete degrees.

Recommendations from the participant group for reducing teaching and faculty-training problems:

- Bring in qualified teachers from the outside to teach in the classes while the current teachers complete their degrees full time. This would require funding for these outside teachers to be hired. This would include transportation, housing and salary. There are several organizations that can provide teachers such as World Teach.
- Expand the concept of summer camps for teachers as well as students. At the present time in several countries there are summer science camps that are available for high school students. They could concentrate on science, math and technology. These camps would need to teach teachers “place and project based” curriculum incorporating cultural sensitivity. This would aid teachers that have degrees but need to improve their abilities to teach in specific areas such as science, math and technology.
- Employ specially-trained tutors at the schools to help students in STEM curriculum. The tutors could be current students or could be graduates that work with the faculty and students. This would help faculty in the development of their capacity and advance their students too.
- Conduct teachers’ “Brown Bag” meetings so they can share ideas and help each other. Here, the teachers can meet and discuss techniques, curriculum and methodology. This cannot only help with content, but more importantly, with delivery. Teachers can exchange ideas and discuss what works and what does not work.
- Provide funding for teachers to attend regional or international workshops/trainings with the goal of building capacity for teaching. This would help the isolated teachers expand their knowledge to understand what others are doing to address similar problems, and how to solve these problems.
- Insure that teachers can work within their environment. This is a most important idea for teachers to be innovative and creative, using not only their schools and classrooms. Not all classrooms or schools have advanced technology or science labs. Teachers need to understand that learning is not limited to the classroom and that the environment around them is available to help students understand and learn. The use of “Learning Gardens” is very applicable to this situation. The classes need to go outside the four walls of the classroom, and the teachers need to know how to do this.
- Redesign or realign the curriculum to accomplish these ideas of working in their environment. Localizing the curriculum will help teachers as they then will be able to teach what they already are familiar with. They should use local examples in their teaching. Textbooks need to be created that are relevant to not only the teacher but to the student. A teacher cannot teach what they do not understand. The curriculum (benchmarks and standards) needs to reflect what is being taught. The teachers need to use these as guidelines to help them align what they are teaching to what needs to be taught.

C. Coping with geographical barriers

The obvious solution to most geographical barriers to STEM education is improving the airline and shipping schedules and reducing their costs so students can attend a high school when there is none on their home island. However, this is not realistic as it would be extremely expensive. As an alternative, participants at the workshop recommended that island high schools must be subsidized to support residences for students who are away from home, as well as the costs to get to the islands where the high schools are located. This problem is especially pronounced in American Samoa, the Marshall Islands, Micronesia and Palau, and these island groups assuredly need the most financial assistance for this improvement mechanism.

D. Removing the financial barriers to achieving college-level training and experience in STEM fields.

The participants noted that it would be easy to say, “All we need is funding and everything for STEM education will turn out OK.” Yet, they insist that to develop NHPI student talent and potential for the future, there is great need for both short-term and long-term planning that includes steps to fund students to express, not suppress, their cultural backgrounds while working in science.

Recommendations from *participants for reducing financial barriers to STEM training and careers*:

- Most especially, support programs that provide financial assistance for mentorships in research-educational centers. Despite all of the barriers outlined above, there are students at each of the island colleges whose interest in science is evident, but the colleges lack the time, training and facilities to provide essential experiences for students to truly become scientists and to recognize that fact for themselves. There is no better way to do that than through mentored internships at research universities.
- Foster multiple communities of interested, motivated students who identify themselves as scientists yet retain their cultural identities and remain members of their families. They should be lead by motivated mentors who will create dynamic but supportive workspaces for these students. Funding will be necessary for all aspects of this, especially for mentoring and coordination of services for the students.
- Provide residential tuition rates at colleges across the Pacific and take steps to increasing articulation and communication so that students can easily move from one campus to another. This should be done under the auspice of a Pacific-wide consortium (NHPI STEM Consortium) that unifies STEM education and assessment programs to provide an evenness to the STEM experience. Such a network could easily create pathways for internship positions for STEM professionals, via partners and federal and other agencies and coordinate across and within participating campuses.

- Build a program that can loan funds from one institution (e.g., CMI) to another (e.g., UHM) just as major universities have a 'prior approval' process that makes grant funds available.
- Implement a minority program across USAPI, where the educational institution builds capacity to loan funds to qualified NHPI students, much like the UHM's prior approval process where a 90-day early start is allowed and funds are advanced, while waiting for federal funds to arrive. This program would provide an almost immediate safety net for many NHPI students who are enrolled in STEM programs but at risk from costly institutional delays.
- Raise stipends to meet true costs on the family for REU participation by a NHPI student.
- Assist promising students who lack adequate preparation by providing tutoring services. Extra time should be allowed to make up course deficiencies.
- Recognize the cultural and familial obligations of Pacific Islander students by allowing them time to tend to such obligations when they arise. In this respect, working toward a STEM degree or career, becomes more like a pathway, rather than a straight 4-year program.

E. Creating a NHPI student-scientist organization.

To continue the momentum of this workshop, some participants suggested forming a 'society' for NHPI scientists, educators and students that would be similar to the Society for Advancement of Chicanos/Hispanics and Native Americans in Science (SACNAS). Such an organization would recognize the unique challenges faced by those of NHPI descent, and provide opportunities to overcome barriers recognized by this workshop. Therefore, this recommendation should be considered:

- Form and organize a NHPI Society to encourage networking between NHPI scientists and students, and provide a clearinghouse for scholarship and grant opportunities. This society would also bridge the gap between STEM and culture by sharing information, knowledge and inspirational stories of successful NHPI students and scientists.

VI. Acknowledgements

The success of this workshop depended on the support of many people in addition to the enlightening efforts of the invited participants. Ms. Dawn Chang organized and led an outstanding team of facilitators whose management in the workshop discussions contributed immeasurably to its success. The team included Anne Marie Smoke of the Matsunaga Institute for Peace and Conflict Resolution at the University of Hawaii and her associates who participated in the session facilitation and recording of proceedings, especially Jose Barzola and Kathryn Ranney. Ms. Shari Goudreault of the Pacific Biosciences Research Center provided essential assistance in all aspects of arranging housing for participants, venues for the meetings

and meals. Dr. Brad Jones of the Pacific Biosciences Research Center video-recorded the proceedings and made them available in multiple forms following the workshop. Dr. David Karl, Director, Center for Microbial Oceanographic Research and Educations, University of Hawaii, provided support for transporting all participants between hotels and the University of Hawaii campus during the workshop. Colleagues in the Hadfield Laboratory provided essential logistical support during the workshop: Marnie Freckelton, Kimberley Lema, Brian Nedved, Melissa Price and Nidhi Vijayan. The workshop was supported by National Science Foundation grant no. 1638738.

VI. References Cited:

Aguon, Julian (2006) *Just Left of the Setting Sun*. Tokyo, Japan: Blue Ocean Press. 85 pp.

de Frutos, David Atienza, and A. Coello de la Rosa (2012) Death Rituals and Identity in Contemporary Guam (Mariana Islands). *Journal of Pacific History*, 47(4): 459-473.

Diaz, Vicente M., (1994). "Simply Chamorro: Telling Tales of Demise and Survival in Guam. *The Contemporary Pacific*, 6(1): 29-58. University of Hawai'i Press.
<http://hdl.handle.net/10125/12956>

Diaz, Vicente M. (2010). Repositioning the Missionary: Rewriting the Histories of Colonialism, Native Catholicism, and Indigeneity in Guam. *Pacific Islands Monograph Series 24*. Honolulu, HI: University of Hawai'i Press. 256 pp.

George, S., N. Duran and K. Norris. 2010. A systematic review of barriers and facilitators to minority research participation among African Americans, Latinos, Asian Americans and Pacific Islanders. *American Journal of Public Health*, 104 (2): e16 – e32.

Hattori, A.P. (2009). Colonialism, Capitalism and Nationalism in the US Navy's Expulsion of Guam's Spanish Catholic Priests, 1898-1900. *Journal of Pacific History*, December 2009; 44(3):281-302.

Hezel, F.X. (2013) *Making Sense of Micronesia: the Logic of Pacific Island Culture*. Honolulu, HI: University of Hawai'i Press. 182 pp.

Hezel, Francis X. S.J. (1982) From Conversion to Conquest: The Early Spanish Mission in the Marianas. *Journal of Pacific History*, 17: 115-137.
<http://www.micsem.org/pubs/articles/historical/frames/convconfr.htm>

Higuchi, Wakako (2001) The Japanisation Policy for The Chamorros of Guam, 1941–1944. *Journal of Pacific History* 36(1): 19-35.

Johannes, R.E. (1992). *Words of the Lagoon: Fishing and Marine Lore in the Palau District of Micronesia*. University of California Press, 320 pgs.

Johnston, Rebecca (2010) Chief Communications: Communication and Cultural Practices among Samoan Matais. *Journal of Intercultural Communication*, ISSN 1404-1634, issue 22, January 2010. URL: <http://www.immi.se/intercultural/>

Kauanui J. (2008) Colonialism in Equality: Hawaiian Sovereignty and the Question of U.S. Civil Rights. *South Atlantic Quarterly* 107(4):635-650.

Kelson, K.P., P. K. Bartram, and A.M. Friedlander (2003). The Use of Traditional Hawaiian Knowledge in the Contemporary Management of Marine Resources. Putting Fishers' Knowledge to Work, Conference Proceedings Aug 27-30 2001. In, *Fisheries Centre Research Report* 11(1): 328-339.
<https://open.library.ubc.ca/cIRcle/collections/ubccommunityandpartnerspublicati/37052/items/1.0074793>

Kupferman, D. W. (2008) No Western Agenda Left Behind: A Comparative Analysis of Higher Education Institutions in the Republic of the Marshall Islands. *International Journal of Learning*, 15(2):69-77.

Lee, S. J. and K. K. Kumashiro. (2005) A Report on the Status of Asian Americans and Pacific Islanders in Education: Beyond the "Model Minority" Stereotype.
<http://www.nea.org/home/15571.htm>

Levine, V. (2015) Education in Pacific Island States: Reflections on the Failure of 'Grand Remedies.' East-West Center, Honolulu, HI. 60 pp.
http://www.eastwestcenter.org/system/tdf/private/pip008_0.pdf?file=1&type=node&id=33999

Mendiola, Tanya M.C. (2014). Women's Roles. *Guampedia*. Retrieved from
<http://www.guampedia.com/womens-roles/>

Miller, J. (2000). Listening to the Elders. *Marine Turtle Newsletter*, 88:1-2.
<http://www.seaturtle.org/mtn/archives/mtn88/mtn88p1.shtml>

Souder-Jaffery, Laura Marie Torres (1997). Daughters of the Island: Contemporary Women Organizers of Guam. *MARC Monograph Series* No. 1, University of Guam. Richard F. Taitano Micronesian Areas Research Center.

Swain, T. and Trompf, G. (1995) *The Religions of Oceania from the Library of Religious Beliefs and Practices*. New York, NY: Routledge. 244 pp.

Tran, J., M. Wong, E. K. Wright, J. Fa'avae, A. Cheri, E. Wat, K. L. Camacho & M. A. Foo (2010) Understanding a Pacific Islander Young Adult Perspective on Access to Higher Education. *Californian Journal of Health Promotion, Special Issue (Cancer Control)*, 23-38.