

FINAL REPORT: WEAVING INDIGENOUS AND WESTERN KNOWLEDGE SYSTEMS

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Final Report: Weaving Indigenous and Western Knowledge Systems

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NSF Includes / Transcending Barriers to Success (TBS)

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Abstract

The Weaving Indigenous and Western Knowledge Systems (WIWKS) Bibliography is an iterative list of publications and resources for students, researchers, teaching faculty, administrative staff, and others in a higher education context seeking to engage in integrating these knowledge systems, particularly to address the Grand Challenges of Climate Change in the STEM fields. Sources were collected in three ways: 1) sources shared in presentations or mentioned in conversations during and following the TBS gatherings, 2) sources collected from a follow up survey, 3) sources gathered through informal interviews. While initial emphasis was placed on integrating biocultural restoration in STEM courses and in increasing Native student success in higher education, the sources that emerged had a much broader and systemic focus. This report is a description of the research process and reflection on this project as an example of Weaving Indigenous and Western Knowledge Systems.

Keywords: STEM Education, Indigenous Knowledge, Indigenous Wisdom, Traditional Ecological Knowledge, Grand Challenges, higher education reform, student success

Final Report: Weaving Indigenous and Western Knowledge Systems

The purpose of the Weaving Indigenous and Western Knowledge Systems (WIWKS) Bibliography is to gather a list of publications and resources referenced and used by participants in the “Gatherings to Transcend Barriers to Success: For This Generation and Those to Come” (TBS Gatherings) held during Spring and Fall 2021. The Bibliography is meant to provide a foundation of knowledge, iteratively created, to aid students, researchers, teaching faculty, administrative staff, and others seeking to engage in or learn more about Indigenous research, knowledge systems, and education, particularly in STEM courses and to support Native student success.

In 2021, over 134 participants including students, faculty, staff, and community partners gathered over Zoom at three TBS Gatherings hosted by the University of Hawai‘i, University of Arkansas, and North American Native Research and Education Foundation (NANREF) (Idaho). Guiding questions for the TBS Gatherings included:

- 1) How can we connect Indigenous and western knowledge systems for biocultural restoration, sustainability, and resilience in the face of climate change?
- 2) How can this connecting lead to academic and career success for Native and non-Native students?"
- 3) How can this connecting be continued and sustained over generations through campus-community engagement and partnerships?

Publications by Native and non-Native scholars in the areas of Indigenous Knowledge, Indigenous Wisdom, and Traditional Ecological Knowledge are rapidly expanding, with wide readership both in and outside of academia. *Braiding Sweetgrass* by Robin Wall Kimmerer is a

frequently cited example. Multiple stakeholder groups (students, faculty, researchers) express acute interest in working with Indigenous communities and knowledge keepers, yet may be unsure how to begin. On the one hand, unintended harm may result without knowledge of decolonizing methodologies or Indigenous research, while on the other hand, researchers with this awareness may be paralyzed by fear of offense. Both conditions prevent relationship building, collaboration, and healing. This situation is compounded by the urgency of the climate crisis and Grand Challenges related to energy, land and water issues, food systems, food security, and agriculture. In addition to these challenges, there is institutional attention to increasing Native student success in higher education and addressing issues of decolonization, diversity, equity, inclusion, and justice.

Western academic literature reviews typically use approaches such as citation count, keyword searches, or content analysis. Indigenous research methodologies might begin with storytelling or visiting elders for guidance. The WIWKS Bibliography combines these approaches. The sources on the list were shared in presentations, or mentioned in conversations during and following the TBS Gatherings: these are the papers, books, videos, songs, chants, poems, and other media that have influenced the participants and guided their work.

Other outcomes and products of the TBS Gatherings included integration of new knowledge into faculty syllabi and pedagogical strategies including project-based learning, service-learning, community engagement, undergraduate research, and internships. In addition, the materials are meant to strengthen program, campus, tribal, and community partnerships, especially in relationship to a) Native student success, b) teaching and research related to climate change and related grand challenges, and c) emphasis on inclusion of both Indigenous and western science, knowledge, and wisdom.

A four-part model for “Transcending Barriers to Success” was offered at the Gatherings:

- 1) Connect Indigenous and Western knowledge systems for redesigned curriculum;
- 2) Tackle Grand Challenges such as ecological and biocultural restoration;
- 3) Support STEM success for NAAN-NHPI students;
- 4) Build authentic and durable campus-community partnerships for continuity and sustained positive impact on the environment and increasing the NAAN-NHPI students in STEM fields.

The Weaving Indigenous and Western Knowledge Systems (WIWKS) Bibliography was envisioned and realized by a team of researchers: Summer Wilkie, Youth Coordinator for the University of Arkansas Indigenous Food and Agriculture Initiative and citizen of the Cherokee Nation of Oklahoma, Miku Lenentine, Coordinator for the Center for Resilient Neighborhoods (CERENE) at Kapi‘olani Community College, and Krista Hiser, a faculty member at Kapi‘olani Community College. Robert Franco, also at Kapi‘olani, served as the Principal Investigator for the EPSCoR grant (#2104126), participated in the Gatherings, and supervised the research team.

Although situated in Western academic institutions, we approached the WIWKS Bibliography through an Indigenous research lens, beginning with relationship building and reciprocity for all involved in the project. This placed an emphasis on practical outcomes – how could such a bibliography serve the communities participating in the TBS Gatherings, and move beyond dialogue to action? Relationship building and reciprocity also meant that the process was slower, and included teachings and listening to elders within and outside of educational institutions.

Background and Existing Literature

Weaving Indigenous and western knowledge systems, or WIWKS as we came to refer to the task during the process, invites us to move beyond the English language into the felt-sense and visual worlds of relationship, symbol, and metaphor. Rather than just compiling a list of

sources, we began from different metaphors that might be used to guide conversations about the papers and books mentioned by participants and presenters. First, we explored the metaphor of Two-Eyed Seeing as introduced by Bartlett et al. (2012) and utilized by Wright et al. (2019). “Two- Eyed Seeing adamantly, respectfully and passionately asks that we bring together our different ways of knowing to motivate people...to use all our understanding so we can leave the world a better place...” (Bartlett et al. 2012, p. 336).

While Two-Eyed Seeing provided a strong initial guiding framework, Indigenous perspectives are not limited to the physical senses, and include mind, body, and spirit (Smith, 2018). Furthermore, Indigenous Knowledges are multiplicitous. Native Hawaiian scholar Noelani Goodyear-Ka’ōpua (2013) points out the oversimplification of a similar metaphor in Indigenous education, thinking of students as “walk[ing] in two worlds”, and recognizing harm in this epistemological tension, stating that metaphor and multidisciplinary, cross-cultural inquiry are spaces best created “by placing living ‘āina at the center” of the educational endeavor (p. 134). Or, in this case, into our research endeavor.

A second metaphor that provided an important foundation for the project was the visualization of a Spider’s Web as developed by Lori Lambert in her 2015 book, *Research for Indigenous Survival: Indigenous Research Methodologies in the Behavioral Sciences*. This metaphor was shared at the Idaho TBS Gathering hosted by the American Indian Consortium GTBS Gathering, as a representation of the integration of knowledge systems.

Figure 1:

Spider’s Web, by Lori Lambert.

Indigenous Research Paradigm: A Conceptual Model



Note: This image is published at The American Indigenous Research Association website (iAIRA) and used with permission.

Lambert's image emphasizes relational and place-based knowledge as well as traditional protocols and respect for Indigenous people. Thus, this image informed our method. The visual image of a web is rich, and contains information beyond what we highlighted as preliminary understanding necessary for integration of knowledge systems. However, this conceptual model

focuses predominantly on Indigenous Research Methodology. In the end, after considering the metaphors of a web, and of two-eyed seeing or walking in two worlds, we selected a metaphor of *weaving* to guide the project because it resonated with the researchers, and was generally supported by the TBS Gathering participants.

The process of weaving maintains the integrity of both warp and weft, while creating new patterns and paradigms that can strengthen both Indigenous and Western Knowledge Systems. The weaving metaphor is also general enough to apply broadly across NAAN-NHPI cultures. In each Indigenous culture and community more specific metaphors may carry more meaning. An example is the metaphor of Osage ribbon work. Ribbon work is an Osage art form that integrated new materials (ribbon) from Europeans to be repurposed and reworked into patterns meaningful to the Osage. This metaphor is used in a thread of Osage scholarship from Jean Dennison as a framework for building a future for Osage people that includes their unique Indigenous perspective (Dennison 2012; Redcorn, 2013; Powell, 2014; Hayman, 2021).

Indigenous cultures all over the world use visual images, symbols, and metaphors to transfer and advance knowledge. Metaphors can also be used to invite the inquiry of paradigms. Cognitive science indicates that metaphors are powerful for advancing new ideas (Bratianu, 2015). However, as fields of study become saturated with metaphors they may lose their effectiveness as discussed by Kenneth Sørensen in the field of metaheuristics (Sørensen, 2015). As researchers, we were conscious of the need to avoid the common pitfall of introducing a new metaphor for every paradigm or process. It is important to focus on metaphor grounded in relationship with Indigenous knowledge and place.

There are several other bibliographies and collections of relevant articles, including the Global Council for Science and the Environment (GCSE) sources that were shared with participants who attended the “Learning Series on Indigenous Knowledge & Western Science:

Collaboration, Relationship, and Climate Solutions” also held in 2021. This conversation, parallel to the TBS Gatherings but unrelated, was hosted by Native scholars Darren Ranco and Sherri Mitchell, and generated a list of over 50 peer reviewed articles as well as media links, white papers, and other unpublished but very relevant work. In addition, Lori Lambert authored a bibliography for the Intercontinental American Research Association (iARA) containing over 144 sources. It is hosted alongside yet another bibliography written by Lynn Gehl containing 47 sources on the iARA website. Another repository of articles as well as presentations related to weaving work is the Institute for Integrative Science and Health which contains over 292 related sources from 2001 to 2012. In addition to all of these sources a new digital resource called *Journal of Native Sciences* (<https://www.nativesciences.com>) has been established by Cleve Davis and Dawn Davis, presenters at the NANREF Gathering, and may hold future sources.

Lists, in general, have many shortcomings: they can become out of date; they are often created by individuals rather than groups, and they may include articles that aren't approved of by Indigenous scholars and/or communities. The latter could be due to the researcher misrepresenting themselves as a member of a tribal community or due to a lack of respect of data sovereignty, poor relationship with the Indigenous community represented in their work, or Indigenous knowledge gained in unethical manners. The peer review process for publication relies on an Institutional Review Board (IRB), and in certain situations, Tribal IRB, to verify credentials and methods. Yet, Indigenous review over Indigenous content is often missing in the peer review process for publication. Therefore, published lists and bibliographies may unintentionally include work published without collective accountability, integrity, or good relations.

There is a temptation to add more layers of approvals, but this can add months to publication or sharing, and create a fraught situation or so many barriers that new researchers

will be afraid to try a weaving approach. Some suggestions, by no means comprehensive, include: methods such as Participatory Action Research; co-authoring and reverse stacking; working with a cultural advisor or advisory council; working through the tribal IRB process if applicable; including letters of support from elders, tribal leadership or community members in an appendix; or adding an “intellectual genealogy” to describe relationships¹. Researchers who want to work with Indigenous communities should seek training in cultural competency, Indigenous studies, and in decolonizing research methods. Such courses should be integrated into undergraduate and graduate education, particularly in STEM.

So, while we studied many lists and repositories to situate this project, we ultimately did not include them, though of course there is overlap. Every strategy for listmaking will have limitations and biases. Part of the question the WIWKS Bibliography seeks to answer is *how best to make this work useful*; thus, for this project we tried to systematically identify the most referenced sources by practical practitioners.

Methods

The researchers were influenced by the Two-Eyed seeing model described by Bartlett et al., who assert that “Post-secondary institutions should be compelled to seek guidance from the Elders’ Council to develop appropriate curriculums related to Traditional Knowledge for relevant post-secondary programming. There is a need to recognize that Traditional Knowledge draws upon the community of elders, and other knowledge holders, as well as the collective

¹ In this project, we used co-authorship and reverse stacking, an advisory council, and intellectual genealogy.

consciousness of the people” (Bartlett, Marshall, and Marshall, 2012, p. 335). Input from multiple stakeholders was critical throughout this project.

Though written sources have been integral to deepening our knowledge, much of our knowledge for how to approach this work did not come from a book or article. Each of the researchers had been trained to seek an elders’ council as part of their cultural upbringing or life experience, rather than advised to do so by any written source. This is one example of the significance of sources that are not “peer reviewed” in an academic sense, as well as direct relational experience with peers and others in the human and non-human world. It is also an example of what we mean by “weaving”. As Bartlett et al. put it “We need to recognize that stories, songs, crafts, practices, family, community, language, ceremonies and connectivity with the land are important for the transmission of TK. It is not a book-based process of learning. Most importantly, TK is living knowledge” (2012, p. 337). Thus, weaving Indigenous Knowledge and Western Knowledge is a living process.

Beginning with the process of building relationship and exploring metaphor as a way of illuminating and integrating worldviews, we then approached the project in a way that would extend collaboration, iteration, and rapport. To emphasize relationship-building in our research method, we included informal interviews held on Zoom, that we called “tea talks” (The term “tea talk” follows advice to engage in conversations “over a cup of tea” which was offered by Lori Lambert during the TBS NANREF Gathering in Idaho.) We revisited the research questions of the TBS Gatherings – how to connect Indigenous and western knowledge systems? How to support academic and career success for Native and non-Native students? How to sustain campus-community engagement and partnerships? Each of us, as researchers, took some time to query our own “logic models” while writing reflective memos after and between meetings. These

practices helped to define the process of weaving as one of co-created meaning rather than compromise and negotiation.

These are the steps that we followed to create the Bibliography:

1. The bones of the Bibliography are references cited in NSF EPSCoR and INCLUDE grant proposals related to the TBS Gatherings. (89 sources)
2. To this, we added citations from presenters' materials, as well as reference lists shared by facilitators and/or distributed in powerpoint presentations from the Gatherings. (14 sources)
3. Then, we sent a Google Forms Survey to key participants (51 sources), followed up with:
4. Informal Interviews conducted over Zoom (7 sources) and then,
5. Review of the final bibliography list by an Advisory Council formed at the beginning of the research process, as well as other stakeholders.
6. Reflecting on the process and co-authoring this report.
7. Review of the report by Advisory Council

Again, what is unique about this Bibliography is that it is based on recommendations by active practitioners and researchers who are using decolonized methodologies and attempting to do integrative cross-cultural work in higher education.

Results

Through this iterative process we compiled 156 sources. **The three most frequently mentioned sources were:**

Bartlett, C., Marshall, M., & Marshall, A. (2012). Two-eyed seeing and other lessons learned within a co-learning journey of bringing together indigenous and mainstream knowledges and ways of knowing. *Journal of Environmental Studies and Sciences*, 2(4), 331-340.

Cajete, G., & Bear, L. L. (2000). *Native science: Natural laws of interdependence* (Vol. 315).

Santa Fe, NM: Clear Light Publishers.

Kimmerer, R. W. (2013). *Braiding sweetgrass: Indigenous wisdom, scientific knowledge and the teachings of plants*. Milkweed Editions.

Across all of the sources there were patterns that emerged for the most frequently cited works. There were 15 sources overall which had at least two or more mentions, listed here in alphabetical order:

Aluli - Meyer, Manu	Kimmerer, R. W.
Bartlett, C., Marshall, M., & Marshall, A.	Smith, L. T.
Bowman, N. R.,	Sze, J., ed.
Cajete, G., & Bear, L. L.	Treuer, A.
Deloria Jr, V.	Whyte, K.
Estrada, M.	Wildcat, D.R.
Johnson, M.D.	Windchief, S.,
Sprowles, A.E.,	

Constellations, Iterations, and other Next Steps

Recommendations for future research in integrative cross-cultural work include: content analysis of the WIWKS Bibliography and the other lists mentioned above; inclusion and study of a wider range of sources such as YouTube videos, chants, prayers, books, and unpublished works; more dialogue in the form of tea talks or otherwise with more authors and researchers. While our original query for sources was open-ended, responses tended to emphasize peer reviewed sources and frequently referenced documents. In the less formal tea talk discussions,

other sources were mentioned. The results are also skewed by the extent of our network. More contributors would improve the thoroughness of the bibliography. In our tea talk conversations there was a call for a dynamic database including both academic and non-academic materials. We envisioned using or expanding a popular research management software to make a truly iterative and growing bibliography for the weaving of Indigenous and western knowledge systems.

To ensure the usefulness of a list of 156 sources (ideally, in the future, an ever-growing community-held, and iterative list) and to invite contributions of formal and non-formal sources from the community that might be engaging and interacting with the WIWKS Bibliography, we created the idea of Constellations. Constellations are mini-collections of sources including peer-reviewed journal articles, unpublished papers, poems, songs, stories, media and any resource deemed important for understanding some aspect of the universe of topics related to integrating Indigenous and Western knowledge systems, particularly in STEM fields.

Constellations can be compiled by anyone in the community in relationship to a particular project, task, event, or challenge. They would ideally fit on one page, including 10 to 20 sources starting from those in the Bibliography and enabling the addition of new sources including informal sources such as YouTube videos, chants, stories, or prayers included with permission of the author.

Constellations would be collaborative, “living” and constantly evolving to match the evolving and living state of integrative research. Constellations might be organized around a particular person (key author), place, or topic. What makes them unique however, is that they could be saved as their own “product” and others could “upvote” them so that certain constellations could rise to prominence. Constellations keep the process relational, and steeped in

the metaphors of the natural world (aka in relationship with our non-human kin and place-based). Future work might also include inviting top referenced authors in the field to contribute their Constellations. In the Appendix, we provide two examples of Constellations:

Wan's Constellation: Sources for a Newcomer to Hawai'i

STEM Faculty Constellation: Including both Indigenous and Western Knowledge in Courses

Conclusion

This report emphasizes the process behind the WIWKS Bibliography and concludes with our thoughts on how to continue iterating the Bibliography as a living document that is “owned” by community users. In this report, we emphasized our research process and made it visible because *the process is the weaving work*. When working with knowledge systems it is necessary to slow down, build relationships, and reflect on the process. Metaphors open a shared field or pattern of understanding that can help the weaving to occur.

We conclude with some thoughts on Albizia trees. Interestingly, this tree emerged independently for each of the researchers, not as a new metaphor (though it is) but rather, as if we had been weaving a blanket or shawl, following a pattern in the work, and the image that emerged was something like this:

Figure 2: Photo of a Native Koa tree (foreground) and non-Native Albizia tree (background)



Note: photo by Krista Hiser, taken at the Waiakeakua forest restoration project, Mānoa, O’ahu

In the foreground, a native Koa tree, planted on the island of O’ahu in an area where giant non-native albizia trees (seen in the background) are being carefully cleared to plant ‘ulu, kalo, and koa. This effort is an example of both decolonizing (removing invasive trees) and restoring (planting native trees). The Koa is a hardwood tree that can also grow to 100 feet, and can be used for carving a canoe. Thus, the efforts in this forest today plant an understory that will meet the needs of a future generation.

In her book *The Seeds We Planted: Portraits of a Native Hawaiian Charter School*, Noelani Goodyear-Ka'ōpua (2013) likened non-native albizia trees in Hawaii to the:

“...dominant disciplinary formations within education such as mathematics and English, destructive when the environmental context was organized around *it* as a fixed and rooted structure, drawing resources toward itself for its own survival. When the invasive tree was cut, decentered, and ordered around the central goal of caring for the Indigenous social and ecological landscape; however, its usefulness became apparent.” (148)

In this project, we learned that integrating Indigenous and Western knowledge systems requires a departure from one's known paradigm. Any integration of Indigenous Knowledge necessitates a decolonizing research stance, but then, as Kovach (2021) asks, “what is left of Western Knowledge systems?” What repurposing of existing knowledge systems, structures, and academic disciplinary formations is needed to elevate Indigenous Knowledge, improve Native Student Success, and increase presence of Indigenous faculty, administrators, and staff in the higher education context?

Albizia trees are magnificent in their way. Hundreds of thousands of these trees were brought intentionally to Hawai'i in order to hold the soil after native forests had been cleared for plantation agriculture. The trees accomplished this, but now are causing harm to the ecosystems around them. They are alive, and offer themselves as a lesson in meeting grand challenges. How do we “take them down” in a way that honors them, as kin, and finds purpose and utility for them as a more integrated forest grows?

###

About the Researchers: an intellectual genealogy

We would like to take a moment to honor our teachers and those who have come before us in this work. We also would like to honor the traditional territories where we are writing from and conducting our work respectively as well as take a moment to share our heritage and honor the people and places who have supported us.

Summer Wilkie acknowledges all her ancestors known and unknown, who are with her each moment. Each ancestral line having been displaced via various routes to the present state of Oklahoma, some in search of opportunity, others given no alternative. She is blessed with parents, grandparents, extended family and community within the foothills of the Ozark Mountains on the reservation of the Cherokee Nation of Oklahoma, land inhabited by the Wazhazhi people (Osage Nation), Caddo Nation, and Quapaw Nation prior to genocide and European and Cherokee encroachment and settlement. Summer currently resides in Fayetteville, AR, still in the Ozark foothills where she serves as the Youth Coordinator for the Indigenous Food and Agriculture Initiative. She also acknowledges and thanks Cherokee scholars Marty Matlock, Clint Carrol, and members of the IKE (Indigenous Knowledges and Experiences) Alliance for their mentorship.

Miku Lenentine was born in Seattle, WA, the traditional territory of the Co-Salish people, and she was raised in Anchorage Alaska, Dena'ina Elnena, the traditional homelands of the Dena'ina Athabaan people. The bones of her ancestors on her Mother's side are buried with the First People of Sinaloa Mexico, though her family is not enrolled or has any tribal affiliation today. Her Mother's people are also from Northern and Southern Italy, with her Grandparents being

first generation Italian immigrants. Her Father's people are from Devils' Bit Canyon, in Tipperary Ireland and are buried with the Gaelic peoples of primarily Irish and Scottish ancestry. Miku has dedicated several years of study with traditional elders of the Saanich, Quaker, Saami and most recently, the Nahuatl lineage (her own ancestral lineage). Now living as a guest and settler on the island Oahu, Hawai'i. the traditional territory of the Kanaka'Ōiwi people, she works closely with Kumu Mālia Ko'i'ulaokawaolehua Helelā and is currently the coordinator of CERENE, the Center for Resilience Neighborhoods, housed at Kapi'olani Kula Nui Kaiāulu, Kapi'olani Community College, as the University of Hawai'i.

Krista Hiser is of Swedish and German descent, and grew up in Nebraska and Iowa, where her grandfather was a pioneer descendant and farmer on traditional lands of the Meskwaki. Krista's father left the farm and was the first to attend college, placing a family emphasis on higher education that led her to a doctoral degree in Educational Administration. She is grateful to Dr. Manulani Aluli-Meyer for core teachings of *'auamo kuleana* and holographic epistemology, and to the 19 Ways community held by Deena Metzger, who writes and teaches the Literature of Restoration. She strives to be a settler aloha 'āina, residing for over twenty years on the island of O'ahu in the ahupua'a of Waikiki in the valley of Mānoa, where she volunteers her time in native forest restoration at Waiakeakua. She is a faculty member in the Language, Linguistics, and Literature department at Kapi'olani Community College, and Senior Advisor for Sustainability Education at the Global Council for Science and the Environment.

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Appendix 1: Constellations

Note: Constellations are mini-collections of sources including peer-reviewed journal articles, unpublished papers, poems, songs, stories, media and any resource deemed important for understanding some aspect of the universe of topics related to integrating Indigenous and Western knowledge systems, particularly in STEM fields.



Example 1:

STEM Faculty Constellation: Including both Indigenous and Western Knowledge in Courses

This Constellation is organized as a reading list for a faculty cohort who might be interested in Traditional Ecological Knowledge or have been directed to increase Native student success and representation in STEM programs in higher education. These ten books and articles would provide a foundation for a collaborative course redesign workshop that would ideally also include local community partners, indigenous elders, and Native/Indigenous faculty colleagues.

We begin a month before the workshop, assigning **Braiding Sweetgrass** to establish a model and build on a widely read and well-embraced example, read alongside the Gewin article from *Nature*, a peer-reviewed publication. A deeper dive would be provided by the Medin and Bang (2014) book, which explores case studies to address “separation from nature” characteristic in Western sciences.

Kimmerer, R. W. (2013). *Braiding sweetgrass: Indigenous wisdom, scientific knowledge and the teachings of plants*. Milkweed Editions.

Gewin, V. (2021). How to Include Indigenous Researchers and their Knowledge. *Nature*. Jan; 589(7841) 315-317. doi:10.1038/d41586-021-00022-1. PMID: 33437060.

Medin, D., and Bang, M. (2014). *Who’s Asking: Native Science, Western Science, and Science Education*. M.I.T Press.

From here, educators could take a step back and consider the broader metaphors of two-eyed seeing and weaving, as well as the broader issues of decolonization, and situating education in an era of climate change that increases the urgency of transformative change.

Bartlett, C., Marshall, M., & Marshall, A. (2012). Two-eyed seeing and other lessons learned within a co-learning journey of bringing together indigenous and mainstream knowledges and ways of knowing. *Journal of Environmental Studies and Sciences*, 2(4), 331-340.

de Sousa Santos, B. (2018). *Decolonizing the university: The challenge of deep cognitive justice*. Cambridge Scholars Publishing.

Franco, R. (2010). From Service to Science in the Energy-Climate Era. *Diversity & Democracy*, AAC&U (Association of American Colleges and Universities). 13:3.

Lastly, four practical examples of course redesign or strategies would be offered, perhaps read in a Jigsaw format, with small groups reading and presenting summaries of the articles and discussing how and if the described strategy would work in their own course. Estrada uses co-curricular examples; Alkholy et al is an example of an elder co-led online science course; the “Portal into the Science of Aloha” invites a place-based spiritual perspective on conservation; Sprowles et al explore place-based learning communities.

Estrada, M. (2014). Ingredients for improving the culture of STEM degree attainment with co-curricular supports for underrepresented minority students. National Academies of Sciences White Paper.

Alkholy, S.O., Gendron, F., McKenna, B., Dahms, T., & Pontes Ferreira, M. (2017). Convergence of Indigenous Science and Western Science Impacts Students’ Interest in STEM and Identity as a Scientist. *Ubiquitous Learning: An International Journal*10(1), 1-13. doi: 10.18848/1835-9795/CGP/v10i01/1-13 Available at: <http://digitalcommons.wayne.edu/nfsfrp/16>

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Example 2:

Wan's Constellation: Sources for a Newcomer to Hawai'i

About This Constellation

This compilation of articles and sources was designed for a researcher interested in engaging in the connection of Indigenous and Western Knowledge systems in Hawaii for a research project specifically focused on working with Native Hawaiian community members. The resources listed here are intended to provide a background for someone who may have been raised as part of the dominant culture from another country who has little to no experience working in Indigenous contexts and has been raised within the Western Science research tradition.

In addition to this reading list Wan would be encouraged to sign up for 'Ōlelo Hawaiian classes, volunteer at community events and take part in as many classes which teach traditional Hawaiian culture as possible. It is critical that the readings are accompanied by direct experience with the land of Hawaii and mentorship with an experienced teacher familiar with cultural practices of this place and ideally who grew up in Hawaii. Even better, would be to study with a living "wisdom-keeper" or traditional teacher (call Kahuna) carrying Hawaiian knowledge if it is possible to do so in a responsible and respectful manner.

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