***SUPII·ṖO'OMAAḰSIN*: SEEDING RECIPROCAL UNDERSTANDING THROUGH HERMENEUTIC ENCOUNTERS IN INDIGENOUS-LED ECO-ACTION RESEARCH**

BRETT WEIGHILL

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BRETT WEIGHILL

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Dr. S. Pelech Thesis Supervisor	Associate Dean Associate Professor	Ph.D.
Dr. M. Hogue Thesis Examination Committee Member	Associate Professor	Ph.D.
Dr. D. Burleigh Thesis Examination Committee Member	Associate Professor	Ph.D.
V. White Cow Thesis Examination Committee Member	Indigenous Employment Navigator	M.B.A.
Dr. T. Skuce External Examiner Brandon University Brandon, Manitoba	Associate Professor	Ph.D.
Dr. K. Wood Chair, Thesis Examination Committee	Assistant Professor	Ph.D.

Abstract

How does reflecting on hermeneutic encounters allow educators to better approach mutual understanding between traditional Blackfoot perspectives and science education? The topic upon which this interpretive inquiry research will focus is a greenhouse sweetgrass project carried out under the direction of elders, Piikani Nation Secondary School leadership, and the Piikani Nation Lands Department, partnering with The Resilience Institute and federal agricultural scientists to explore how Piikani students can contribute to scientific achievements and literature without departing from traditional language, culture and values. Sweetgrass was grown by students and staff and transferred under traditional Piikani protocol for published research on its role in the carbon cycle to further support natural revitalization efforts in the community. As a non-Indigenous educator, expanding my understanding of the importance, process, and protocol of including culturally responsive pedagogy within environmental education supported my own and students' growth and development by guiding us towards a sustainable, iterative, Indigenous-led, eco-action research program focused on the youth as the most valuable renewable resource, instead of economic or energy output. The semiotic role of sweetgrass in bridging, braiding, translating and teaching diverse concepts of cultural and ecological values was explored, revealing a pathway of good practices for myself and other educators seeking to authentically include Indigenous ways of knowing and being in the curriculum.

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Thank you to my family - the newest members and those we lost during this process. I am here because of your sacrifice, effort, and encouragement. I love you.

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Chapter 1: Conducting and reflecting on eco-action research

The proposed study seeks to undertake a hermeneutic reflection on my own experiences as a non-Indigenous educator who led Piikani students through a Sweetgrass (*Hierochloe odorata, Anthoxanthum nitens*) cultivation and conservation research project. Sweetgrass holds cultural, spiritual, and ecological significance for the Piikani Nation, and the project has contributed to cultural revitalization, scientific inquiry, and pedagogical growth. The fusion of horizons between Traditional Ecological Knowledge (TEK) and Western science will be explored, focusing on how Indigenous language, perspectives, and priorities intertwine with scientific methods and practitioners to form a culturally relevant educational framework. This interpretive research can be reflected upon when guiding other Educators interested in valuing Indigenous perspectives within the science curriculum and (re)evaluating their own perceptions.

This reflective exercise will draw upon hermeneutic philosophies and emerging concepts from eco-hermeneutics and eco-semiotics. These perspectives will allow me to explore the interpretive process involved in this learning experience and its broader implications for including students' and teachers' cultural identity within environmental education.

Research Questions

The earliest motivation for implementing the sweetgrass project was: How can Piikani students contribute to scientific literature and ecological resilience while maintaining fidelity to traditional Piikani values, culture, and language? A research inquiry of the understandings encountered before, during, and after the completion of that project now aims to explore the following qualitative question: How does the process of hermeneutic reflection allow educators to better approach mutual understanding between traditional Blackfoot perspectives and science education?

Through synthesizing the exploration of these two questions, I hope to reflect and expand on my understanding of the importance and process of including culturally responsive pedagogy within a school greenhouse to support student learning in eco-action research projects.

Background

In the spirit of relational accountability that honours an Indigenous research paradigm (Wilson, 2008), I would like to begin by positioning myself, my chosen writing style and the topic of my study. I was born a third-generation Canadian of settler heritage on a farm North of Lloydminster, along the Alberta, Saskatchewan border. My father farmed and drove the rural bus route heading into the Lloydminster school system, both inherited from his father, who had served in the Navy during World War Two. We lived on the farm that he had started after returning from war and eloping with my grandmother. My mother came from cowboy roots in Saskatchewan. She worked full-time as a program coordinator for people with developmental disabilities while we grew up, all while juggling raising my brother, sister, and me through a variety of extracurricular sports. We had a modest upbringing but were disproportionately blessed in love, connection to the land, and a family life free from the hustle and bustle of downtown.

I attended school within the local Catholic school system. My parents were not active in faith, although my grandparents would take me to mass with them, and my parents supported the religious aspects of my schooling. I have learned in Piikani that my close relationship with my grandparents would classify me as a *kipitakipooka* (grandparents' child, or "spoiled brat" jokingly). I loved reading and was competitive in academics and athletics. Although never being one of the town kids, I often felt somewhat of an outsider. It was not uncommon to be lumped in with the other rural kids and Indigenous students from the reserves. My farm was close to the

Onion Lake reserve, and my mother's family leased land that bordered the Thunderchild Reservation for a fishing spot. Growing up, many of my playmates and friends were Cree or Metis, including my best man in my wedding. However, this was not something I placed much thought towards until race relations became more ubiquitous in my post-secondary and career placement. I wasn't a townie, I wasn't a rez kid. I didn't go to the rural schools with my neighbours. I floated somewhat successfully.

I attended college first in Lloydminster before transferring to the University of Alberta, and then the University of Lethbridge. I had told my high school teachers that I wanted to be a teacher, but they had insisted that I should instead look to make more money as a scientist or engineer. I had an inkling of a vision that I could somehow do both, so I entered college studying Chemistry and Drama, hoping to excel in both the nitty gritty bench work and the performative communicative realms of science. I added Spanish for a second language to round out my courses, as I had always wanted to travel and study the Amazon rainforest like the ethnobotanical explorers I had read of. Although I loved chemistry theory and mechanisms, I learned that I did not enjoy lab work and that I preferred to be in the field. I switched to biology, thinking I would rather work with plants than their chemical isolates. I took on cooperative work placements at Parks Canada, petrochemical facilities, and coordinated summer student research at the university. In doing so, I began to find the passion for education and being a teacher again. To me, science as literature could only be as effective as the way it was interpreted, communicated and put into real-life application by the younger generations. I wanted to become a teacher who brought science to life to create tangible value for the next generations.

I completed my biology degree and my education practicums within the public and catholic school systems around Lethbridge. As graduation neared, I was faced with two choices:

A temporary position teaching high school science in the Catholic School, essentially a prodigal return to the lifestyle and culture of my youth experience, or a full-time junior high position forty-five minutes away in Brocket for Piikani Nation Secondary School. After much contemplation and surprisingly productive prayers, I chose the adventure, learning and growth I hoped to encounter by embracing the unknown realm of band-operated education. Within a week of starting, I was tasked with a project combining all the interests, passions, and skillsets I had been working towards, bringing a vision to life.

The initial project question arose from an engagement with a community Elder and school board member who tasked me with addressing the inclusion of Piikani language and knowledge in my science curriculum. There was a desire to renew Piikani's interest in competing with the world in science projects while remaining situated within the lens of Piikani culture. There was also an abandoned greenhouse structure they wanted to see revitalized as climate change and colonial histories currently impact food, environmental, and employment security within the Piikani Nation and other Indigenous communities (Cunsolo & Ellis, 2018; Smith Ahern, 2020; The Resilience Institute, 2021).

The elders wanted to delegate me, the new guy, to find a school-based program that could address these multi-faceted concerns. I was under no illusion that I could answer this on my own, but I had enough young teacher energy to believe that I could bring the right team together to have a minor impact on them. I have always positioned myself like an enzyme, focusing on catalyzing the specific rate-determining steps within an organizational task to raise the efficiency and sustainability of an entire initiative as if it were a chemical reaction.

As I approached and was introduced to different stakeholders and experts, local and external, I learned that many potential partners and I were operating from different predetermined goals, objectives, and knowledge sets that they hoped to cram this project into – that the proposed reactants and products were not balanced.

Early in the project, an Environmental Science researcher from the University of Lethbridge was recommended to the community and engaged me in the process of applying for a Master of Science program based on the initial planning work I had already set in motion with my local partners regarding the use of the greenhouse space to address climate impacts. However, preconceptions of renewable energy technologies as the primary solution to global climate impacts, a belief that higher energy and produce yield was all that was needed to generate the wealth required to sustain and protect culture, and the proposal of a technological greenhouse to create a competitive agriculture market in Piikani did not properly align with the community requirement of not departing drastically from Piikani cultural beliefs. Furthermore, elders insisted to me that the more tied to academia I made myself, the less I would understand their true priorities and the less successful the project would be. On the other hand, they highlighted the benefits of my being a graduate student with access to the networks, priorities, and language of that world. I was stuck between real life and written literature.

When the community asked me to take the project in a different direction, I returned to the ethnobotanical interests of my undergraduate degree and listened to the elders on what plants and activities they deemed to be culturally important. Through numerous discussions, prayers, and stories, I learned that aiming at the process would generate the proper outcome, while aiming at the outcome would permanently disrupt the process. Every time these discussions were had, the common theme was sweetgrass. From the starting smudge to the analogies that were danced around, I began to see an answer to what we should focus on in the greenhouse.

I realized then that the task given to me was much broader than a simple hypothesis or one-off study could solve, and that I had been asked to take on the role of multidisciplinary and interdepartmental interpreter to weave these varied approaches into something real and actionable for our students. It was revealed that the approaches and answers would be shifting drastically in real time. I needed to deepen my understanding, look beyond a rigid proposal structure, and constantly translate between cultures and disciplines to create action through listening.

I personally tied myself to the community by becoming a kinship home and focused on infusing my personal life with Piikani and the project, committing myself fully to its success or failure. I introduced my wife to the community and indicated that her connection to Agriculture and Agrifood Canada could help us complete the scientific research they desired. Her connection to me would help ensure that the project did not stray away from community control. I learned that the carbon credit scheme becoming popular at the time need not only apply to renewable energy technologies or companies, but that Indigenous stewardship of native grasslands and their biocultural understanding of the role of traditional plants could be leveraged to not only protect and restore this important heritage but also position Piikani as leaders in the carbon-climate discussion. In short, we could help protect Piikani culture, contribute to environmental literature, and potentially participate in the carbon economy by focusing on a novel quantification of the ecological properties of Sweetgrass to provide knowledge to assist in its restoration within the school greenhouse and different landscapes.

Without departing at all from Piikani priorities or investing in expensive infrastructure, we could excel at the Western scientific and economic game, earning a seat at the table with future hands to play. In this process, our students could engage with the Piikani language, worldview, and governance, infusing these into their discussions with the environmental instructors, experts, funders, and politicians who often court Indigenous involvement for their own gain.

My students, school elders and I grew the sweetgrass in our school under traditional protocol, presented our project at several conferences, and once we completed the appropriate ceremonial protocols and permissions, we transferred our sweetgrass samples to partnering scientists for multi-method analysis of the plant and its associated soils carbon profile, which was published in a peer-reviewed microbiology journal (King et al., 2024). Our partnership team with Lands and The Resilience Institute then leveraged this successful building of capacity for further funding support, representation, career training and knowledge sharing for our students across various environmental and educational networks. In 2024, our work was shared with the world through several documentary films our students helped to produce, and Piikani gained national recognition by being awarded the Clean50 2025 Sustainability Top Project of the Year. The project was successful, though the initial hypothesis of renewable energy solutions to climate change had been challenged with an alternative pathway that was paved by the community's own intentions.

I learned a new way of viewing the world and interpreting the signs of nature, different than that of my biology degree. The journey was something that brought me back to my own childhood roots of curiosity with our environment as a living, communicative being. When I would encounter some new or unknown plant while exploring as a child, I would often try to learn as much as I could, jumping between the texts of the library and observations in the field. The more you read, the more you learn what to look for in nature. The more you observe, the more you know what you need to study in the library. I would dance between these two contexts towards a goal of entering a dialogue with the plant. I wanted to be able to speak the language of nature not through the breadth of species I could identify, but in the depth of what I could understand.

Most recently, I learned that this process exists, has been described in literature, and is a valuable lynchpin between natural science, spirituality, pedagogy, linguistics, and culture. In my quest to teach science, I discovered hermeneutics, semiotics, and the phenomenological connection of the two. Through an embodied experience with differing interpretations of *sipatsimo's* (sweetgrass) significance, the meaning of intentionality in process arose, allowing me a deeper understanding of how science can be perceived, symbolized and experienced through an alternative cultural lens, revealing and reflecting our own cultural presuppositions. The experience of completing this research landed me in the allegorical waters of David Foster Wallace's fish (2009). Just as the younger fish in the story is so immersed in the experience of living in water that the medium ceases to register on its senses, my original focus on the science aspect of science education had left me blind to the pools of values, priorities, motivations, and hierarchies of knowledge that make up the original justifications for bringing science to Indigenous peoples.

Through this research, I learned that even in momentary encounters with the revelation that these liquid biases make up our environment and inform us, we cannot objectively free ourselves from their grip any more than a fish can rationally decide to leave water now that they know it exists. The wise fish of the allegory knows he is in water, yet he does not attempt to flee. Instead, he engages the youth in a dialogue that helps reveal the medium for them, deepening their understanding of their surroundings and their position in it. Marshall McLuhan (1964) famously stated that "the medium is the message". This research was a process of arriving at and diving deeper into a place where two waters meet to create action and reveal a positive message for and from our students that could be shared with the Nation and beyond. I realize now that I had been swimming with the fins of hermeneutics during this entire project without knowing it. First, attempting to translate the local values and knowledge into academic signals and symbols that could be understood and used within the environmental literature context, but later expanding my view to recognize the power of communities translating scientific values and knowledge through Blackfoot signals and symbols so that they can be understood and used within their own local context, for their own priorities.

This interpretive inquiry research will employ a hermeneutic phenomenological approach, particularly from Gadamer's (1975) concept of expanding horizons. As I encounter unfamiliar realms of understanding, words, symbols and interpretive landscapes, my a priori modus operandi was to situate these new conceptions within the realm of my preconceptions. Instead, by engaging with the intentions of the process and situating them within the local context, new interpretations of our work that were culturally relevant first, yet still secondarily relevant to global scientific and education concerns, were revealed.

You may notice the writing style is often punctuated by shifts in style, tone, and subject. In this paper, I use the italicized blocks of narrative to situate you, the reader, in my personal perspective as it existed in defining moments of encountering either new questionings or expanded understandings. These narratives are bridged together by more traditionally academic blocks of cited research essays in regular font that act as a record of my attempts to situate the learnings I was experiencing on the ground within the broader published literature. Just as this foreword also serves as a conclusion and summary of the entire project upfront, the expansion of my understandings through this time cannot be understood as simply linear progress. I hope that my writing will highlight the shift I went through as I slowly learned to free myself from the need to translate the knowledge of personal experience and cultural practices into the realm of scientific fact for it to be justified in its validity – that science is neither a means nor an end, but rather a set of tools and methods that can be employed under a variety of cultural philosophies to address locally derived means and ends. Regardless of the utensil used to consume it, food is food and knowledge is knowledge.

That said, the structure of the paper retains the skeletal remains of my original scientific inquiry. There are still reviews of literature and explicitly stated theoretical methodologies. There are sections where I drift heavily into formal writing and appeals to objectivity. There are allusions to the scientific literature and the obtainable outcomes of the sweetgrass project. There are sections on the scientific uses of sweetgrass. I have left these remnants in as they are an authentic record of my bicameral experience during this research and my new understandings have grown from its tilled surface.

No more is the shift in my learning, perspective and intentions more evident and documented for reflection than in two interviews done with Global News, one in the beginning of the project during our first Keepers of the Land Workshop, and one five years later upon completion of the project and award announcement. I shifted from a view of what neglected knowledge can the landscape, species, and people offer for the betterment of science and for the youth to access economic control, but ended with how science can be used through a local community lens to strengthen the connection to land through knowledge encoded in language, ceremony, and story for their youth. I set out to answer a scientific question. My hypothesis was proven wrong, though we had results far better than what we hoped for. I set out to do science on the reserve and in the process of reading the mistakes, seeing the mistakes, and making the mistakes, I found answers I had not originally sought.

1.1 Theoretical Framework

Indigenous Knowledge Systems and Critical Pedagogy

Indigenous education frameworks stress the importance of multi-generational learning, TEK, and a state of constant flux and motion (Little Bear 2012). Bastien (2004) highlights the vital role of land in Blackfoot pedagogy, where learning is deeply tied to the environment. For Piikani students, cultivating sweetgrass in a school greenhouse could serve to engage with traditional practices while also applying scientific methods in a way that honours Piikani biocultural heritage (Provost, 2023). Research by Kimmerer (2013) similarly emphasizes the mutual inclusion of Indigenous knowledge and Western science, arguing that both approaches can coexist and enrich ecological education.

Gadamer's Hermeneutic Circle

Gadamer (1975) views an individual's horizon as a combination of cultural, historical, and personal perspectives that sum up to what we perceive as understanding, which can be challenged and expanded through interaction with another's horizon of understanding. Through fusion of these horizons, neither is erased, but instead they merge, bringing assumptions and biases to the surface to be reshaped in a new mutually shared understanding. By acknowledging this process as an educator, I can position my students as offering diverse, valuable perspectives that allow my, and other environmental educators', horizons to expand through a bidirectional knowledge exchange. In interacting with students and the larger community, I can flip between teacher and student to approach a shared understanding that allows action projects such as the one described above to be conducted successfully, respectfully, and adaptively through ongoing dialogue and a mutual journey of lifelong learning with my students and their community.

Understanding and meaning are shaped by the interaction between preconceptions and new experiences (Gadamer, 1975, 1989) in cyclical iterative fashion. Building off the work of Heidegger, Gadamer expanded the idea of the hermeneutic circle beyond textual analysis to encompass all forms of understanding. He posits the impossibility of detached, objective understanding, free of bias and pre-checked prejudice. My reflection on teaching the Sweetgrass project will focus on how my own prior knowledge of TEK, science, and culture shaped the pedagogical experience and project success through the iterative cycling between isolated tasks, readings, encounters, and conversations with repeated reference back to the broader contextual wholes I was embedded in between Piikani culture, my personal experience, and the academic literature. I will use the iconography of a mobius loop to symbolize my interpretation of the hermeneutic circle and the expansion of horizons.

A mobius loop is a topological shape with a one-sided surface that can be constructed by affixing the ends of a rectangular strip after first having given one of the ends a one-half twist. This space exhibits interesting properties, such as existing in three-dimensional space without being able to properly reduce to two dimensions and it remains in one piece when split down the middle. While the traditional idea of the hermeneutic circle seeks to push back against a sequential, positivist, and endlessly progressive mandate of Western epistemology by looping the ending of a timeline back to the beginning, it still encloses the cycle within the bounds of numerical iterations. Or in other words, I complete one cycle and return to the start to complete a second cycle, to complete a third... in additive perpetuity analogous to the infinite growth of place-value positions in the denary, decimal system of mathematics. I do not see this as a fault of the hermeneutic circle but rather a matter of resolution refinement.

The simplicity of the circle betrays the complexity and depth of personal growth within the singular lived experience of an individual operating within a much greater context which is key to the hermeneutic practice. It implies that the expansion of horizons is an outward stacking of material and contextual experiences, rather than an inward deepening of meaning. Therefore, I utilize the mobius strip in its looped form to illustrate that although we think of knowledge as two sided, sides which we flip between in practicing the hermeneutic circle, our perception of time and space is single track. When we travel once around the Mobius loop, we find ourselves in the same cartesian coordinates, although on the opposite side of the loop from where we started. We must travel twice around the loop to arrive back at our true origin. In this process, our displacement is negated, but our distance travelled has grown. We return home, but our inherent properties have changed so that the being arriving home cannot be the same being that departed from that place originally. What we lose in breadth, we gain in depth.

This is a much more fitting geometric analogy for the hermeneutic process than a circle, as the Mobius loop does not have a clearly defined inside or outside, nor top or bottom. It is impossible to point at any singular point of the Mobius strip to differentiate it from a separate shape; the singular point is determinate only in the context of the whole. Our travel around it cannot be experienced in a linear fashion, and if we attempt to split it down the middle, it remains intact and expands. It is also a fitting metaphor for the knowledge transfer and ecological stewardship goals of this project, as its practical uses include continuous loop recording devices, the sustainability-evoking logo for recycling, and to prevent the uneven wearing of a belt that drives machines.

Eco-Hermeneutics

This approach explores the relationship between humans and nature, particularly how ecological processes and Indigenous spirituality are understood through interpretive acts (Plumwood, 2002; Drengson, 1995). Eco-hermeneutics, the interpretive framework that connects human understanding with the natural world, plays a critical role in situating the approaches of eco-action education and Indigenous environmental perspectives within the broader literature. Drengson (1995) and Plumwood (2002) argue that interpreting ecological phenomena is not just a scientific process but also a cultural and philosophical one. This aligns with Gadamer's (1975, p. 308) concept of "fusion of horizons," where separate ways of knowing—Indigenous and scientific—approach mutual understanding without either knowledge set subsuming the other or requiring coherent agreement.

The Mobius strip serves as a powerful metaphor for the approaching of horizons between science and Indigenous knowledge, illustrating how these epistemologies are not necessarily separate but can be continuously interwoven, with neither situated inside, outside, top or bottom. Rather than a binary opposition, the Mobius strip models a relational, process-based understanding, where engagement with different knowledge systems along a twisting path leads to a deeper, evolving perspective rather than assimilation or reduction. The cutting paradox of Mobius topology further symbolizes how attempts to separate these traditions only reveal new space, expanding our horizon of knowledge just as the Mobius loop grows and further twists upon splitting. New epistemic spaces can emerge and create gaps of liminality through the interactions between distinct traditions. Just as a Mobius strip has a continuous structure that rotates upon all three dimensions, knowledge is dynamic, recursive and reflective. Scientific and Indigenous perspectives can loop into and offer transfers for one another, generating a broader, non-hierarchical space of co-creation and mutual understanding through education that situates us in our understanding of the world.

Martinho Soares (2021) and Irina Boldonova (2016) connect hermeneutics to the environment by arguing that the creation of aesthetic, educational spaces can exhibit meaning that connects deeply to local stories and traditions, further enriching culture and environmental awareness as two threads upon which to draw stewardship and responsive action. Furthermore, the reflective, iterative nature of hermeneutic encounters, both in the text and landscape, benefits the educators leading such a process.

Eco-semiotics

Drawing from multiple authors, this framework will explore Sweetgrass as a cultural and ecological symbol, integrating Piikani values with scientific understanding. Eco-semiotics is an interdisciplinary field that explores how living organisms, including humans, interpret and communicate through signs within ecological systems. Rooted in semiotics and ecology, it extends beyond human language to include all life forms, emphasizing that organisms engage in meaningful exchanges with their environment. Building on theories from semiotics, such as those of Charles Peirce and Jakob von Uexküll (Kull, 1998; Nöth, 2001), eco-semiotics argues that all organisms participate in communication processes through a perceptual, subjective construction of the world coined umwelt (Von Uexküll, 1982). Scholars like Kalevi Kull (1998) and Jesper Hoffmeyer (2008) have emphasized signs' role in biological and cultural evolution, promoting a deeper understanding of nature as an interconnected web of communicative relationships.

Methodology

A hermeneutic methodology is well-suited for reflecting on this intercultural, interdisciplinary Sweetgrass project, as it provides a framework for exploring meaning beyond objective analysis. Gadamer's (1975) notion of hermeneutics as a "fusion of horizons" enables Indigenous perspectives to approach understanding with scientific methodology and vice versa, fostering a respectful engagement of Piikani values and insights with science education. Through the iterative process of the hermeneutic circle—moving between specific project interactions and overarching goals— I may gain a more comprehensive understanding of the project's cultural and educational significance (Gadamer, 1975; Moules, 2002). Ricoeur's (1991) concept of narrative identity further supports this approach, as reflection on the Sweetgrass project allows me as a teacher to shape my own identity and pedagogical philosophy, integrating the experiences and insights of the students' identity development within an ongoing narrative of my role as an educator.

Moreover, hermeneutics promotes self-awareness of personal biases being momentary and achieved through confrontation with the new, contradictory, or strange. I hope my strategies may help other teachers move forward into difficult or unfamiliar mediums and messages about how their preconceptions influence their understanding of Indigenous ecological knowledge (Gadamer, 1975; Moules, 2002). This reflective stance is crucial in a cross-cultural setting, where awareness of personal and cultural contexts supports a genuine "fusion of horizons" (Gadamer, 1975; Ricoeur, 1991). Embracing this complexity emphasizes my need to accept ambiguity and multiple perspectives on timelines, metrics, and end goals, making hermeneutics particularly fitting for the diverse, interdisciplinary cultural aspects of the Sweetgrass project.

Narrative Reflection

I will reflect on my teaching experience, documenting key moments from the Sweetgrass project, how they connect to my own evolving personal narratives and how my current role fits into the broader historical narrative of Piikani's relationship with land, government, education and local resources.

Thematic Analysis

Using the Mobius interpretation of Gadamer's hermeneutic circle, key themes may emerge as I flip between encounters, reflection, and action, including the interaction between TEK and Western science, the tensions of historical context and modern priorities, and what it means to engage as a non-Indigenous educator on reserve.

Dialogical Reflection

Engaging in ongoing dialogue with Piikani elders, students, and community members, and incorporating their insights into the hermeneutic reflection. Reflecting on specific encounters during the sweetgrass project, using a blend of personal narrative and reflective connection to prominent literature, I will examine how my journey has impacted my understanding of conducting scientific inquiry within a band-operated school.

Pre-Reflection: Engaging with Productive Prejudice. I will reflect on understandings/prejudices within the role of scientific education, cultural differences in perspective to ecological landscapes, and currently proposed environmental solutions as I encountered them within the project. Gadamer (1975) suggests that interpretive inquiry reveals first and then allows one to truly acknowledge these preconceptions which opens the door to deeper engagement with Indigenous and scientific perspectives by confronting personal and cultural contexts over time. This was not a singular task that could be completed prior to commencing the project. It is instead an ongoing discovery, or uncovering, of that which I do not know I know, that which I do not know I do not know, that which I know I do not know, and the rare, convicting temporality of that which I know I know.

Dialogical Engagement: Facilitating Fusion of Horizons. I will encourage and facilitate dialogue, in both words and deeds, between Indigenous knowledge and Western science. It has been cautioned that in hermeneutic research data collection and analysis are not distinct phases; rather, interpretation begins from the first encounter with the research question and continues throughout the project (Moules et al., 2015). My experience was indicative of this approach as I began to reflect on my own family history, role as a teacher, view of the limitations of the scientific method and more from the very first meeting with the Elder who tasked me with bringing this project to life. I began working backward into my own preconceptions while simultaneously moving forward into the preconceptions of the local context through further meetings, discussions, and story-sharing with students, elders, and other teachers. In his later reflection, Gadamer (1989) describes this fusion of horizons as merging perspectives that enrich understanding **without subsuming one another**. Given my role to walk between both worlds, without ever being able to become the other, allowed my own horizon to expand, providing further meeting points with the horizons of others, and opportunities for deeper, meaningful understanding.

Thematic Interpretation: Applying Eco-Semiotics. I will reflect on the process of guiding students in interpreting Sweetgrass through an eco-semiotic lens, drawing on Maran and Kull (2014) and Ricoeur (1991) to explore the plant's biological and cultural meanings. I will reflect on students' participation in traditional ceremonies and environmental conferences, highlighting their growth in both worlds. I will approach an understanding of the holistic relationship with the sacred plant we are studying by following cultural protocol, spiritual engagement, and a reciprocal process of cross-cultural knowledge transmission in my interactions with it.

Place-Based Reflection: Engaging with Eco-Hermeneutics. Derby (2015) emphasizes the importance of place-based encounters in eco-hermeneutic education. I will reflect on how a relationship with the whole of the traditional Blackfoot territory shapes student and teacher understandings of sustainability and culture. Through personal participation in elder-led sacred site tours, accompanied by students, I will situate the sweetgrass project and my own reflections of it within the broader geographic and cultural context, deepening my own understanding of the meaning and importance of this work to the larger Blackfoot community, and to myself as a resident within this territory.

Final Reflection: Integrating the Hermeneutic Circle and Eco-Semiotics. In the final reflection, I will integrate the hermeneutic circle and eco-semiotics to explore the cultural and ecological interpretation of Sweetgrass and Indigenous-led Science. This reflection helps educators and students synthesize their knowledge from Indigenous and scientific perspectives, ensuring that future projects reflect this approach of mutual respect and understanding.

Moules (2002) states that while hermeneutics is well spread and disconcertedly weaves between theory, philosophy and practice, the desired outcomes are not intended to be definitive but instead pay heed to Hermes and history (as her title suggests) through an interpretive journey that unfolds the hidden depths of meaning within the data over time. While the original sweetgrass project contributed to the objective scientific literature on the ecological role of sweetgrass, this subsequent reflective research on its implementation will lend to pedagogical research on eco-hermeneutics and Indigenous education. It will provide practical insights into how Piikani students can engage with scientific principles while maintaining cultural connections to the land, language, and living beings around them. For educators, it will serve as an interpretive document for authentically approaching Indigenous perspectives within scientific education. It will focus on how hermeneutic encounters, reflection, and re-encounters can help to navigate the revealed and yet to be revealed prejudices often prevalent in the proposal, planning, and implementation of this type of intercultural, multidisciplinary project.

1.2 Literature Review

This research contrasts the metaphysical constructs of land between European and Indigenous perspectives, integrating Gadamer's views on culture and nature (Gadamer, 1989). Specifically, nature is not merely a passive object but an active (or animate in the Indigenous perspective) partner in dialogue. Gadamer sees the natural world as imbued with meaning and responsive to human engagement, where our interpretations of nature are shaped by cultural and historical contexts. This idea resonates with his critique of modern science, which he argues often treats nature as something purely objective, devoid of intrinsic value or meaning outside of economic utility. I argue that modern science's historical role in perpetuating the materialist reductionism prevalent throughout the Industrial Revolution and colonial resource expansionism is deeply engrained within the Eurocentric psyche, preventing comprehension and acceptance of Indigenous perspectives across the contemporary political or educational settings.

The conflict between European, Canadian colonialist, and Blackfoot perspectives on land and agriculture has had profound consequences for Indigenous communities. Colonial policies eroded traditional practices, severing Indigenous people's connection to their ancestral lands and disrupting knowledge transmission (Cajete, 2000; Zedeño et al., 2014). This has had significant impacts for Indigenous health, education, and governance sovereignty (Bombay et al., 2014; Corrado & Cohen, 2003; Fox, 2005; Harris et al., 2013; Tjepkema et al., 2019; Tomaszewski et al., 2011; Smylie et al., 2010; Valeggia & Snodgrass, 2015; Varcoe & Dick, 2008). Due to this negative history, much of modern research interactions with Indigenous community has centred on the people as subjects and operated from a model that highlighted deficiencies within these communities through comparison and measurement of outcomes through a dominant Western value system. These dynamics form the backdrop for eco-action projects like the Piikani Sweetgrass (*Hierochloe odorata*) initiative, which seeks to reconnect Piikani youth with their cultural and ecological heritage by weaving TEK and contributions to Western science literature, positioning Indigenous communities and their youth as leaders, partners, and innovators in land-based research and education.

Before the Industrial Revolution, Europeans viewed the land through a spiritual and pastoral lens, emphasizing stewardship and harmony with the natural environment. Cosgrove (1998) explains that agrarian European societies saw landscapes as part of a divine order, with human beings acting as stewards responsible for maintaining balance. However, the onset of industrial capitalism fundamentally altered this view. Williams (1980) argues that land became commodified, seen as a resource for extraction and economic exploitation. This shift had profound implications for how European settlers approached land in North America, mainly as they encountered Indigenous peoples who viewed land as part of a reciprocal and spiritual relationship founded in respect rather than property.

The imposition of colonial policies in Canada further complicated these relationships. The Indian Act of 1876 and the pass and permit system, implemented under John A. Macdonald and Duncan Campbell Scott's leadership, sought to assimilate Indigenous peoples into European-style agriculture while restricting their access to traditional lands and harvesting practices (Carter, 1990). Daschuk (2013) illustrates how these policies were part of a broader colonial strategy designed to dismantle Indigenous self-sufficiency, forcing reliance on government support and weakening Indigenous nations' connection to their land-based knowledge systems. The pass and permit system not only controlled Indigenous agricultural output but also marginalized their traditional methods, further entrenching settler dominance over land and resources.

In contrast to these European and colonialist perspectives, the Blackfoot peoples, including the *Apatohsi* (North) Piikani in Canada and the *Amskaapi* (South) Pikuni (Blackfeet) in Montana, maintain a holistic and relational worldview regarding land. Leroy Little Bear (2000) argues that Blackfoot metaphysics emphasizes the interconnectedness of all beings, where plants, animals, humans, and the land are part of a dynamic and reciprocal system. Bastien (2004) supports this view, noting that Blackfoot land practices are grounded in principles of balance and reciprocity, with plants like Sweetgrass playing a critical role in both spiritual and ecological systems.

The historical displacement of the Blackfoot people through forced relocation and the establishment of reserves, such as the Blackfeet Reservation in Montana being cut off from their Northern families, disrupted traditional practices and severed vital connections to the land and neighbouring peoples. Cajete (2000) emphasizes that the loss of land-based knowledge and restricted access to traditional hunting and harvesting areas resulted in the erosion of TEK, impacting cultural practices and ecological sustainability.

Climate Change Impacts on Indigenous Peoples

Climate change is a contemporary disruption that can, in conjunction with colonial histories, create local and global impacts on Indigenous practices like traditional harvesting, political agency, community health, education and employment (Downing and Cuerrier, 2011; Ford et al., 2016; Houde, 2007; Schindler & Donahue, 2006; Simpson, 2004). Economic and political impacts can be felt through the positioning of disadvantaged reserves within the borders of developed economies responsible for the majority of climate emissions (Adua, 2022), and thus, Indigenous Nations are incentivized to limit further resource development for the global poor to catch up (Kartha et al., 2020). Indigenous people's mobility in Canadian society are also impacted by a growing number of climate and economic immigrants, who place a strain on Canada's social benefits (Kulp, 2019; Singer, 2022; Xu et al., 2020) and primarily gather in energy consumptive urban environments (Mercer, 1995: Satterthwaite, 2008) where the majority of proposed climate support funding is centered. Current environmental solutions proposed through a neoliberal, scientific lens, such as renewable energy technologies, often disregard Indigenous philosophies and their habitat (Bauer et al., 2018; Kucic-Riker, 2017; Lerer & Scudder, 1999; Sovacool, 2014).

I argue through this research that the modern perspective on energy consumption and production suffers from a fallacy akin to Jevons Paradox (Jevons, 1866), in which any efficiency gains are offset by a propensity to chase perpetually growing yields and expanded consumption, which is at odds with the guiding principles of *Supii-po'omaaksin*, the name granted to our project. I will draw on literature, further highlighting how TEK, BEK and LEK provide insights into climate resilience outside of this economic cycle (Kimmerer, 2013; Maran & Kull, 2014).

Indigenous peoples in Western Canada are on the frontlines of climate change, experiencing profound effects on their traditional ways of life, environmental knowledge systems, and cultural practices. Climate change has disrupted ecosystems, altered traditional food sources, and intensified natural disasters such as wildfires and flooding. These impacts are particularly significant for Indigenous communities, whose cultural identity, health, and well-being are intricately connected to the land and natural environment.

Downing and Cuerrier (2011) highlight how changing temperatures, precipitation patterns, and seasonal cycles have affected the availability of plant and animal species that Indigenous communities rely on for food, medicine, and cultural practices. Climate change threatens the preservation of traditional plant-based practices for communities like the Piikani, who have historically harvested wild medicines like Sweetgrass. Schindler and Donahue (2006) note that changing precipitation patterns and the rapid melting of glaciers in the Rocky Mountains have reduced water flow in major rivers. For Indigenous communities, this threatens community water availability, agricultural practices, fishing, and sacred water ceremonies. Houde (2007) emphasizes that the degradation of water systems also threatens riparian ecosystems crucial for Indigenous lifeways as valuable corridors of plants and animals.
Due to climate change, wildfires, droughts, and floods have become more frequent. Ford et al. (2016) show how isolated Indigenous communities are particularly vulnerable to such events. For example, wildfires have destroyed vast ecosystems essential for hunting, gathering, and performing traditional ceremonies. The spiritual connection between Indigenous peoples and the land is deeply rooted in their knowledge systems. Simpson (2004) notes that climate change has disrupted these connections by damaging ecosystems and affecting the plants and animals essential to cultural practices. Kimmerer (2013) emphasizes the cultural loss associated with the decline of species like sweetgrass, which is integral to Blackfoot ceremonies.

Despite these challenges, Indigenous communities are adapting through TEK. Cajete

(2000) suggests that TEK's adaptability is critical to climate resilience. Indigenous Climate Action, for example, works with communities to restore wetlands and practice traditional farming. Whyte (2018) underscores the role of TEK in empowering Indigenous communities to adapt to environmental changes.

Blackfoot Contributions to Academia and Literature

The contributions of Blackfoot knowledge to science and academia have undergone historical marginalization (Fox, 2005, 2021; Zedeño et al., 2014), but now, modern reengagement with environmental science, education and other academic disciplines looking to incorporate these views into broader fields of understanding is happening (Little Bear, 2012). This remedy cannot come soon enough, particularly in recognizing the significant role Indigenous peoples play in ecological protection, restoration, and knowledge stewardship (Johnson, 2021; Pavlik et al., 2021; Schuster et al., 2019).

Blackfoot contributions to academic literature and environmental action are vast, spanning fields such as food sovereignty, humanistic psychology, and ecological restoration. It is a repeated assertion among Indigenous Educators that the teachings of the Blackfoot Confederacy on self-actualization and community cooperation significantly shaped Abraham Maslow’s development of his hierarchy of needs. Maslow observed that self-esteem and fulfillment were collective pursuits in Blackfoot society, challenging his previously individualistic understanding of human development. However, these contributions have gone mainly uncredited in academic psychology (Mackenzie et al., 2024; Ravilochan, 2021).

The Iinnii Initiative, another notable project, combines traditional Blackfoot ecological knowledge with modern conservation science to restore buffalo to Blackfoot lands. This initiative, part of a broader conservation effort, challenges colonial borders and asserts Blackfoot sovereignty through the re-establishment of buffalo herds across the US-Canada border, allowing buffalo to roam freely and reclaim their role in Blackfoot ecosystems and culture (Van Beek, 2019). This effort demonstrates how cultural practices, political action, and environmental stewardship are intertwined with academic pursuits, fostering ecological balance and revitalizing Blackfoot cultural practices (Fox, 2024). Additionally, Blackfoot environmental philosophy views stewardship as a scientific and spiritual endeavour rooted in respect and reciprocity toward the land and animals, such as the buffalo (Heavy Head, 2005). Recent events, such as the ceremonial bison hunt in Banff National Park, highlight ongoing successes in revitalizing traditional practices and strengthening Indigenous connections to the land (Franklin, 2024).

As seen in Bruised Head's (2022) dissertation, Blackfoot scholarship also emphasizes the importance of reclaiming traditional place names and restoring spiritual practices disrupted by colonialism. The erasure of Blackfoot names for mountains in Waterton Lakes National Park is a loss of spiritual and cultural connection. By restoring these names and reinvigorating practices such as vision quests, Blackfoot scholars are actively working to decolonize land and academic spaces to reproduce their culture and language in the next generation (Bruised Head, 2022).

Additionally, efforts to reclaim cultural heritage through projects such as the Blackfoot Shirts Project demonstrate Blackfoot resilience in preserving sacred items and cultural knowledge. By returning sacred Blackfoot shirts from British museum collections to Blackfoot communities for ceremonial use, these initiatives strengthen connections to ancestors and sacred practices while also serving as an educational tool for younger generations in the traditional material use of the land's resources (Peers & Brown, 2016).

Projects like the Piikani Well-being Project in Montana, which focuses on Indigenous-led metrics to monitor agricultural and human health and integrate traditional knowledge and cultural values into sustainable land use and food systems, are most relevant to this research. These initiatives promote food sovereignty and reclaim data sovereignty, highlighting the central role of Indigenous communities in shaping sustainable agricultural practices (BirdRattler, 2019; Paul et al., 2023).

Pedagogical Theory Supporting Eco-Action Projects

Eco-action projects like the Piikani Sweetgrass initiative are rooted in pedagogical theories prioritizing experiential learning, place-based education, and culturally responsive teaching. These educational frameworks provide the foundation for integrating Indigenous ecological knowledge with Western science, offering students a holistic and hands-on learning experience that fosters cultural resilience, environmental stewardship, and scientific literacy.

Paulo Freire (1970) advocates for education as a tool for liberation through praxis, where reflection and action intersect. John Dewey (1938) emphasizes the importance of learning through real-world experiences. Gruenewald (2003) expands on this through place-based education, emphasizing that education rooted in the local environment fosters deeper connections with culture and community. Lev Vygotsky's (1978) theory of social constructivism highlights learning as a social process constructed through interactions with peers and community members. The Piikani Sweetgrass project emphasizes intergenerational knowledge transfer, where students collaborate with elders and community members, enriching their local understanding of TEK and challenging the power dynamics of Western scientific methods.

The original sweetgrass project, which this research reflects on through a lens of hermeneutics, involved extensive participation of the students and the broader Piikani community. In their study on the role of Participatory Action Research (PAR) in educational environments, Barrett et al. (2024) emphasize the importance of equitable partnerships and power sharing in action research contexts. By positioning students and their extended communities as co-researchers, PAR allows for a balanced integration of scientific and traditional knowledge, aligning with Indigenous approaches to learning.

Similarly, Zeni et al. (2024) focus on how participatory action can empower students to contribute to broader ecological and educational goals, particularly when integrating outdoor learning and ecological stewardship in school environments. Eco-action research adds another layer to this discussion by focusing on ecological restoration and sustainable practices. Clewell and Aronson (2013) argue that involving students in ecological restoration projects, such as growing native plants, fosters a sense of environmental responsibility and scientific understanding. Through this process, I argue that the reproduction and development of youth embodied with culturally imbued respect for the land are the main priority of Indigenous peoples and are the most valuable form of renewable resource in of themselves.

Indigenous education frameworks stress the importance of land-based learning and TEK (Cajete, 1999). Bastien (2004) highlights the vital role of land in Blackfoot pedagogy, where learning is deeply tied to the environment. For Piikani students, cultivating sweetgrass in a school greenhouse could serve to engage with traditional practices while also applying scientific methods. Research by Kimmerer (2013) similarly emphasizes the mutual inclusion of Indigenous knowledge and Western science, arguing that both approaches can coexist and enrich ecological education.

Drawing on Battiste (1986, 2004), wherein knowledge generated by Indigenous people is a decolonial practice that allows us to reflect on the motivational prejudices of Western education, and Ottmann (2017) who argues that Indigenizing curriculum through embracing language, values and practices creates environments of learning for all students, this research aims to break down what Donald (2012) calls “fort thinking” and the static positioning of insider and outsider realities through an exchange of semiotic understanding, similar to what Aikenhead (1997) proposes as a cultural transmission or border crossing, where both Indigenous students and non-Indigenous educators participate as equals to recognize and validate their epistemological differences (Aikenhead & Ogawa, 2007). The process can apply not only in science education and environmental action, but also in how we perceive and translate the conceptual symbols associated with Indigenizing space, such as sweetgrass, smudging, and traditional languages or knowledge.

School Greenhouse Projects and Indigenous Greenhouse Initiatives

Growing programs in schools provide a unique educational opportunity for integrating science, sustainability, and cultural knowledge. These projects allow students to learn about plant cultivation, ecosystems, and environmental management while reconnecting with traditional knowledge systems, particularly in Indigenous contexts. The UNESCO Climate Change Project highlights the importance of a whole-school approach to climate action, where schools engage in comprehensive initiatives that integrate governance, community partnerships, and sustainability into the curriculum. This approach empowers students to take part in meaningful climate-related projects, both inside and outside the classroom (Hargis et al., 2018)

School gardens can serve as valuable tools for interdisciplinary education, combining science, history, literature, and the arts (Ozer, 2008). They are increasingly being adopted to promote experiential learning and environmental stewardship in the US and internationally, demonstrating a holistic approach to education that integrates various subjects (Zarger, 2008). Greenhouses provide immersive, hands-on learning environments that align with educational standards. These spaces encourage reflective learning and are integral to experiential education, offering students a unique setting to explore plant science and sustainability (United States Botanic Garden, 2023). Greenhouses extend the growing season in northern climates, allowing students to experience the complete plant growth cycle. Seasonal expansion is significant for school-based projects, as it allows for alignment with the academic year and enhances student engagement in agricultural and ecological learning (Rudge, 2023).

However, previous research has identified challenges to implementing rural agricultural education in the continental North, such as high upfront energy costs, maintaining a skilled workforce, and creating a profitable produce market (Doyle et al., 2014). Skinner et al. (2014) conclude that although community-based greenhouses can aid rural food security and revitalize traditional harvesting practices, they require local project champions and frank discussions around operational responsibility.

The Green Bronx Machine project, led by Stephen Ritz, integrates urban agriculture and food justice into classroom learning. This greenhouse-based education fosters student engagement in urban sustainability efforts (Hofstein & Lunetta, 2004). Similarly, the Edible Schoolyard Project in California instructs students about sustainable agriculture through hands-on gardening and greenhouse work, integrating plant biology and environmental stewardship into education (Bevins & Price, 2016). As part of its “Simply Living Simply” program, Bruce Peninsula District School integrates greenhouse activities into their climate action curriculum. The greenhouse allows students to learn about sustainable food production, climate change, and local ecosystems. The project also engages the community by involving parents and local experts in greenhouse operations (Hargis et al., 2018).

In Canada, the Northern Manitoba Food, Culture, and Community Collaborative incorporates greenhouse initiatives to address food sovereignty and sustainability in Indigenous communities. These projects promote traditional agricultural knowledge alongside modern techniques, helping students reconnect with their heritage while fostering environmental responsibility. The Dehcho First Nations Greenhouse Project in the Northwest Territories (United States Botanic Garden, 2023) and the Mi'kmaw Greenhouse Initiative in Nova Scotia (Rudge, 2023) also provide valuable examples of how greenhouses teach Indigenous students about traditional plants and sustainable agriculture. Both initiatives integrate TEK with modern greenhouse cultivation, promoting food sovereignty and cultural revitalization.

The Piikani Sweetgrass project builds on these models by using a school greenhouse to cultivate Sweetgrass, a culturally significant plant for the Blackfoot people. The project weaves TEK with Western scientific methods, teaching students about ecological sustainability while strengthening their cultural identity

Eco-hermeneutics, Hermeneutic Encounters in Science Education, and Eco-Semiotics

Gadamer's Hermeneutic Circle, Productive Prejudice, and Fusion of Horizons

Hans-Georg Gadamer (1975) posits in *Truth and Method* that understanding is a dialogical process where different traditions, perspectives, or "horizons" expand, meet, and merge to create new meanings. Indigenous knowledge surrounding sacred plants represents one horizon—rooted in a deep, spiritual, and ecological relationship with nature. Western resource management (agriculture, environmental regulation, greenhouse technology) represents another horizon—grounded in industrialized, scientifically driven approaches to the landscape.

The goal of this project is not to impose one system on the other but to allow a dialogue between these two ways of knowing where neither perspective is erased but instead mutually expanded. Through the process of growing Indigenous sacred plants in a greenhouse, the sacred meaning of the plants and the technological aspects of agriculture evolve in mutual understanding. Tending to these plants in a modern system becomes an act of hermeneutic interpretation—where the greenhouse does not just grow plants but nurtures meaning and relationship between diverse ecological cultures.

Gadamer's (1975) hermeneutic circle also suggests that understanding is a continuous process of interpreting parts within the context of a whole. Students can interpret Sweetgrass's scientific properties within the broader cultural context of Blackfoot spirituality. Educators can interpret modern scientific education within the broader cultural context of colonialism. Jean Grondin (2017) further elaborates on this educational tie by noting that understanding nature involves acknowledging the dialogue between presuppositions and experiences to engage in a continuous interpretive process. Gadamer's productive prejudice highlights how educators and students bring cultural perspectives into the learning process, refined through dialogue with TEK and scientific methods. Davey (2006) further emphasizes the fusion of horizons, where different perspectives unite, enriching Indigenous and Western knowledge systems.

This hermeneutic process aligns with Indigenous ways of knowing, which are cyclical and relational. Little Bear (2000) explains that Indigenous knowledge systems view understanding as a dynamic interaction between humans and the land, mirroring the hermeneutic circle's emphasis on continuous dialogue, interpretation, and expanding horizons.

Eco-Semiotics: Bridging Cultural and Ecological Meaning

Eco-semiotics is an interdisciplinary field that explores how living organisms, including humans, interpret and communicate through signs within ecological systems. Rooted in semiotics and ecology, it extends beyond human language to include all life forms, emphasizing that organisms engage in meaningful exchanges with their environment. Building on theories from semiotics, such as those of Charles Peirce and Jakob von Uexküll (Kull, 1998; Nöth, 2001), eco-semiotics argues that all organisms participate in communication processes through a perceptual, subjective construction of the world coined *umwelt* (Von Uexküll, 1982).

These processes shape behaviours and relationships within ecosystems, as seen in phenomena like animal signalling or plant responses to environmental changes. By viewing nature as an active participant in these semiotic processes, eco-semiotics challenge the anthropocentric view of communication. The field has practical applications in environmental education and sustainability, encouraging a holistic approach to ecological challenges and providing plentiful observations, cues, and knowledge. Scholars like Kalevi Kull (1998) and Jesper Hoffmeyer (2008) have emphasized signs' role in biological and cultural evolution, promoting a deeper understanding of nature as an interconnected web of communicative relationships. Eco-semiotics highlights the importance of understanding and respecting the communicative agency of all life forms, fostering a more integrated approach to ecological issues.

Maran and Kull (2014) suggest that eco-semiotics help bridge the gap between Indigenous and Western knowledge systems by interpreting plants like Sweetgrass as ecological entities and cultural symbols. Hoffmeyer (1996) argues that organisms, including humans, continuously generate meaning from their environment, making eco-semiotics a valuable tool for understanding the cultural and ecological significance of species like Sweetgrass and other traditional plants from the human perspective. Eco-semiotics are the foundational basis for all TEK. It is not only about practical knowledge but also involves a deep respect for nature, recognizing its power and spiritual communicative ability. The approach resonates with eco-semiotic principles emphasizing the interrelation between signs, organisms, and ecosystems.

TEK contributes valuable insights to ecological restoration and sustainable management, aligning with eco-semiotics' focus on all organisms' communicative roles (Turner et al., 2000).

In the context of the Amazon Rainforest, Tønnessen (2020) agrees that a multi-scale ecosemiotic approach emphasizes the importance of Indigenous knowledge in understanding complex human-nonhuman relationships within ecosystems. Indigenous communities' experiences contribute vital perspectives to ecological sustainability, enriching broader environmental education efforts. The Anthropocene requires rethinking human-nature relationships, calling for a deeper understanding of nature’s agency. Drenthen (2016) critiques human-centred approaches like ecomodernism, suggesting that humans should learn from non-human agents instead. Rewilding projects, where human intervention is reduced to allow nature to "speak" and respond, demonstrate the ecological relations and semiotic interactions between species. This perspective encourages educational practices that recognize non-human agency and ecological interconnectedness.

In the Piikani Sweetgrass project, eco-semiotics allows students, scientists and educators to see Sweetgrass as more than just a plant—it is a cultural sign that embodies the Blackfoot people's relationship and ongoing interpretation with the land and sky. In conjunction with hermeneutic encounters, this framework fosters dialogue between TEK (specifically Blackfoot, BEK and specific forms of Local, LEK) and scientific inquiry, positioning both as complementary knowledge systems under the shared human endeavor of interpreting nature. Sweetgrass is both an ecological and cultural signifier, supported by theories from Umberto Eco (1986) and others. By engaging in eco-hermeneutic practices within the greenhouse, Piikani students can develop a more nuanced understanding of Sweetgrass cultivation that encompasses both scientific data (such as growth cycles and soil conditions) and cultural practices (such as the ceremonial use of Sweetgrass in Blackfoot traditions). This dual approach encourages students to see themselves as scientists and knowledge keepers, contributing to academic research and preserving their cultural heritage. This situates Western science and TEK as different yet valid forms of the ecosemiotic interpretation of nature. By bringing the visiting scientists into Piikani cultural protocols and priorities and using that as the foundation to bridge our students' understandings of the procedures and priorities of the scientific method and Western environmentalism, we positioned our research as ceremony (Wilson, 2008). Entering into a slow pedagogical relationship with sweetgrass and sharing this knowledge cross culturally contributed to what Leddy and Miller (2024) call a decolonial literacy by expanding both scientific and cultural horizons of sweetgrass as an icon (the image of a braid or the symbolic abstraction of weaving understandings), an index (the smell of smudge or its ecological role in cycling carbon), or a symbol (the learned understanding of sipatsimo through stories, translations, teachings, and scientific observations of the plant). This helped define the important interpretative role sweetgrass plays within the current educational semiosphere as we aim to Indigenize the academy in an authentic way, infusing diverse literacies into multiple curricula.

Chapter 2: The Sweetgrass Project

With a kiss of the banana leaf, the smoky aroma of tobacco left my lips and danced toward the candlelit canopy above my head. The shacapar became indistinguishable from the rustling breeze within the trees; the chupar and soplar were inseparable from the gurgling stream a few meters away. Sounds of the jungle blended into the rhythmic, vibrational whistle of the icaros. A whistle became a song, the song became words, and the words became a being. "Why are you here?" it asked, dancing, swimming, swirling around the inside of my head. "I just want to help, My interest is to study and protect plant medicines." This was met with roaring laughter that filled my head without touching my ears. "Look"

A timelapse downloaded into my consciousness. In an instant, I was shown, or more accurately, made to understand, myself working and saving money for the trip, but also everything that my work and money had touched outside my perception and timeline, getting all the gear, and the entire supply chain needed for it to go from soil to my hand, the network of agents, employees, paperwork, and binary digital switches involved in booking my tickets, the materials coalescing into the cars, airplanes and fuel needed to bring me across the continent, the exhaust covering the distance of my flight and all of the energy infrastructure behind the scenes. Then, I was shown the small lavatory holes I had dug within the village, and the brick washhouses we had constructed atop them were minuscule in scale as my perspective zoomed out to show me the adventurous jungle I had been exploring was but a garden like my grandmothers, constructed in a language and breadth that my mind had been unable to translate without this Rosetta stone moment. I was shown the kids in the school, the ones I played soccer with, the ones I traded English and Spanish with, the ones I read to and juggled for, and was given a glimpse of the infinite ripple of their lives, actions, and future in the world. I have yet to *find words not limited by the baggage of my scientific discipline to describe the feeling of instant and unexpected revelation, seemingly free of any personal construction or connection to previous knowledge. But as the indescribable feeling of my embodied antenna finished transducing the signal, I whispered back in awe, "Understood. So, what do I do instead?"*

"You will go home, and you will help my people there. You will do everything you want and what is needed there. You will work to protect the plant medicines there. And in doing that, you will help me and my people here." I was shown people I didn't know, places I hadn't been, and unfamiliar scenes of cultural practices. My disbelief was transparent and was met with laughter harder than before, it faded away as I called out, "How do I know I am on the right path?"

Although Canada is the second-largest country by total area and fourth in available land, its native flora remains vastly understudied and under-classified in terms of ecological and economic importance (Klemet-N'Guessan et al., 2019). While ecosystems like the Amazon or Congo are well-known for their ecological diversity and ethnobotanical potential, Canada's unique geographical zones—shaped by its vast latitudinal and longitudinal range—create specific ecological niches involving complex relationships between native flora, fauna, and peoples.

One such area is the Rocky Mountain Foothills in Southern Alberta, where prairie, forest, and mountain ecosystems intersect, creating rich ecological diversity shaped by generations of human curation. However, climate change, industrial developments, and human activities now threaten these habitats before much of the scientific or traditional knowledge can be documented or passed on. Despite studies highlighting the importance of Indigenous-led management in protecting biodiversity (Schuster et al., 2019) and conservation movements like Bears Ears

National Monument (Johnson, 2021; Pavlik et al., 2021), a growing generational gap exists in both Indigenous and non-Indigenous communities in terms of land stewardship skills and environmental knowledge. This disconnect threatens to worsen issues in rural areas where access to fresh produce, education, energy, and employment is already limited.

The Piikani Nation proposed a solution: a school-based community greenhouse that serves as a hub for both traditional Piikani knowledge and Western environmental science. By integrating different ontological, epistemological, and practical perspectives, interdisciplinary teams aimed to establish accepted, adopted, and authenticated approaches to addressing climate concerns within the Nation's territory. This greenhouse serves as a model for Indigenous-led sustainability projects, flipping the script on corporate environmentalism by incorporating Indigenous spirituality into local environmental stewardship. The project shifts the focus of sustainability from Western notions of capitalist efficiency to the Blackfoot principle of *supii·ṗo'omaak̇sin*, originally translated by William Big Bull (2018, p. 135) as "a transfer back to the earth," and enacted through this project. as a reciprocal relationship of planting seeds in balance with nature. Lisa Crowshoe (2024) discusses how "*pommakssin"* or transfer of knowledge initiates new members to take on the responsibility of important cultural symbols and concepts in the service of community survival and most importantly, in the service of Piikani youth.

This project addresses these challenges through collaboration among government, education, energy, and environmental science sectors. The Piikani Board of Education Society aims to engage students in environmental stewardship and local food responsibility through a comprehensive greenhouse program focused on food security, environmental land conservation, and preserving traditional knowledge. The greenhouse will provide sustainable learning opportunities and will incorporate renewable energy systems, where possible, to help students build skills in science and technology while connecting these to Piikani cultural concepts. It will also offer employment opportunities, serve as an environmental knowledge hub for students, and function as a gathering space for elders and local departments.

The eco-action project explored the hypothesis that school greenhouses can serve as model hubs for interdisciplinary environmental research by addressing the following questions:

- How can a school greenhouse address education, social, health, and environmental issues in rural communities?
- How can a school greenhouse help protect traditional knowledge in rural areas?
- How can the benefits and risks of inter-departmental and interdisciplinary collaboration on community resilience projects be navigated?

The project attempted to assess the community's local issues and the feasibility of using renewable energy (geothermal, solar, wind) to construct the greenhouse while exploring integration with other energy sources (LNG, direct transmission lines).

It aimed to involve school and community members in the design and development of a growing regimen that supports food security, cultural resource protection, and the re-introduction of beneficial native species.

- Develop scientific literacy curriculum and programs that equip students with the knowledge needed for agriculture, environmental, and cultural protection and restoration.
- Maintain experimental plots for reintroducing Indigenous species in collaboration with the Piikani Land Department and academic researchers.
- Engage stakeholders to support the long-term financial and operational sustainability of the greenhouse and building local capacity.

The key guiding principles included:

- **Free, Prior and Informed Consent** (UNDRIP)
- **Principle of Common Good**: fostering pathways for local innovations to inform global climate change efforts
- **Safe, Ethical Spaces**: where multiple ways of knowing are respected and explored
- **Mutual Respect**: established, developed, and nurtured through empathy and trust
- **Community Guidance**: on ceremony and protocol, including the gifting of tobacco and prayer

Discussions with Elders and community members were conducted following the guidelines in *More Than Personal Communication: Templates for Citing Indigenous Elders and Knowledge Keepers* (Macleod, 2021). Perspectives shared in these conversations were not collected as formal data. However, they provided context and guidance for the design and execution of this and future studies conducted in partnership with traditional landholders.

The three of us met in the elementary school staff room. This side of the school was much older than the high school side where I normally taught, and the many rumours of the negative energy, even hauntings, that filled its halls were acknowledged humorously by the Elder as she took her chair. She and the Lands Department Manager opined on whether the proposed new school would ever come to fruition. She told us of her grandchildren at the school and pointed out the lone 1993 Science Fair Champion poster won by one of her children. Then she turned to me and bluntly asked, "So, Science-Man…Where are you from?"

I explained that I had always assumed that I would return to the family farm at some point but that it was no longer an option. That I had come to school in Lethbridge and my wife *and I were settling down here as we both found jobs after university. "Ahh so you are like the sage plant, blowing across the prairie and setting down your new roots here."*

I laughed, although inside I had a tinge of uncertainty. I wasn't sure if my blowing in and setting down roots was a welcomed idea. I recalled a few days earlier there had been some sage in the classroom I was moved into. I had lit a smudge and some of it had been burned. My principal came down the hallway to inform me that Blackfoot people don't really smudge with sage, that the sage was left there by a Cree teacher. I figured I better go home and research exactly how the Blackfoot people viewed and used sage.

In 2019, Roberta Yellow Horn, a Piikani elder and member of the Peigan Board of Education Society (PBOES), initiated the idea to create a holistic, interdisciplinary program to develop Piikani students into future "Keepers of the Land". The goal was to bring together elementary, secondary, and post-secondary students, scientists, charities, and researchers to study and educate the community on environmental impacts while staying true to traditional Piikani culture and language. In partnership with Noreen Plain Eagle, Manager of the Piikani Nation Lands Department (PNLD), and Laura Lynes, President/CEO of The Resilience Institute (TRI), the project focused on food security, drought/flood adaptation, prairie grassland and bison restoration, and understanding the strategic use of traditional Blackfoot plants to address climate change.

Permission for the original scientific research and my Master of Science Thesis Proposal was obtained through PBOES Director Lisa Crowshoe and through cultural guidance from Elders. The PNLD (represented by Noreen Plain Eagle) and TRI (represented by Laura Lynes) secured a Band Council Resolution (BCR) to conduct the project, aligning with the goals identified in Local Early Action Planning (LEAP) (The Resilience Institute, 2021; 2022). The initial objective of energy assessment was replaced with an assessment of traditional Piikani plants and their habitats through engagement with local priorities and elder guidance.

Blackfoot Language Instructor William Big Bull and I obtained an official land-use agreement from the PBOES Board of Trustees outlining the geographical boundaries and proposal for the sweetgrass project, future greenhouse to expand our current space, and outdoor learning spaces. The project team visited Blackfeet Community College in Browning, Montana to explore student greenhouses and academic partnerships. External support was secured from Alberta Eco-Trust, the EJ4Climate: Environmental Justice and Climate Resilience Grant, The Calgary Foundation, Indigenous Agriculture and Food Systems Initiative, Climate Change Health Adaptation Program, First Nation Inuit Youth Employment Strategy, SucSeed, and Growcer.

Dr. Harry Penn (Arctic Institute/University of Calgary) and Dr. Wade Abbott (Agriculture and Agri-Food Canada) were formally introduced to Elders and community stakeholders and received protocol guidance. Steven Tannas of Tannas Conservation Services led workshops on seed identification, collection, and propagation, and consulted on greenhouse design using traditional plants, including transplanting sweetgrass. A three-row shelterbelt, containing plants of cultural and food value, was planted by students to protect the greenhouse, future Growcer unit, and outdoor spaces from environmental hazards:

Botanical Species List:

- *Amelanchier alnifolia* – Native Saskatoon
- *Cornus sericea* – Red Osier Dogwood
- *Populus tremuloides* – Quaking Aspen
- *Potentilla fruticosa* – Native Yellow Potentilla

- *Prunus virginiana* – Native Chokecherry
- *Ribes aureum* – Golden Flowering Currant
- *Ribes oxyacanthoides* – Native Gooseberry
- *Rosa acicularis* – Prickly Rose
- *Shepherdia argentea* – Silver Buffaloberry

Hardy Non-Native Species:

- *Lonicera caerulea* – Haskap Berry
- *Malus 'Rescue'* – Rescue Crabapple
- *Malus 'Norland'* – Norland Apple
- *Prunus cerasus 'Evans'* – Evans Sour Cherry

Sweetgrass transplants were obtained in September 2021 through Tannas Conservation Services and planted in a 1 m^2 nursery bed in the greenhouse, following Piikani protocols involving prayer and tobacco offerings. Seedlings incubated over winter and propagated in spring 2022, with students harvesting leaves for ceremonial use.

In September 2022, students, elders, and researchers participated in a knowledge-sharing ceremony, granting researchers permission to take samples of greenhouse sweetgrass and other wild grasses. Samples were collected and analyzed through glycomic, metabolomic, 16S metagenomic, and chemical analysis, in partnership with the Abbott Lab and other researchers from Agriculture and Agri-Food Canada and the University of Lethbridge.

Due to challenges in locating wild sweetgrass and aligning timelines with funding deadlines, the project would benefit from a multi-year approach. Scientific research findings were shared with the Piikani Nation for approval before publication, and for use to inform future locally developed environmental initiatives related to protecting grasslands, river habitats, and

Piikani cultural resources. Copyright was vigorously negotiated with Crown agents to ensure that Piikani was properly credited within the scientific literature, and that this new precedence was not overlooked in favour of publication expediency.

2.1 Renewable Values

After our initial meeting and first Keepers of the Land workshop, our team scheduled to meet again to discuss next steps on the project development. They had been pointed in the direction of an environmental researcher from the University that had some experience in greenhouse technology and climate change. After our meeting, the professor mentioned that what we were trying to do could be a Masters project for me and may help get the community some additional funding. I brought it up with my team and administration, they all agreed it was a good idea, but that I should be careful in what information I share and what priorities I promote. I was nervous, I had just started here, been given a rather large assignment, and now was being encouraged to tie my own tuition, time, and transcript grades to the project. I was only on a one-year contract. However, something about putting my own skin in the game added a sense of urgency, focus, and follow through to my commitment to the project. I told myself that this would give me a rigid timeline to finish the project quickly. The dangling carrot of advancing my education would encourage me to put in the extra hours necessary for a project like this to succeed. Not to mention, academia was familiar. Thus far my experience navigating the requests of elders to lead students through a culture I was just learning had been one of naivety, insecurity, yet eagerness to provide service to the school community. Structuring my research around this project provided a framework of comfort. I could provide scientific rationales, justifications, and data to support our projects development and thesis, giving the community a record of the project in academic literature Even if my contract here was short *term, I wanted to have some positive impact using the skills I had. My first assignment was to research the impacts of climate change locally and explore the feasibility of a renewable energy greenhouse here in the community.*

Climate change is one of the most significant ecological, political, and ideological challenges facing humanity today. The Intergovernmental Panel on Climate Change (IPCC) reports that human activities have caused approximately 1.0°C of global warming above pre-industrial levels, with a range of 0.8°C to 1.2°C (IPCC Assessment Report, 2018). The IPCC projects that global warming could reach 1.5°C between 2030 and 2052 if current trends continue. Scientists agree that exceeding this threshold by continuing to burn fossil fuels will lead to far-reaching, catastrophic impacts. NASA reports that over the past 170 years, human activities have raised atmospheric carbon dioxide (CO2) levels by 47% compared to pre-industrial levels (NASA, 2020). Before 1950, CO2 levels peaked at around 300 parts per million (ppm); as of October 2020, they have risen to 415 ppm (NASA, 2020).

This sharp increase in carbon dioxide and other greenhouse gases is driving widespread environmental changes, including Arctic ice retreat, permafrost thawing, sea level rise, ocean acidification, more frequent extreme weather events, and mass species extinction. Humans are not immune to these effects, as technological advancements are often politicized and weaponized, rather than collectively leveraged for solutions. These climate-induced changes could lead to concentrated resource conflicts, political unrest, and a surge in climate refugees.

Canada faces the challenge of balancing global climate accords with its energy and food economy, which increasingly relies on immigration for population growth. National policies and local developments must also involve the explicit permission and inclusion of Indigenous populations. This situation highlights the growing ideological rift among government, activists, academics, and communities regarding environmentalism. It is critical to reflect on how market-driven thinking—the same thinking that contributed to the climate crisis—may be hindering solutions. Indigenous culture should play a leading role in shaping national energy and environmental policies to avoid repeating colonial-era mistakes.

Energy consumption and emissions are disproportionately driven by the wealthiest. Studies show that the richest 1% of the global population is responsible for double the emissions of the poorest 50% (Adua, 2022; Jorgenson et al., 2017). Oxfam and the Stockholm Environment Institute (2020) argue that the developed world must address its high consumption rates to make room for the industrialization of developing nations within our climate limits. However, Western energy producers and politicians resist this, claiming that regulating emissions in some countries while allowing others to grow unrestricted is both unfair and counterproductive to global energy goals. They argue that energy produced in nations with stricter environmental and human rights laws, like North American LNG, should be exported to developing countries (BRG Energy and Climate, 2024). The resulting private wealth, they argue, could be invested in efficient "green" energy solutions to improve existing oil and gas infrastructure in developed nations. Critics, however, counter that this strategy will worsen inequalities between "Have" and "Have Not" nations, with any efficiency gains lost during transportation. Despite these debates, the world still needs more energy.

Jevons Paradox

I looked out at the small, weed-ridden plot of soil behind the school greenhouse. I had resisted my initial urge to till and spray the area and replace it with rows of neatly cultivated European vegetables in the reproduction of my grandmother's garden. This would have been the most familiar, efficient, and easy way for me to follow through on the deliverable of harvestable *produce yield for the greenhouse. Instead, I had given pause to take heed of a momentary epiphany that I should instead first ask if there were traditional uses for any of the wild plants that I had prejudiced as weeds. I had seen the way Elders responded to my graduate supervisor's suggestion of chasing a profitable vegetable produce and from what I could see there were often some beautiful flowers, berries and grasses that bloomed from the abandoned plot. What if there was a yield here already, one that had not received the buzz-cut harvest treatment of the neighbouring grain fields. Our Blackfoot Instructor responded to my questions with an offer to take me to a place where he could teach me about the deeper meaning behind our project's name and gather some important plants to bring back to this plot.*

As we left the townsite on what amounted to a goat trail, twisting its way in a south-westerly direction toward the edge of the reserve, William Big Bull explained the effect of road allowance on legal definitions of territory, the history of energy and agriculture projects on the reserve, and the knowledge provided to him through dreams. He warned me not to tell anyone of the dreams he shared, as he would know if I did. Despite my curiosity, I chose not to let my curiosity run wild on the mechanisms of how. Besides, we had jumped the railway tracks and arrived at our destination: a mature grassland and favoured historical harvesting ground for plant medicines. He told me how he used to drive his elders out here to connect with the land but was worried that there would be no youth to take that torch for his generation. We loaded our pails, shovels and tobacco offerings to begin our hike. "It saddens me that it seems only people like you who are keen to learn the value of our language and knowledge."

"People like me?" I earnestly asked.

Both sides of the political spectrum often ignore a fundamental issue in addressing climate change on national and global scales: the Jevons Paradox. This principle suggests that environmental or efficiency gains are nullified by the increased demand generated through the increased supply of energy (Jevons, 1866). For example, English farmers did not use the surplus of steel tools from the Industrial Revolution to simply ease their workload; instead, they used them to increase production, expand, and fuel population growth. This expansion required more energy and resources, revealing limitations in British land and natural reserves. It also had social consequences, such as air pollution affecting natural selection in the peppered moth (Tutt, 1896) and the exploitation of vulnerable populations in mines, where youth traded their potential for furnace burn time. The colonial apparatus employed to find and refine further material sources led to cultural genocides and the subjugation of land and resource sovereignty for Indigenous peoples worldwide.

Today, the physical limits of the Earth remain unchanged, even as the energy budget required to sustain digital infrastructure continues to expand. This has led to what David Harvey and Doreen Massey term "Time-Space Compression" (Warf, 2011), where technological advancements in communication and transportation distort temporal and spatial distances, driving increased consumption and capital turnover (Massey, 1994). Indigenous communities, with deep ties to specific regions, are more affected by these globalizing forces than those who identify as world citizens, detached from traditional collective affiliations to the land. David Goodhart’s (2017) concept of "Anywheres and Somewheres" echoes this, highlighting the contrast between those with deep connections to place and a cosmopolitan elite who are more mobile and globalized.

Concerns over peak oil, once a significant fear, have been somewhat alleviated by innovations like fracking, which unlocked vast natural gas reserves in North America and levelled off carbon emissions from North America. Other advancements, such as hydro, solar, wind energy, and biofuels, increasingly contribute to global energy needs (Ellabban et al., 2014). However, these solutions are not without environmental and political costs. Hydro disrupts ecosystems and displaces communities as seen recently in the Site C dam controversy in British Columbia (Lerer & Scudder, 1999; Kucic-Riker, 2017), solar and wind energy require substantial upfront land, material, and economic resources (Bauer et al., 2018; Chewinski et al., 2023), and fracking has long-term detrimental effects on aquifers and geological stability (Jackson et al., 2014). Biofuels, too, raise land-use concerns and conflict with agricultural producer needs (Tilman et al., 2009). While these alternatives provide critical substitutions for traditional oil and gas, they remain driven by market forces that prioritize profit over sustainability (Sovacool, 2014).

Urbanization exacerbates climate-related challenges, with 50% of the world's population producing 70% of emissions, primarily by residing in energy-hungry urban areas (Satterthwaite, 2008). Climate change is expected to drive mass migration, with 3.5 billion people estimated to move due to health concerns linked to extreme heat, disease, and air pollution (Xu et al., 2020). Rising sea levels, projected to increase by two meters, will also displace coastal populations (Kulp, 2019). This creates a dynamic where nations must be seen as migrant donors and receivers, rather than simply "have or have not" countries. As developed nations contribute more emissions, immigrants from developing countries will inevitably increase energy demand in these regions, offsetting efficiency gains.

Canada's vast land, freshwater resources, and potential for agricultural expansion make it an attractive destination for migrants. The country relies heavily on immigration to sustain population growth, with plans to welcome 1.2 million immigrants in the next three years (Singer, 2022). Climate change will further increase the number of refugees, driven by political conflict and food security concerns. This influx may exacerbate tensions within and between Indigenous and rural populations, who may view global climate regulations as favouring urban growth at their expense. If global environmentalism is seen as politically adjacent to, or an extension of, colonial industrialist philosophies, it may be challenging to separate sustainability efforts from historical exploitation.

To avoid perpetuating these issues, access to sustainable technologies, infrastructure, and financial tools must be equitable, not restricted by corporate or governmental gatekeeping. Environmental assets and benefits should be controlled at the individual or community level. This project, guided by Blackfoot principles, seeks to empower Piikani youth with the skills and knowledge to lead local, sustainable energy and food production. Furthermore, through privileging the revitalization and reproduction of Blackfoot values encoded within the language and plants, generations of Piikani students can continue to provide novel, traditionally informed perspectives on the proper balance of local resource development, distribution, and protection. By connecting school students to their cultural community through elders, ceremony, and land-based learning alongside Western science curriculum, Piikani youth will continue to be a valuable renewable resource for their community and a changing Canada.

Youth are the real renewable resource

The darkened room was punctuated with hunched shadows cast upon the walls by the dim glow of twelve phone screens. I excitedly handed out the itinerary and permission slips to mixed reactions of apathy, groans, and restrained interest in where we might be able to shop on this field trip. I tell my students that some people have taken notice of our sweetgrass project and that we have been invited to an environmental education conference in Canmore, all expenses paid!

The questions circulated around what the mountains were like, how far it was, and whether they might have Pepsi, but one question stood out above the rest:

"Whoop-di-doo, we grew sweetgrass, wooow! What do a bunch of kids from Brocket have to offer rich kids from a white school?"

Indigenous people make up 4.9% of Canada's population, comprising 634 distinct First Nations, each with its own unique culture, knowledge, traditions, and dialects (Statistics Canada, 2013). Preserving language and culture is one of the most pressing challenges these nations face today. For over a century, Canada's residential school system forcibly removed an estimated 150,000 Indigenous children from their families and communities. These schools aimed to destroy Indigenous language and culture by prohibiting children from speaking their languages, practicing ceremonies, sharing cultural knowledge, or passing on oral stories. The schools' mandate was to assimilate Indigenous children into Euro-Canadian working-class society. Today, we recognize that authentic, inclusive education is the true path to reconciling the educational history between Indigenous people and the Canadian government.

Three main goals have been identified by The Truth and Reconciliation Commission of Canada's (TRCC) *Calls to Action* (RCAP, 1996) as critical to initiating proper reconciliation policies:

1. Language and culture must be preserved in an authentic, living embodiment.
2. Gaps in socioeconomic status, health, and education between Indigenous and non-Indigenous Canadians must be addressed.
3. Indigenous-centered curriculum outcomes, housed within culturally inclusive learning environments, must be implemented in K-12 education.

This project focuses on the Piikani Nation in Southern Alberta, part of the larger Blackfoot Confederacy. The Confederacy includes the Kainai, Siksika, and both Northern and Southern Piikani, united through communal gatherings to celebrate their shared major ceremony, *Okan* (the Sun Dance).

The Blackfoot people have historically lived in an area of significant political and geophysical division, covering the transitional zones from the Rocky Mountains, foothills, and great grassy plains—territory that once spanned Southern Alberta, Saskatchewan and Northern Montana. The drawing of the U.S.-Canada border disproportionately affected the Piikani, dividing their families and territories. This international boundary disrupted the ability of the *Aapátohsipikani* (North Piikani) and *Aamsskáápipikani* (South Piikani) to negotiate with consistent governments on either side of the border. A key goal of the greenhouse project is to strengthen relationships with Blackfeet Community College in Browning, Montana, providing shared learning opportunities that reconnect the Piikani through collaborative greenhouse programs. Through these efforts, students can become agents of change in their communities, using their own cultural knowledge to guide their relationship with nature rather than relying on curricula centered on Euro-Canadian or American views.

In addition to addressing climate change, the project tackles a variety of issues affecting Piikani communities, such as language and culture preservation, grief and loss, and addictions. With an aging population in many Indigenous communities, the transmission of traditional knowledge, language, and culture is under direct threat with community health and well-being directly impacting educational outcomes (Crowshoe, 2024). In 2003, UNESCO developed criteria to assess language viability, and today, more than two-thirds of the 70 Indigenous languages spoken in Canada are classified as endangered. Blackfoot is listed as “Severely

Endangered," with only 3,300 speakers, most of whom are over 45 years old (UNESCO, 2017). Language is the most significant component of culture, and without it, a unique perspective on humanity is lost.

The TRCC (RCAP, 1996) placed pressure on the federal government to develop an Aboriginal Languages Act to preserve and revitalize Aboriginal languages. Since 2015, educational language initiatives, such as Aboriginal Head Start Programs, have emerged across Canada, focusing on language acquisition in early childhood education. At the baccalaureate level, strides have been made to include Blackfoot ontology and cosmology in academic literature. Mike Bruised Head (2022) emphasizes the importance of incorporating the Blackfoot language into spaces like national parks and scientific literature, ensuring that culture is reproduced across generations. Lisa Crowshoe (2024) highlights a need for language and cultural revitalization to be viewed alongside community health and well-being. This project aims to fill this gap, leap-frogging the process of anglicized translation that clouds authentic cultural writings, by making elder knowledge tangible and interactive through the greenhouse environment and academic publications. As a learning space, it provides opportunities for language about and from the land to be shared orally with examples of traditional plants on campus.

Globally, Indigenous populations suffer poorer health outcomes than non-Indigenous populations. A study from Yale found that Indigenous people worldwide experience lower life expectancy, higher infant and child mortality, maternal morbidity, and high rates of chronic diseases, substance abuse, and depression (Valeggia & Snodgrass, 2015). Canada's Indigenous population follows this trend, with a much lower probability of living to age 75 compared to non-Indigenous Canadians (Tjepkema et al., 2019). For Inuit men and women, the probability of living to age 75 is 23-25 percentage points lower than for their non-Indigenous counterparts (Tjepkema et al., 2019). Indigenous Canadians also experience higher infant mortality rates (Smylie et al., 2010), heart disease (Anand et al., 2001), and higher rates of Type II diabetes at 3-5 times higher than the non-Indigenous population (Harris et al., 2013). Diabetes-related complications, such as chronic kidney disease, amputations, and retinopathy, are also more prevalent (Harris et al., 2013). Community garden programs, like the greenhouse sweetgrass project, provide a solution by increasing access to nutritious food year-round, which can reduce cases of chronic, life-threatening illnesses (Ley et al., 2014). Additionally, these programs encourage physical activity and strengthen ties to traditional biocultural heritage in an accessible setting.

Trauma from the Indian Residential School (IRS) system has caused long-term mental health impacts for Indigenous communities across Canada. Residential school survivors suffer from high rates of mental health issues, including PTSD, depression, and substance abuse (Corrado & Cohen, 2003). Survivors often turn to drugs and alcohol to cope with the abuse they experienced (Varcoe & Dick, 2008). Intergenerational trauma has further harmed the descendants of survivors, who report higher rates of childhood abuse and neglect (Bombay et al., 2014). Programs like the sweetgrass project provide a healing space for Blackfoot students and community members, combining cultural and scientific knowledge in an outdoor setting (Mitchell, 2013; Timler et al., 2019).

Canadian society places an economic premium on education, through job market access, increased wages and informal social bias. Despite its troubled history in modern Indigenous circles, it has also been stated that, “Education is the new Buffalo" (Ottmann, 2017), meaning that it is now what the youth must look towards to secure food, shelter and resources. Education is, in semiotic essence, a symbolized environmental niche to be sustainably utilized. Ryan Heavy Head of Kainai Nation (2005) describes how education is a feeding process, wherein participants embark on a journey, returning with a nutritious bounty to share amongst the community. Sustenance builds the body, enforcing the idea of an educational path being that of becoming fully yourself. However, Indigenous students, parents and communities are suspicious of Western education systems, including the food choices historically dictated within their institutions. William Big Bull (2018) describes IRS school meal culture in his book,

> here is where I got my first taste of cod and liver oil pills. “OK.” I had enough, time to go home, not a chance; I was here for what seemed like an eternity…Even though we had daily meals, we went hungry… the big boys would recruit us smaller ones to crawl through the hedges and trees to a garden on the side of the school to pick parsnips for them to eat…due to my frequent visits the supply thinned out quickly…the area was just about picked bare…You would pay for your protection at the table with fruit and dessert...The morning ritual of being fed the little black iron pills and cod liver oil was a positive side of living under Department care, the down side was having to eat someone else’s vitamins…breakfast fare included toast spread with molasses, the lingering taste made repulsive by swallowing all these vitamins, giving me residual nausea that lasted on into adolescence. (p. 50)

Curriculum has not authentically included Indigenous people - their traditional knowledge, histories, stories, ceremonies, or governance - and it is a widely held view in Canada that curriculum lacks the respect and dignity afforded to other historic peoples (Kanu, 2007; Schaefli et al., 2019; Webb & Mashford-Pringle, 2022). Even with current trends towards ending the historical approaches of assimilatory education such as the introduction of language, culture and experiential learning opportunities from an Indigenous perspective, some Indigenous students feels trapped when making the important decision to begin or carry on with their education journey, as the acceptance of one path can seem to come at a loss of connection with the other if making the move off reserve. On the other hand, Indigenous students on reserve today are expected to become fully literate in both the Blackfoot culture, as well as English language and curriculum. Their grandparents and local band-operated schools are encouraging language and cultural revitalization, yet they are still beholden to standardized curriculum and structure for other subjects taught in English schools. Off-reserve schools are offering cultural connections but are predominantly non-Indigenous and still cater to Western society. Some students attend school in town but live on reserve semi-embedded in both contexts (Crowshoe, 2024). Often, this can lead to students feeling alienated from both, forced to code-switch, juxtapose, and hide parts of themselves daily.

I experienced this act of daily code-switching throughout the duration of teaching in Piikani and gained empathy for the students and parents I saw who also had feet in both worlds. The feeling of never being enough on either side was maddening. Each time progress was made in understanding one context, it simultaneously unravelled the congruence of the other. However, I now see that this can be a productive practice; a form of hermeneutic circle where one is primed in the bits of a certain context all day and then placed into the larger context of another (Gadamer, 1975). The experience was similar to the 20th century shift within Anthropology from studying other cultures for the sake of foreign interest to a practice of using other cultures as a foil to examine the biases, oddities, and intricacies of your own home base (Peirano, 1998). For non-Indigenous educators teaching on reserve, the distancing from one's own culture while immersed as an outsider in another can often be the largest hurdle to making it through the first year. If navigating the discomfort of the cultural dissonance is acknowledged as a reflective practice, educators and students can both benefit through an inverse shared exploration between the requirements of each cultural milieu in the pursuit of understanding the individual and community goals as they exist for Indigenous students operating between reserve and off-reserve contexts.

The ballroom was well-decorated, the closest thing to a prom you will see in Canada. Delegates from thirty schools were formally dressed and seated amongst political dignitaries, corporate executives, Olympic athletes and prominent environmentalists. As the panelists discussed how best to include students in the environmental industry, my students scrambled on an iPad to submit a question from our table. We settled on one of the provided prompts involving Indigenous engagement but adjusted the wording to ask how they saw the role of Indigenous sovereignty in environmental projects. As the moderator read our question aloud, she omitted the word sovereignty completely, stumbling for a more sterile term. This was a pattern that had been repeated throughout the weekend wherein the theme of including Indigenous voices in the environmental industry took privilege over Indigenous ways of thinking, knowing and being. The panel chose their words slowly and carefully in front of their corporate sponsors, making direct eye contact with me.

"Indigenous engagement is a laudable goal, but the question we have to ask is whether the capacity is there to lead projects like this?"

The educational gap between Indigenous Canadians and non-Indigenous Canadians is well documented. Indigenous Canadians are severely underrepresented on college and university campuses (Tomaszewski et al., 2011). Statistics Canada (2008) reports that only 35% of the Aboriginal population ages 25-64 had received a certificate, diploma, or University degree, while

51% of non-Aboriginal Canadians of the same age group had done so. High school graduation rates for Indigenous students are also less than for non-Indigenous Canadians. The statistics for high school completion rates of Indigenous students in Canada are even more astounding. The Assembly of First Nations (2012) reports that 61% of First Nation young adults (20-24) have not completed high school, compared with 13% of non-Indigenous people in Canada.

Western education has traditionally relied on memorization, regurgitation of facts paired with standardized tests as the single most important tool in assessing student learning. In what William Pinar (2012) refers to as “cram schools”, curriculum outcomes neglect meaningful critical engagement with knowledge in service to exam preparation. Traditional Indigenous education involved children learning from elders, oftentimes familial relations - grandparents, parents, aunts, uncles. It was centered around great storytelling, shared by elders to teach children morals, values, and important life lessons (Archibald, 2008). Assessment of learning was not measured by a one-size-fits-all, exam-based approach. Learning was measured by children's ability to demonstrate their understanding of these concepts and ideas in their everyday behavior and actions in the community.

Indigenizing the student experience is a recent goal of many Universities, but the rehearsed land acknowledgments and updated signage have largely been viewed as lip service and corporate posturing - the distrust runs deep for Indigenous students because the traditional and authentic voice has been stifled before they even step foot in any Canadian educational institution (Ottmann, 2017). Rather than implementing policies that force Indigenous populations to subscribe to either the left or right wing of the same colonial bird, environmental sustainability efforts and educational concepts that support them should instead be grounded in the traditional principles of those directly stewarding the land. An extensive philosophical examination of the assumptions held within ALL modern thought, is needed to elucidate the moral and intellectual underpinnings that equally pervade the political machinations of both liberal and conservative ideological tinkering in the modern world - and local Indigenous knowledge is one of the few mirrors that can reflect these shared prejudices back to us (Battiste, 2004).

Knowledge that is invented elsewhere and imported through the education system is seen as a weapon of cognitive imperialism (Battiste, 1986). Approaches should avoid subscribing to Eurocentric or pan-Indigenous bias and engage with the specific, local culture that is represented within the geographic context of the learning. Band-operated schools offer an important opportunity in this aspect, as they often integrate land-based learning, Western curriculum, and culturally specific protocols. Marie Battiste (2004) recognizes both this strength and sovereignty of band-operated schools by arguing that while Indigenous peoples recognized the need for expanded education to properly interact with the new, incoming settlers, they did not cede the cultural authority of education from their families or communities. Instead, the treaty agreements on education were understood to be the crown's fiduciary responsibility to provide school infrastructure to the band as they requested them for their own need, not to offload educational responsibility and oversight to the church or provincial authorities for assimilatory purposes.

The warmth of the fireplace carved paths in the frost clinging to the outside of the cabin's windows. Outside, two students were having a sword fight with icicles longer than their arms. Someone had found Twister and was rallying the other students to get a game going. A young couple shared a chair and snacks they had brought over from the food lodge. One of my students was writing poetry in his notebook while two girls from a large Calgary school snuck glimpses over his shoulder, then back at one another approvingly. I couldn't put my finger on why everything had an air of nostalgia to it, like a Christmas memory from a far-gone childhood.

Then it hit me, it had been 12 hours since the students realized we didn't have wifi or service in the mountains. The phones had long since died while searching for bars and had been slowly abandoned in the students' bunks. I felt a tap on my shoulder. "How come we have never done stuff like this before? We should do this every year!". I swelled with pride before letting my teacher's brain take over. "A lot of people were excited to hear about this sweetgrass project," I replied. "Are you ready for your presentation tomorrow?"

The Values of Teaching Environmental Science

Throughout my teaching of the project and this reflective inquiry research process, I have been acting in the important role that the Jody Wilson-Raybould (2024) describes as an "inbetweener", attempting to work between different groups of people to break down silos and engage in projects that are larger than the performative reconciliatory symbols of orange shirts and trotted out acknowledgments that seem to populate at the detriment of engaging meaningful change. Critiques could be raised that it is not the place for outsiders to break down silos, that this is internal business. Yet the role of a non-Blackfoot educator employed by a Blackfoot nation often muddies this line. We are employed specifically to teach the values, concepts, and languages of the previous colonial system, though (thankfully) our employers now have the authority under band-operation and shifting teaching quality standards to infuse more Indigenous subject matter into the provincial curriculum. Perhaps our role as educators in these situations revolves around identifying the different silos that may exist and creating bridges, ladders, windows, and doors for our students and community to effectively navigate and communicate between them.

Although I was at the table on many important meetings and visits, I had to accept that there were conversations that I could not be privy to from the Piikani perspective. However, my positionality awarded me access to conversations from the other side of the aisle. I learned that although yes, there had been improvements in dialogue between Indigenous and non-Indigenous groups surrounding inclusion of Indigenous ways of knowing in discussions around policy, curriculum and resource management, conversations often became uncomfortable or curtailed when the topic of Indigenous sovereignty or active ways of being came up. The political niceties were dropped as opinions drifted back to tried and tested inferiority or deficit stereotypes residing in what has been historically accepted or expected of Indigenous expressions of agency. I noticed that although the Indigenous way of thinking was welcomed and place was made for the knowledge to be voiced as a passive participant, there was still resistance to an active embodiment of Indigenous ways of being as it pertained to matters of education, economic, resource or territory matters. Indigenous values were fine as slogans but became a problem if acted upon. They were fine so long as they upheld the expected perspective but became an issue if they proposed unique, alternative, or autonomous pathways forward. This strengthened my resolve that the sweetgrass project emphasized science learning as embodied through Piikani priorities, purposes, language, and culture, and that the research represented more than just a passive voice, but that it was grounded in Piikani practices, authenticated ways of being that are the foundation for students to connect with and reproduce ways of knowing into the future. The language, the land, and the body are all interwoven through a semiotic literacy that allows connection to values to be reflexive and renewable across generations. Like other modern classroom tools, greenhouses can be used as an effective third-space to help improve students' literacy through interaction with alternative technologies and multiple semiotic libraries (Crowshoe, 2024).

In the spirit of Supii·ṗo'omaak̇sin seed planting, this research does not view the infrastructure or produce yields as the major resource generated. Instead, we view human knowledge and action as the most important renewable resource. Instead of using modern environmental technologies to find new ways to plug into devices, environmental solutions can be used to find new ways to plug into landscapes. It is through education, language and culture that the human being is transformed from a finite material resource into a renewable, multigenerational, sustainable resource. Friere (1970), alongside Bourdieu and Passeron (1977) both see this process as turning the inanimate human object into an agent capable of transforming and sustaining the societal milieu they exist within and to serve, or an act of becoming. However, when grounded in Indigenous perspectives, as done by Battiste (2002), Kimmerer (2013) and Smith (1999), this process is more akin to an act of being and renewal. Where the student is already (and always) animate, yet also becoming connected to the land and culture, past and future, through a multigenerational transfer of knowledge and iterative renewal of identity. These are subtle differences but an important signifier of cultural differences on the role of our role in nature and society. This thesis most closely aligns with the latter approach, though also alludes to the work of O'Sullivan (1999) who posits that ecological education embedded with cultural understanding results in students who are a sustainable, renewable resource in of themselves, not simply agents or stewards of a separate nature.

Energy used to supply a greenhouse is given back to the student body and given back to the land. Students become producers rather than just consumers in their food choices, learning the entire cycle from food to compost and finding both cultural and scientific meaning in the role of maintaining that balance. Plants grown in the greenhouses are reintroduced to the land, replacing biomass that is harvested and offered elsewhere. In this sense, students are giving back to the earth for providing the carbon upon which all modern fuels are based, and which is cycled in our bodies and environment. This is a cycle that is encoded in the iconography of the common smudge box contents and in the act of burning sweetgrass on charcoal (Strikes With a Gun, 2022).

Through comparing of environmental science technologies within the artificial environment of a greenhouse versus the natural landscape curated through Blackfoot language and stories, students of all backgrounds can become familiar with the Blackfoot perspective and develop appreciation for the advanced ecological and survival knowledge of the Blackfoot people By establishing this program within the school, a Growcer unit was funded and paid for as a trial space for education and career training, supplementing the school food program, and providing novel approaches to conserving and restoring traditional Piikani plants. The Growcer unit was decided upon due to its lack of glass windows, which satisfies cultural aesthetics and mitigates damage from inclement weather or security concerns. Initial infrastructure is in place for the Growcer unit, and the start of operations is being synchronized with the construction of the new school, which includes the outdoor design of land-based learning centers. The student planting of an irrigated shelterbelt proactively addresses environmental wind concerns for future projects, providing a cache of culturally important plants for the community to use for traditional and educational practices. The Piikani Chief and Council will continue to evaluate success and future demand to explore the further expansion of multiple Growcer units, or a much larger, traditional glass community greenhouse in the footprint of the current elementary school closing upon completion of the new school. In a way, the energy and commercial expansion idea proposed by my initial supervisor is still in play, yet it was imperative that partners, students, and school staff understood that the project process had to follow Piikani protocol and priorities first.

They could still converge upon a mutual understanding of a shared solution and value, but the means are just, if not more important than the ends.

The elementary school secured 3 classroom hydroponic grow kits from SucSeed to teach younger students the principles of growing technology in support of the United Nations sustainability goals. The high school was provided 3 hydroponic grow tents for students to conduct micro-experiments in their classrooms in conjunction with the greenhouse spaces. The new space provides traditional harvestable foods and, eventually, basic vegetables to be used in cooking classes and the school's food program. It also offers educational space for students to learn curriculum and experiment with novel approaches to repopulating native plant habitats from seed. The classroom grow-kits, the original greenhouse, and shelterbelt serve as starting incubators for sweetgrass and other seedlings that can be harvested or transplanted for community needs. Students can use Blackfoot to explore important cultural foods and medicines with Elders on the school campus.

Students were included in several activities through this project including climate surveys, air quality monitoring, greenhouse tours, grassland workshops, traditional iinii (bison) harvests, meat smoker construction, transplanting traditional plants across the reserve, environmental DNA sampling, youth advocacy conferences, hands-on training in laboratory techniques, the knowledge transfer ceremony, and career skills in greenhouse technology.

Participation in these activities sustained a direct connection between the scientists and the community through the establishment of a framework for students to engage with technical experts in the use of methodologies and analytical techniques to address locally important problems. Inclusion of students, educators, and elders in the development of climate solutions and associated curriculum prioritizes their local cultural perspectives when approaching environmental issues and promotes long-term acceptance, adoption, and authentication within the community. Content and data generated through this project will be included in the Piikani digital archive for use in future curriculum and environmental discussions.

The Sweetgrass project guided educators, students, researchers and project funders through a shared intimate relationship with one of the most regularly and rapidly disappearing Blackfoot plants, sweetgrass. It was found that energy for energy's sake, and a neoliberal belief in limitless growth is a biased and ineffective selling point for renewable energy projects in certain circumstances. The scope of this study shifted away from maximizing the use of renewable energy because the local community is focused instead on the energy of youth, maximizing the renewability of knowledge across generations, and plugging technology into Piikani culture and language versus plugging the Piikani people into technology. Much like any living member of a tribe is given a name and role within the group, technology is seen as an animate spirit and must be authenticated by passing through Blackfoot language, song, and ceremonial protocol (Many Guns, 2023). The practices carried out in this research were critical to defining the role of reductive, materialist scientific methodologies and perspectives in serving the biocultural heritage, customary laws and interconnected relations formed through the inherent values and principles of the Piikani people (Provost, 2023). This serves as a model for alternative pathways to future eco-action projects by using educational institutions, with the culturally specific ontology and epistemological modalities they reflect, as a direct justification and network for expanding community acceptance, adoption and authentication of climate solutions across multiple generations.

Students joked about showing off for the aunties as I rushed out the door with a stack of chairs. We had spent the morning setting up a tipi as a documentarian filmed the students going *through the process under the watchful eye of an Elder. People were now arriving, and I was hurrying about to find seats for everyone. It was quickly realized that not everyone would fit in the tipi and some students would need to sit around the entrance for the ceremony. Representatives from the School arrived. My students showed up dressed for the occasion in ribbon skirts. They had brought sweetgrass braids and offerings for the elders. Today they, alongside the scientists would be gifted the permission to conduct scientific research with the plant in service of protecting Piikani lands and connecting students to their culture. Representatives from our supporters and the scientists arrived shortly thereafter. Among the scientist delegation was my wife, 9 months pregnant, and here for the ceremony. I had booked these days off work to prepare for the delivery of our son, but the ceremony ended up being scheduled a few days before our due date. I had come into work off the clock from teaching but hosting what to date was the biggest event of my teaching career. As we settled into our circle around the Elders, we all took a moment to share our introductions and intentions with the project. I was then asked to explain the smudging protocol to our guests, and as we began, the elder told us the story of sipatsimo and how we are all connected through it. Our students then brought forward the braids they had grown. These were blessed and gifted to the scientists. We finished with a traditional feast and completed the sweetgrass sampling process. This was a day that had been years in the making, and now it had arrived successfully. Our project had the full acceptance of community stakeholders. I would soon have the quantitative data to validate and round out the completion of my scientific thesis. A few days later, I was blessed to begin my journey into fatherhood. I was at the peak of my research experience, the project was showing tangible movement, and I now truly understood the impact of children on one's values, perception of time, and hopes for the future.*

I thought back to my childhood running through the fields of my farm believing that I could communicate with the plants, to the vision I had experienced in Ecuador, to the answer I had received when I prayed for direction on accepting an offer at Piikani or at the city Catholic School, to William's answer of what he meant by people like me. "The Jesuit types" he had answered back then. Basking in the reverence of ceremony, seeking connection to Creator through the exploration of creation's diversity, celebrating the making of the material sacred and communicating the complex interconnectedness of our existence through parable, symbol and semiotic conductance. I laughed to myself as the comparison finally clicked. Other Elders had similarly pointed out that they recognized a form of "belief" in me, something that showed an authentic curiosity in their ways. As much as I had presented and been hired as a representative of science curriculum, it was my willingness to engage openly in understanding the spiritual connections to the ecological worldview of Piikani that had informed the scientific object of investigation and my permissions to undertake them.

Like a Jesuit, I sought Creator in all things, dedicated myself to service of others, and attempted to integrate faith or spirituality with reason, scientific inquiry and philosophy. Many years after this light-hearted accusation, I feel seen more than I see myself. This would never be a label I self-ascribe, but it is fitting. Even now, I embody the Jesuit spirit through a hermeneutic practice reminiscent of the five elements of Ignatian pedagogy - context, experience, reflection, action, and evaluation. I somehow found that doing Science in Piikani had reconnected me with my own religious foundations. I had been given the gift of completing a scientific, ecological project that my younger self would have dreamed of while connecting deeper with my own faith, family, and cultural history. It was this ongoing Blackfoot methodology of situating myself within my identity that allowed me the deepest learnings. I discovered the depths of my own *cosmological upbringing and form of Western education that make up the invisible culture I swim in, but I also recognized that my adolescent rejection of those principles had framed my scientific and environmental pursuits within a box that either excluded spirituality or attempted to validate its claims only through scientific means. After teaching and learning for many years, I see the value of diversifying the semiotic lens we situate ourselves in as educators and in the classroom. Whether that is other languages, narrative structures, mythology, spirituality, religion, political ideology, or material scientific exploration, a decolonized literacy allows us and our students to walk productively between these realms of understanding.*

Spiritual Ecology

The knowledge sharing ceremony, as a condition for truly grounding the external and internal research team in the deeply embodied connection between the people, their medicine and the land, highlighted the importance of cultural and spiritual buy-in when undertaking environmental action projects. The experience shortened the gaps between the motivations of the science team and local Indigenous stakeholders. The smudge served as a shared prayer, a contract of sorts, that adopted the scientific practice into a Piikani practice of further exploring their intimate relationship with creation and the animate technologies it has gifted us. The researchers were brought into an authenticated, albeit limited, temporary role and granted permission to undertake their study. Only through this practice of ongoing dialogue and upholding localized community protocols over multiple years could a research relationship with the land authentically and ethically begin.

The direction of conservation research or the expression of ideals cannot be decided prior to engaging the community (Provost, 2023). This was a reality met by members of the original research team when proposing that Piikani land could be used for expansive, renewable energy greenhouses to compete with the Californian lettuce market, something which still garners laughs and head shakes among the Piikani members seated at the project table. The attempts to fit a market-focused project proposal developed off-reserve, and leverage Piikani participation for increased grant funding to pay off-reserve students to conduct their research off-reserve to be shared with other off-reserve stakeholders was something that needed to be left… off-reserve. This issue, while drastically impacting my academic progress, also provided me the opportunity to reaffirm my allegiance to Piikani goals not only through the scientific lens, but also through an authentic commitment to the spiritual and ceremonial priorities demanded of the community.

There are environmentalists bearing all stripes and ideologies: big game hunter conservationists, vegan bloggers for PETA, Indigenous warriors, CFOs of NGOs, William Kamkwamba, Greta Thunberg, the staunch atheist and the papacy of the Vatican. Some want to save their local hunting ground; some want to stop hunting. Some are devastated by the rising water levels in Venice's museums, others by the decreasing water levels in their crop fields. Regional problems require regional solutions, and it is often those most impacted by the problem that are willing to invest the effort to address it, whether the reasons be practical, financial, cultural, or spiritual. There is an emerging field that aims to address the nexus of cosmology, environmentalism, and academia.

Spiritual Ecology, or in its stauncher forms, Theological Ecology and ecotheology, refers to the idea that there is a spiritual aspect to conservation beyond materialist resource economics; that there are cosmological, cultural, or religious beliefs that drive human interactions with our environment beyond basic sustenance (Sponsel, 2016). If taken to its full conclusion under the charter rights and freedoms, land, energy and food sovereignty could theoretically be claimed under religious pretenses and any environmental regulation that enforces certain conflicting practices would be in violation of that sovereignty. I explored this idea within the context of Amazonia during my undergraduate degree (Weighill, 2017). In the Blackfoot sense, environmental regulation is carried out by ceremonial bundle holders in a relationship with other animate natural beings. Regulatory authority is garnered through knowledge of protocol and information encoded in song and the language, rather than degree and governmental decree. Governance is not separate from spirituality but is instead explicitly informed by it.

Despite best intentions, current environmental policies are motivated by a bevy of political bodies subscribing to narrow, purportedly opposing philosophies in capitalism and socialism. One seeks to leverage competition between businesses seeking to find the most cost effective way to supply and increase demand through technological efficiencies or new material sources, motivated by shareholder profit; the other attempting to use collective force to legislate more environmental and economic regulation by limiting government approvals to select companies which leverage corporate compassion and a stakeholder perspective to protect certain social and natural environments from the disruptions brought on by climate change. The problem with each of these is that important decisions are made in boardrooms that are physically and metaphysically disconnected from the land, or the people dependent on the land which they seek to control.

The current cultural and ecological revitalization projects being undertaken by various members of the Blackfoot Confederacy aim to realign environmental motivations from the ground up and heavens down by guiding the projects with the traditional perspective of Niitsitapi to protect the language, spirituality and the centuries of knowledge held by the original inhabitants of North America. The alignment of the food program with future renewable energy, ecological restoration, and conservation projects allows the Nation to gain further food, energy, land and financial sovereignty by accessing the benefits of global carbon markets and demand for sustainable, community-led solutions. However, this process cannot be undertaken at the risk of losing cultural identity and spiritual connection to the land. Steps must be in place to protect the cultural expression and agency of Indigenous groups through an environmental education that is not dismissive of spirituality, nor ignorant to the conscious or unconscious religious biases that underpin the Western view of nature whether one is theologically active, agnostic or atheist.

Educational theories, strategies, and philosophies need to change to remedy the problems Indigenous students are faced with. There is a need for real and meaningful Indigenization of curriculum; Full Indigenous-lead learning, content and curriculum created by Indigenous peoples for Indigenous peoples, connected to Indigenous land and culture. The prevalent Western liberal view narrows the perspective of educators and experts to reaching individualist, and progressively directional outcomes within a structured hierarchy. But learning is not only a personal experience. It is also a social experience. This view is very much in line with how traditional Indigenous peoples viewed education - a learning experience created by community for community and educed through a dialectical relationship with nature. If a community is involved in the learning process - classmates, nation members, traditional knowledge keepers, ceremonialists, elders - the production of knowledge becomes a social and participatory dialogue - a spiritual cycle more than a cataloguing of skills and facts. Educators and students can learn to interact with themselves and nature through the interpretive signs and symbols that interface between the Blackfoot language and the surrounding environment.

This alludes to the ideas of Gadamer in his 1985 work, “Boundaries of Language” (Gadamer and Schmidt, 2000) when he describes how one learns to speak. We do not simply learn one word, then the next, and the next, until one day we know all the words to be considered literate. There is a serve and return, a dialogue not only with interlocutors but also with our surroundings and our own bodies (he uses the example of a baby playing with their fingers), leading to us becoming communicative beings. This mirrors the hopes of Piikani Elders that their children will become communicative beings with the Creator, the Blackfoot language, the traditional territory, and themselves. That they will understand the language to speak with the land through a semiotic interpretation that prioritizes Piikani interests, resources, history to protect and reproduce their cultural heritage into the future.

Research shows that when Indigenous students are permitted to engage in culture-specific learning activities, where the mental, emotional, physical, and spiritual domains are equally acknowledged, engagement increases (Gallop & Bastien, 2016). The sweetgrass project accomplishes this by engaging students in community-based experiential learning, cultural knowledge sharing, and language development for Blackfoot students. It grants them access to industry experts and academic resources involved in greenhouse and land-based activities, making technical worlds less foreign to students isolated on rural reserves by situating these concepts within Piikani icons, symbols, and signs. It also provides something back to the scientific body of literature by including previously neglected perspectives which may find novel ecological solutions for modern problems through engaging with more traditional interpretations of our relationship with our environment or one another.

2.2 What makes a symbol?

3..2..1.. PIKANI! I looked up to the scoreboard. 10 minutes to go and we were up substantially. I proudly glanced left of the clock where our retired jerseys and banners hung. Redskins Championship Basketball. The phrase always caught my eye. It had remained proudly displayed alongside the names of Elders in the gymnasium throughout the controversy of the

Washington NFL team. However, when I took over the athletics program in 2019, there had been a change in the policy wherein our team was simply called Piikani. I had asked around, and the answer I always got was that someone complained about the name being racist, and it was all in the news. Therefore, they were reviewing its use. After the game, I asked an Elder about the name. "Good Question. To understand that you need to understand our ceremonial paint."

Ok. Bit of a curveball but I was hooked. I could not comprehend the connection. He explained that the red ochre that had been used in a paint ceremony earlier that week had been used for purification and warrior preparation for battle. "That team in Washington was actually named to honour one of our Piikani Chiefs." I was a football fan, but this information was entirely new to me. I had been exposed to the student protests, Obama's pronouncement, and all the media around this and other sports team names being insensitive, outdated language, symbols and logos. I realized that my understanding of the debate and the opposing views was completely neglecting a Blackfoot perspective on what Redskin meant. It had been informed by two sides of my own culture's conflict, with representatives of differing Indigenous peoples and non-Indigenous academics and politicians weighing in on what the name meant. Yet, here was an elder telling me that not only was there a natural environmental origin to this story, but the name was a now-deleted example of honouring the contribution of Blackfoot spiritual values and people in the broader culture. This was a local history that had been visible my entire life but not translated for me, and now through the work of well-intentioned activists, teachers and students, the Redskin name and icon had been redefined and removed from the public realm preventing others from uncovering this nuance. I was encouraged by the elder to research this history further if I wanted to understand how governments and academics jump to conclusions and solutions without understanding the actual cultural contexts, stories, and meanings encoded *within an image, item, or practice. I realized that I had been employing a similar assumption in my approach to the greenhouse. I was short-handing the community priorities within a broader discussion of social-environmental justice, and therefore, the solutions generated were preordained. Healthy vegetable diets grown with electricity generated by renewable technologies. There was a business model, an environmental model, and a social justice model all included in this initial proposal, but was this set up for Blackfoot students to simply check the boxes of Western environmentalism, diet, employment skills and pedagogy? I now saw a need to flip the transfer process on its head. The Redskin name and logo embodied the spirit of the Washington Football Team competing in a Blackfoot way while honouring what the Blackfoot culture had given them. I wanted scientists and students to use the tools of science in a Piikani way, for science to contribute to Blackfoot culture, rather than simply having Piikani students doing science in a Western way for Blackfoot culture to contribute to science. However, I also saw the dangers of misunderstanding, opposition, and cancellation that lurked in the uncertain process of translation between these realms, especially from those outside of the community.*

The controversy surrounding the Washington Redskins logo and name provides a lens to explore the intersections of cultural representation, historical erasure, and the reclamation of Indigenous identities. For the Blackfoot people, the story of this logo and its origins offers a nuanced perspective that bridges history, cultural symbolism, and modern debates about environmental revitalization projects, such as the Piikani Sweetgrass initiative. Understanding these connections illuminates the broader struggle of Indigenous communities to protect their cultural heritage while navigating contemporary sociopolitical dynamics.

The Washington Redskins logo, introduced in 1972, was modelled after Chief Two Guns White Calf of the Blackfeet Nation. Designed with input from Walter "Blackie" Wetzel, a former chairman of the Blackfeet Nation, the logo was intended to honour Indigenous people by elevating the image of a respected leader. For many in the Blackfoot community, the logo was a point of pride, signifying a global recognition of their heritage. The term "Redskin," while controversial in broader contexts, has historical roots in sacred practices, including the use of red ochre in purification ceremonies, where warriors adorned themselves with the pigment as a symbol of strength, vitality, and spiritual resilience. The red ochre, or *a'saan*, holds profound significance in Blackfoot culture. It was applied during spiritual rituals and war preparations, symbolizing blood, life, and protection. The use of red ochre extended to ceremonial artistry, quillwork, and even rock art, underscoring its centrality in Blackfoot traditions. For the Blackfeet and other Indigenous communities, the symbolism of red ochre is deeply intertwined with their worldview, connecting them to their ancestors and the land.

The eventual retirement of the Redskins logo and name in 2020, driven by social justice campaigns, was heralded by many as a victory against racial stereotypes. However, for the Blackfeet and other Indigenous groups who found pride in the logo's origins, this decision symbolized a different kind of erasure—one that dismissed their agency in defining what representations of their culture mean. This mirrors a larger trend where external actors, often with good intentions, inadvertently overshadow Indigenous voices in cultural and environmental discourse. This dynamic is paralleled in environmental revitalization movements, where global or technocratic solutions sometimes replace localized Indigenous practices. Modern environmental philosophies, though aimed at addressing critical issues like climate change, can risk sidelining TEK by framing it as outdated or incompatible with contemporary science. For the Blackfoot, whose cultural practices are deeply rooted in sustainable relationships with the land, such approaches perpetuate a cycle of marginalization akin to the cultural silencing in the Redskins controversy.

The Piikani Sweetgrass project exemplifies how Indigenous communities can reclaim their agency by weaving traditional knowledge into contemporary science and weaving science into their traditional knowledge. Sweetgrass embodies resilience and ecological balance. By contributing to peer-reviewed research on sweetgrass's role in ecological restoration, the Piikani not only validate their cultural practices but also demonstrate the relevance of TEK in addressing modern environmental challenges. This project offers a model for how environmental initiatives can respect and amplify Indigenous perspectives. Unlike top-down approaches that impose external solutions, the Sweetgrass project integrates local cultural values, ensuring that the revitalization of ecosystems aligns with the community's spiritual and historical connections to the land. It underscores the necessity of approaching environmental challenges through an expansion of horizons where Indigenous and Western knowledge systems dialogue and coalesce without one eclipsing the other.

The debates around the Redskins logo and name, alongside the symbolism of red ochre, reveal a broader truth about Indigenous representation: efforts to "correct" historical wrongs must be guided by the voices of the communities they aim to support. The risk of erasure, whether in cultural symbols, languages or traditional practices, highlights the importance of collaboration and respect for Indigenous autonomy. Environmental movements can learn from these dynamics by ensuring that Indigenous perspectives are central in designing and implementing revitalization projects. Their ecological practices embody a deep understanding of sustainability that modern environmental science can benefit from. Projects like the Sweetgrass initiative demonstrate how to honour these contributions while addressing global challenges.

The Washington Redskins controversy, Blackfoot historical use of red ochre, and environmental revitalization efforts like the Piikani Sweetgrass project are interconnected in their implications for representation, respect, and cultural continuity. They highlight the challenges and opportunities in navigating the balance between modernity and tradition, ensuring that Indigenous voices are not just included but centred in shaping their narratives and futures. Developing an authentic Blackfoot project, curriculum, or greenhouse is more than plugging one's preconceptions through Google Translate, doing Western activities in an Indigenous setting or Indigenous activities in a Western setting. Assimilating Indigenous culture and spirituality into the Eurocentric, industrialized world was a primary driving force of the residential school system, and modern educators should be wary of following the same well-intentioned error. Gadamer, translated through Schmidt (2000), warns of industrialization and digitization narrowing human existence and understanding to pure instrumental reason, which denigrates or destroys more traditional forms of spirituality, meaning, dialogue and practice in favour of profitably efficient, progressive, and mechanically reduced allowances for language, labour, and lived experience. R.F. Kuang (2022) champions the idea that every translation is an act of betrayal, leading to a break from the phronesis, or practical wisdom, espoused by Gadamer in favour of a more exploitative ethical model. Kuhn (1962) highlights how the scientific endeavour is not one of linear progress, but of shifts in dominant paradigms, with certain linguistic and conceptual frameworks coming to dominate in a power struggle that Michel Foucault described in *The Archaeology of Knowledge* (1972).

The ideas above point to a power struggle within linguistic relativity, most notably described in the Sapir-Whorf hypothesis, which is well-discussed within academia, yet controversial within the physical and natural sciences (Cibelli et al., 2016). Practitioners of the scientific method, and those involved in the pedagogical transmission of its findings, too often believe themselves to be shielded or outright immune from noumenal assumptions grounded in the specific cosmological and ontological frameworks of their own culture.

This research now attempts to contribute to a new paradigmatic shift within science education by situating Indigenous knowledge as a parallel with the foundations of scientific observation through a **shared practice of ecosemiotic interpretation of nature within a translinguistic, productive prejudice of the universe as a knowable, predictable, and responsive reality within a cosmological creation.** The shared experience of physical laws, relational transcendence, and a sense of universal ethics provides space for distinct cultural dialogue, allowing us to weave together the scientific method and TEK in a combined observational effort of environmental and social health. An ecological education that is cognizant of the spirituality and language of the land's original people must be rooted in the guiding principles of that culture, while still allowing the contemporary renewal of that cultural lens through the willful, consensual and authentic adoption of different practices and technology in the continuous building of distinct, shared, and interwoven biocultural heritages. The Sweetgrass project is just one example of Piikani taking outside technologies in the service of their own cultural goals and self-determination.

It is essential to understand the distinction between biological and cultural ecosemiotics (Nöth, 2001; Tian & Wang, 2022) to grasp the importance I am ascribing to sweetgrass as a signifier within ecological habitats, Indigenous culture, and pedagogical motifs. Biological ecosemiotics examines the significance of various species and their relationships with the environment, while cultural ecosemiotics focuses on human connections to the natural world through a semiotic lens. Scholars have advanced the field of ecosemiotics, with Nöth's biological ecosemiotics—now commonly known as biosemiotics—investigating the signs and relationships between biology and its environment while Kull's cultural ecosemiotics explores the interactions between human culture and nature.

However, I argue that this distinction is becoming increasingly redundant, as it is rooted in separations of humans from nature—assumptions that modern eco-theology seeks to dismantle through critical bidirectional reflections on theology and the environmental harm caused by contemporary practices. Some challenges, such as the Earth-Bible Project (Conradie, 2013), have emerged from a Christian framework. Yet, it is crucial to acknowledge the growing inclusion of Indigenous spiritual perspectives that emphasize the interconnectedness of humanity, the earth, and the creator in sustaining ecological harmony, as evidenced by the diversity of beliefs examined within the broader field of spiritual ecology.

Essentially, the balance of life and organic systems is a matter of semiotic equilibrium. Addressing ecological balance involves not only cultural challenges but also the imperatives of human health; thus, safeguarding both biodiversity and cultural diversity are interconnected elements of the same critical issue—preserving diversity and quality (Petrilli & Ponzio, 2005). Biosemiotics aims to reframe the study of human ideologies by restoring the focus on signs and communication within academic and scientific dialogues. Theoretical frameworks such as Complexity Science and Post-normal Science have arisen to address the intricate relationality factors and diverse motivations that exist within the complex systems that science aims to study. These fields aim to include perspectives, people, disciplines, and contexts that science has traditionally isolated out in favour of reasoned material objectivity to focus on the how interplay between different components, value systems, and judgements of factual evidence can develop emergent properties at the larger scale. This shift is vital to dismantling discriminatory academic views based on species, race, ethnicity, gender, religion or language. Yet, we must remain vigilant against the persistent tendency to uphold a reductive and religiously informed distinction among humans, animals, plants, and a nebulous concept of nature within academic discourse. Recognizing and addressing these intertwined relationships will foster a more holistic understanding of our place within the ecosystem. This research attempts to define the role of sweetgrass as a signifier of meaning that is valuable in the cultural, scientific, religious, and pedagogical settings, acting as a bridge of understanding between them.

When discussing the relationship between culture and nature, Hoffmeyer (1996) divided nature into internal and external nature, thus drawing a triangle relationship including culture, external nature, and internal nature. The relation between internal and external nature is the domain of biological semiotics, the relation between culture and external nature is the domain of ecosemiotics, and the relation between culture and internal nature is the domain of psysemiotics (Kull, 1998). Kull's elaboration of the semiosphere in the form of the ecosphere as a space of diversity seems essential. Diversity exists in ecosemiotics and biosemiotics, and diversity is the central concept of ecosemiotics and biosemiotics. The suggestions made by these authors indicate that the diversity of the semiosphere probably goes beyond humans to incorporate both the semiotic activities of other species as well as semiotic potentials of what has been considered "inanimate" nature. Cultural and biological diversity should be a process of mutual interaction and influence between these actors.

The semiosphere is a domain just like the atmosphere and biosphere. It includes every aspect of other spheres, incorporating all forms of signal communication: sounds, smells, colors, shapes, heat, electromagnetism, touch, and other signs of life. The term ecosemiosphere proposes another interpretation of the semiosphere that connects culture and nature. Ecosemiosphere means an ecological bubble of meaning. In the same way, a biosemiosphere means a biological bubble of meaning. Ecosemiosphere and biosemiosphere are parts of the semiosphere. However, semiosphere also covers the edusemiosphere, or pedagogical realm of meaning.

Within the Blackfoot context, the specific Piikani context of this sweetgrass project and my hermeneutical encounters with its significance, the Indigenous philosophy of education positions itself as a true example of not just employing semiotics as a practical tool towards education but operating fully within edusemiotics, particularly in its focus of process over the product (Olteanue & Campbell, 2018; Semetsky, 2015), and how agents within the landscape communicate narrative knowledge that is beneficial to human development through their existence, interactions, or lack thereof. Indigenous education, as evidenced by the approaches to this project, does not draw such firm boundaries between the semiotic interplay between culture, nature, and the internal psyche as highlighted by the pioneers of this field. They are instead viewed as connected within a shared story, and when aligned properly, unified towards the universally right way of being. A simple starting point that addresses the distinctions of Kull and Hoffmeyer lies in the Blackfoot view of animate nature. There is no need to draw lines of semiotic research between human interpretation, other species' interpretation, or some yet-to-be-proposed interpretation of the inanimate world. The educational "bubble of meaning" composing the edusemiosphere of Piikani encompasses the seamless interpretation and transduction of signals between these realms. This project, as an exercise of expanding cultural and biological diversity simultaneously, is a prime and practical example of the in-depth research that Tian and Wang (2022) call for. In this way, the Blackfoot contributions through Sweetgrass and other restoration efforts to the emerging fields of ecosemiotics and edusemiotics mirror the early influence on the hierarchy of needs expounded by Maslow. Scholars in edusemiotics and ecosemiotics are only now defining, through academic semiosis, a communicative, educational framework known for centuries by the Blackfoot people.

In this light, Buffalo is the new Education. Non-Indigenous educators seeking success in their students could benefit from authentically engaging with cultural tools and perspectives through a similar methodology laid out here when reflecting on how to introduce symbols, signs, and knowledges from an Indigenous perspective into the Western edusemiosphere, addressing the onus placed on Euro-Canadian educators identified by Seth Agbo (2004).

Self-sufficiency: Environment and energy histories

The beeping tone of a beckoning FaceTime call jolted my focus away from the project proposal and grant application I was attempting to synthesize. My initial irritation eroded once I saw my grandparents' faces light on up the screen. We had been in Covid lockdown for a few months and I was blessed to assuage my concerns regarding their health and mental well-being during their captivity within the walls of the nursing home. They asked me how teaching was going and that they had heard I was back in school working on another degree. My grandmother tsk-tsked at the thought of me spending more money on school when I should be focused on work and starting a family. My grandfather chided in that he hoped I would return to the family farm at some point and put roots down among the rest of my family. I sheepishly explained that I wouldn't be neglecting work to continue my schooling, that teaching was going well at Piikani, and that I was completing my Masters in a field tangential to agriculture with the hope of gaining valuable, labour-applicable skills that could contribute to the success on the farm.

My younger brother had always been more involved in the hands-on operations of the farm. He was highly proficient mechanically and worked at the local John Deere dealership we had been frequenting our entire lives. On the other hand, I had always been a bookworm and *explorer. I couldn't care less about driving the machines. My core memories revolved around word searches with my dad in the grain truck, political discussions with the old-timers around the coffee table, and exploring the varied tree stands, wetlands, and living beings that occupied the outskirts of our fields. My grandparents and I laughed as we reminisced on these childhood differences. "I always knew you would be stuck in school your whole life!" my grandma said facetiously, referring to a recurring joke my extended family would rally at my expense as a child. I thought back to warnings they gave me as a teen about a distant cousin who had made it to post-secondary, had more degrees than wall space, yet seemed to just sit on the computer in his mother's basement. I knew their prodding was in jest and well-intended to motivate me to not get lost in the big city, chasing frivolity at the expense of family. Besides, they had regularly updated my personal library and encouraged my attendance in the more academic Catholic high school over the trades-focused public high school that had been the only option for their children, and which my brother had attended.*

Our conversation turned to the greenhouse project at the school. "So, with all your studying, what do you think the future of farming is going to look like?" my Grandfather asked. I responded cynically with my concerns about industrial agriculture, the decay of family farms, the increased costs of inputs and machines, the shift toward large-scale multinational corporate capture of lands they would never live on, the continued overreach of the same colonial monarch system that had kicked our ancestors out of Britain to expand the land for industry. My grandfather listened and looked at me with the wise eyes he reserved for responding to all of my youthfully arrogant opinions. "Ah, that may be so…". He paused, then continued, "But I am optimistic. I think we need more involvement from the local natives, there's enough room for all of us if we aren't greedy, it is a new world now. I dunno what that looks like, but I hope there is a *return to many small hobby farms. Diversified, local, family-run. I remember your grandma and I when we just had a few pigs, the milk cow, the large garden and our home quarter. It was work for us and your aunts and uncles, but not too much work. We traded with our neighbours for what we needed. We were self-sufficient. It was a good life."*

I responded with reverence towards this moment, a passing of the torch, the ending of one multigenerational cycle and beginning of another, "That's the idea of what I am working on. I hope I can make you proud." I promised that I would call them back in a couple of days, I needed to get back to work to hit a deadline. Regretfully, I wasn't able to keep that promise. That was the last conversation I had with my Grandfather. He died a few days later, and my Grandmother joined him soon after.

Over a year later, as Covid restrictions had been lifted and I was composing myself after delivering their Eulogy at the jam-packed community hall, I was approached by some of their friends. "So you must be the professor your grandparents always bragged about!". I deflected back to my lowly position as "just a Teacher." They laughed, "Well, maybe not now, but you will certainly be one in the future. That was a great speech, and your grandparents were incredibly proud of you". I thanked them and walked out the door. Looking out across the prairies, towards the only home I had ever known, I realized then that I was working towards a truth much larger than that described in the data or literature. A truth that was partly mine, but also connected within a much larger community. I thought to myself, "I am blessed to be a Teacher."

The production of energy for powering lights and an artificial landscape was of little interest to community stakeholders. Piikani Elders were far more interested in directing the energy of youth towards maintaining the land and understanding their cultural identity as Piikani

(Big Bull, 2020). This involved exposing students to the varied history of energy and environmental projects spearheaded by Piikani members, and explaining the complications of tribal, provincial, and federal sovereignty over different projects.

Students were told their current school was on land donated by a successful Piikani farmer. Students heard stories of how residential school children were taught the skills to maintain a farm, operate machinery, and balance a sales book. Yet, when these historic students and residents became successful, the government took away individually owned machines and instituted a communal band system that was easier to regulate and control.

Students learned of the negotiations surrounding the nation's only wind turbine, "Weather Dancer" being constructed in 2001 and how William Big Bull was able to start a Peigan utility corporation, entering a 50-50 partnership with EPCOR to operate the turbine on reserve land while providing jobs and training to Piikani members. It was the first turbine of its kind and has been refurbished to continue operations as hopefully the first of many larger wind farms operated by Piikani.

The Oldman River Hydro Plant is a 32-megawatt (MW) run-of-river project in southern Alberta, commissioned in 2003. The facility is jointly owned by ATCO and the Piikani Nation and is one of 35 Indigenous partnerships that ATCO supports across Canada. Piikani Nation also holds a 51% equity stake in the AltaLink (co-owned by Berkshire and Hathaway) Transmission lines that cross its territory, providing the nation with a regulated rate of energy return and operational partnership of the line's Piikani assets. This partnership is evidence of the Piikani Nation's resilience and motivation to control their energy destiny and maintain separation from provincial priorities and policy. The lack of formal participation from other province's

Indigenous Nations in transmission line partnerships is an example of the approximate monopoly that most provinces have over their electricity infrastructure (Van de Biezenbos, 2022).

By housing the information and stories of these different energy projects within the school and connecting them to the greenhouse project, students are exposed to the community initiatives led by their neighbours and family members. They see how energy and environmental projects connect the information they are learning in class directly with their local community's living conditions, economic opportunities, and financial well-being. By understanding that partnerships with ATCO for energy infrastructure directly lead to community initiatives such as the construction of the community's multipurpose center, students accept that they soon will have a position within the community, adopt responsibility for the future of their land, and begin the ceremonial protocols to gain the authenticity as Piikani members to represent their Nation's interests on the larger stage.

This cycle of acceptance, adoption, and authentication parallels the traditional Piikani ceremonial protocols to transfer ecological rights and responsibilities through participation in societies and the reproduction of traditional songs and stories. It is the nation's preferred method of integrating new technologies and outsider perspectives into the Piikani paradigm as evidenced by the Digital Literacy project, titled "*Iinaaka Siinakupii Tsiniikii*" or "Little Story Tellers" to honour the animate role of camera technologies in capturing the modern stories of Piikani (McMahon et al., 2020;2024). Lisa Crowshoe utilized podcasting technologies to revitalize language learning curriculum (2024). The Piikani Stories of Resilience (Resilience Institute, 2021) exhibit in Banff and across university campuses in Alberta was another example of how project partners worked with the school and the community to display Piikani pride and empower students to be the authors of their own story of sustainable resistance.

In this way, schools serve as a model environment for incubating interdisciplinary community projects around sustainability as they connect multiple generations with the information, skills, and resources to make science happen. Through the community aspect of schools, science education can be woven with the specific cultural, religious, or political motivations of the broader social network to develop solutions that are warranted, wanted, and conducted within the cultural norms and practices of a local area.

Interdisciplinary interactions

"You're going the wrong way!" whispered one of my students as I started to follow the two random tourists already at the medicine wheel when our group of Blackfoot Confederacy delegates arrived at the top of the mountain. "Stick with us, those napikoans will get their pictures and leave." said the other. I followed my students around the circle clockwise, informally checking out the medicine wheel from behind the fence and locked gate. As the rest of our group joined us, a Park Ranger came up and opened the gate. We gathered our offerings and entered the fenced-off area. With the beat of a drum, our ceremony commenced. Out of the side of my eye, I noticed the two tourists from before had stopped their hike down, and had turned to watch with their cameras out. Once our ceremony finished, we settled into a circle for stories and to be painted. One of the elders was talking to the Ranger, who then hastily ran down to the tourists, there was a brief argument before they begrudgingly put the camera away and continued hiking down.

As I took in the Wyoming landscape far below us, my mind drifted to the sweetgrass project, We had sent off all of our samples to the lab and I was thinking of all the permissions required for us to do the science properly within the Blackfoot context. I drew a parallel in my mind between the sequencing of the sweetgrass and the tourist filming of the ceremony. I hoped I *had done everything right, and also hoped that I had gotten the right message across to the external scientists. My MSc thesis was mostly completed, and I was just waiting for the data analysis to be completed so I could touch on those results. I was praying for guidance with the group when a small child tapped me out of my focus.*

"Are you a principal at a school?" he asked. I laughed and said no, but my mind started racing with our staffing issues and wondered whether we would return in a month to the start of the school year still without a Principal. "You should be the Principal!" one of my students said to me. "No way! Brett doesn't want to be the Principal. Besides, the principals never last very long and I like Brett as a teacher", replied another. I laughed in agreement and assured them that I wasn't going anywhere and that we would find out in a month who the new Principal would be. My mind wandered to whether that was something I would take on if the Nation requested it of me, whether it was something I even wanted. "I think you would be a good Principal." the third student whispered to me.

As we finished our ceremony and drove down the steep grade of Medicine Mountain, we stopped to cool our brakes and for the students to take scenic photos. I looked to the sky, where the evening sun illuminated the Western clouds in dizzying arrays of purples, oranges and pinks. The largest cloud looked like a large bear chasing two young children towards the edge of a cliff. As the winds shifted, the cloud slowly changed shape. In place of the bear, there now appeared to be a warrior on a horse with a bear head for a hat. The two children had widened out to give the appearance that they had backpacks on and were now following the man on the horse upwards in the opposite direction. I felt the familiar tingle of experiencing something beyond my rational comprehension and resolved that everything would be alright this year. I whispered to myself, "Hmm, I am sure I will find out what that means."

Recently, there has been growing awareness of the ethical missteps of natural science researchers attempting to do research *on* Indigenous peoples and their land. This has led to increased calls for action to remedy the situation by establishing culturally informed frameworks for natural scientists to work with Indigenous communities (Wong et al., 2020). This project aimed to put these calls into practice and develop real-world objectives that breathe life into the empirical standards of written statements stamped on dusty pages within the walls of academia.

The grassroots organizational structure of this project began with Elders, teachers and students meeting with the Piikani Lands department to determine the best way to culturally inspire, environmentally educate and technically train the next generation of students to be “Keepers of the Land" in traditional Piikani territories. These initial meetings led to partnerships with TRI, researchers with the University of Lethbridge, the Abbott Lab with AAFC, Environment and Climate Change Canada, and several external funders and companies that provided support. Although there was a variety of expertise, deadlines, and motivations involved in generating “on the ground” and “in the lab” results, the Piikani Nation was the primary initiator and decision-maker in all aspects of the partnerships, taking the lead on the commissioning, protocol, and publishing of the research conducted. By including different perspectives and professionals within the shared goal of resilient climates and communities, the foundations have been laid for future collaborations that position both the traditional local knowledge encoded in the living linguistics of the Piikani people and the empirical, material data generated through academic methodologies as equal interpretive frameworks within an ecosemiotic understanding of nature.

Projects conducted within this framework allow us to expand our own horizons of understanding to approach a productive conversation with ourselves, each other and nature through hermeneutic reflection on the process, results, and proposed next steps. We must be allowed to do this without the semantical jousting for the avoidance or elevation of rigid objective terms like appropriation, assimilation, integration, weaving, braiding, bridging or any other number of contested standards proposed as the panacea for describing interactions between the scientific method and Indigenous epistemology. Iterative hermeneutic action and reflection, free of positivist bias, can be messy but provides an ongoing strength of intercultural, interdisciplinary, and intergenerational authenticity to defend the interests of Piikani stakeholders at the negotiation table while helping offer guidance for researchers to generate that data within good faith for Piikani's benefit.

The ethical practices developed through this project can be an example for other environmental research and educational partnerships in Indigenous and non-Indigenous contexts. We must remember, though, that in the interest of continuing the multigenerational circle of life described as a priority for the Piikani Nation, these cyclical reflections must be done in the service of our students and children, who shall inherit the fruits of, and responsibility for, this process. We cannot get trapped in temporal snapshots of a singular timeline toward progress. It may take many trials of a similar project to truly gain the trust of local stakeholders that you are in it for the right reasons over the long run. This research aims to do for science education and environmental research what Leddy and Miller (2024) are doing for Slow Principles and Pedagogy, mainly highlighting avenues of shared understandings with Indigenous philosophies that allow us to move forward together authentically in dialogue and knowledge.

Chapter 3: Reclaiming Indigenous space, history, knowledge and language through regenerative agriculture and land-based education.

I walked through the cottonwood forest filled with trees I recognized but knew to be non-existent. I spotted a clearing up ahead that glistened with the green-blue sheen of thick grass blades reflecting the high noon sun. I was reminded of the glow given off at night by the star stickers my father had helped me excessively decorate my room with as a child, but these were glowing in the daylight. I could hear water nearby, but it was out of sight. Some of the blades were actively stretching toward the sky, reaching with the potential of growth. Others had curled over under their weight, strewn peacefully amongst the more erect stems. Mixed in between these were blades of various widths and lengths that had begun to lose their pigment, gradually browning in a striped pattern to give the appearance of a textured camouflage.

I knelt towards the feminine, personable energy emanating from the flowered panicles dotting the landscape. The tiny white blossoms had hardened into seeds that fluttered to the ground like microscopic leaves in the autumn. As I watched them fall between the curled blades closest to the ground, I felt a burning in my finger. I snapped my hand upward, and the rolled cigarette I suddenly remembered holding dropped to the ground. It burned a hole into the soil, which I quickly covered with dirt, and I began picking the blades lying closest to the hole. I was afraid to uproot the grass, lest it disturb and reopen the smouldering hole made by the cigarette. I pinched the stems and tried to cut into them with my fingernails.

At first, I was unsuccessful, but as I went further down the stem just slightly beneath the top layer of soil, it became easier. Where I cut the stems, they turned a purplish-red like tiny bruises. I paused but received the feeling that I was to continue. When the area around the hole was clean of all the blades not pointing towards the sky, I took one of the thinner brown blades, *which was moist and disconnected from the soil already. It was flexible yet strong like a rope. I used it to bundle the grass I had collected and placed it in a safe place up in the corner of a cottonwood branch.*

When I turned back, there was a pipe lying on the ground in the spot I had picked. It was longer than any pipe I had seen before and had a very tiny bowl. As I picked it up, I got the feeling of being watched. I looked up, and my colleague, Jesse Plain Eagle, a ceremonialist and EA from the school was watching me. I put the pipes to my lips and looked at him. He shook his head with a smile and said in a joking matter "Uh-oh,..Don't do it…", but I did it anyway. He laughed and came over. I handed him the pipe and we both blew smoke rings into the cottonwood canopy. As our smoke rings spun up into the sky, they spun closer together, first forming a Venn diagram shape, before merging, spinning together in opposite directions and floating out of our vision. My eyes snapped open, and I realized I was going to be late for work. I hopped out of bed thinking, "I wonder what this means?"

Sipatsimo Seed Bank

Plants native to the Northwest prairie grasslands and foothills are understudied and underrepresented in academic literature. Local efforts have been made through the Prairie to Pharmacy program to weave Indigenous language and knowledge with scientific research to explore medicinal properties within these populations (Owens, 2021). However, the ecological properties and the ethnobotanical use of these plants by the traditional Blackfoot inhabitants is not very well documented from the Western science perspective.

Sweetgrass, or Sipatsimo, (*Hierochloe odorata, Anthoxanthum nitens)* is a perennial rhizomatic poaceae grass which grows in cool, moist regions bordering waters across North America and Eurasia (Dorn, 1984). Although there are up to 4 recognized species, Canada is home only to common sweetgrass (subspecies *artica*), and alpine sweetgrass which grows in the Arctic and Rocky Mountain slopes (Turner, 2018). Species native to Eurasia are primarily used commercially for distilled alcoholic beverages and fragrances. However, Canadian species were employed much more ubiquitously by the Indigenous people.

In contrast with many other First Nation tribes, Blackfoot peoples preferred rawhide containers for storage and therefore did not traditionally weave sweetgrass baskets. The scent, smoke, and bioactive properties of sweetgrass were much more important in practical or spiritual use. Contemporary practices still include ritual burning during daily prayer, honorific displays, and ceremonial offerings. But, historically, sipatsimo was also used by traditional peoples for respiratory ailments (Turner, 2018), reproductive health (Hellson, 1974), cleansing salves (Hart 1974), and perfume braided clothes (McClintock, 1909). Warriors used it for purification of themselves and horses, as well as a stamina supplement or saddle-sore soothe (Densmore, 1928).

Today, bioactive compounds in sweetgrass, such as phytol and coumarin, the source of sweetgrass' vanilla fragrance (Lewis, 1977), are being explored for applications in insect repellant (Cantrell et al., 2016), reduction in the oxidative stress of alcohol consumption (Dobrzynska et al., 2013), anticoagulation medications (Leung, 1980), and recently in ice cream flavouring (Chapman's Ice Cream, 2024). Due to these pharmacological properties, the active compounds in sweetgrass are listed as toxic and potentially harmful. This perspective is reflected in the Blackfoot protocols around plant medicine and the belief that improper conduct, misuse, or overuse can result in negative health consequences.

Metaphysically, sweetgrass is employed as a metaphor for the life journey and as an animate agent in the delivery of prayer to the heavens. It has been referenced as a beneficial ecosemiotic archetype for overcoming challenges such as finding space in higher education

(Brant, 2023), indigenizing mathematics (Czuy, 2020), or our everyday interconnected, physical and spiritual role within the ecosystem (Strikes with a Gun, 2022). The scientific method of the sweetgrass project set out to explore the ecological relationship of sweetgrass and soil, and the extent to which its carbohydrate composition can contribute to climate change solutions in the form of carbon sequestration and other wetland ecosystem services. I was responsible for growing the plant under Blackfoot protocol at our school and helping connect our students with cultural teachings on its use and importance.

In that process, I learned that I could not materially reduce my communicative relationship with this plant any more than one could reduce the role of their mother, wife, daughter, or sister to simple mechanistic interactions of organic Lego. This plant's cosmological importance should not be quantified, nor meaningfully qualified purely in an objective sense. Yet, because of its central role for many Indigenous peoples, its prominence in pop science environmentalism, and the ecosemiotic symbology of the braid within Indigenous education, the impact of its presence in the landscape should be studied further through scientific means, especially if it is a way to expand student learning into other semiotic spheres.

Like the way it is a mediator between the earth and sky, us, and creator (Strikes With a Gun, 2022), it can also act as a mediator between academic disciplines, intercultural relationships, and the spiritual-secular divide. Within educational settings, the sweetgrass smudge has filled a gap left by traditional prayer, ritual, and ceremony as more school operations and leadership have gradually shifted from religious institutions into the secularized public sphere. The attempts to start and continue to honour the spiritual and cultural contributions of First Nations Peoples in a more authentic way has positioned the Blackfoot as leading practitioners in sharing an acceptable practice of daily hermeneutic reflection with students and educators of diverse backgrounds in Southern Alberta, though not without some criticism ("Smudging in Public Schools: Reconciliation or Religious Act?," 2016).

Sister Plants

There is substantial habitat loss and subsequent population decline for some plants most important to the local community. Traditional medicines are found in wetlands, wet meadows, and marshes, which are under decline due to various factors. Beyond cultural uses, these plants play important ecological roles. Sweetgrass develops large underground networks of rhizomatic stems which, alongside its fibrous roots, are known to be stores of carbon in the form of nutrients, storage molecules, and complex carbohydrates. The morphology of this subsurface anatomy allows sweetgrass to positively impact soil erosion, slope stability, and water retention, stabilizing the habitat for other species. It is an important "sister plant" to other native plants like wild mint, which have a traditional relationship with the local people and animals. Sweetgrass is most easily propagated through cuttings or rhizomatic spread, as seed production is sporadic with low rates of germination. Sweetgrass is winter-hardy and requires a period of cooling for proper reproduction from seed. Following seed production, plants enter a dormant stage which is the primary time for collection and separation for greenhouse growth (Hartmann et al., 1990).

It has been suggested that reductions in controlled burns, loss of traditional harvesting knowledge, and competition from colonizing plants could negatively impact sweetgrass populations (Shebitz et al., 2004). This research indicated that traditional harvesting practices could mimic the disturbance of naturally occurring herbivores and promote the spread of sweetgrass, but the loss of traditional knowledge has led to debate over which practices, some seen as traditional, may actually be destructive. The loss of riparian and wetland zones due to drought, overgrazing, overharvesting, and irrigation infrastructure removes key areas for interactive, resilient ecological relationships to develop. Habitat that remains is under threat of rapid ecological succession from nonnative plants.

Sweetgrass is becoming increasingly more difficult to find in Piikani, according to Noreen Plain Eagle (2020), and a sentiment that has been circulating for 50 years in other Indigenous circles (Hart, 1976). To proactively mitigate population loss and promote restoration efforts, further information is desired on the individual and interactive roles of different native plants with their landscape, including how they impact the engagement of bison and other animals, including humans. The baseline profile for sweetgrass generated in this study can be replicated for wild mint and other culturally significant plants identified. Greenhouse growth environments could then be used to repopulate traditional sites with other sweetgrass companion plants.

Resilience from Land to Sky

Arriving early at the Office of Graduate Studies, I took a moment to read and reflect on the Piikani Stories of Resilience posters proudly displayed in the University auditorium, collecting my breath from the stairs and composing my agitated demeanour. This visual narrative project had been adjacent to our eco-action project within the school and part of the same funding package that initiated the request for me to start a Piikani cultural greenhouse. I looked upon the face of William Big Bull, the elder I had worked most closely with for the project's duration. “We do not write our language”.

In all of its ironic juxtaposition, the quote jumped out at me. I was flooded with memories of our discussions of sun dogs, chinooks, and predicting the weather, his patience in teaching me the alphabet and phonetic sounds of nīītsiiṗo”sin - the Real Talk so that my text-based mind could lead my tongue and ears, his frustrations with the world of academics and its impact on *the noumenal frameworks of the students that became snared in its rites of passage. I wondered then if I had lost the path, becoming exactly what he had warned me of as I mistranslated between the symbols.*

I thought back to all of his teachings, the dreams shared with me, the knowledge he imparted on our trip to Browning and the sheepish warmth I felt when he vouched for me to the border guard's questioning about the one young white guy amongst the elders. I replayed the stories of people he had met, animals that spoke, and fighters that fought. I looked to the upper floors of University Hall, where my anthropology and biology professors had offices during my undergrad. I recalled conversations wherein I inquired about pursuing ethnobotanical research. Inquiries typically ended with warnings after I answered their questions on my ancestral heritage.

I remember two different professors indicating something along the lines of, "This is an increasingly tough field for someone like you, it may be an uphill battle with the direction the academy is taking." Nearly 10 years later, my proposed PhD committee members currently say the same thing. But now it was the Elders' voices that rang louder "people like you".. "what does your name mean" … "where are you from"…" … "People like you"… This project, in all of its synchronicity, personal reflection, and progress towards a vision not yet revealed in the phenomenal sense had now provided me with answers and what felt like a shield from Creator.

I had come to understand myself deeper through this process, strengthened my identity as a grandson, son, brother, teacher and now father. While there may be conflict on the process, findings or value of this environmental research, I had grown the sweetgrass, I had grown as a person. I entered the office and was met with, "So...you are the teacher... quite the mess you are in, what exactly have you done here?"

The project developed a platform for the Piikani Nation community, federal scientific researchers, and non-government organizations to collaborate in the production of ecological data that prioritizes local cultural knowledge to promote resilience in local spaces and environmental practices. The data generated in this project will directly serve the interests of the Piikani Nation Lands Department in future environmental negotiations around the restoration of the Old Man Dam River valley and prairie grasslands in a way that sustains the relationships and practices between the plants, animals and people that have resided there through history.

Conservation, restoration, and reclamation practices that include the ethnobotanical perspectives of people most proximal and practically engaged with the land are crucial to long-term community acceptance, adoption, and authentication. This model develops sweetgrass as a culturally important biomarker of ecosystem health and a symbol of weaving disciplines and cultures together in a productive educational pursuit. Through engaging in the protocols of Piikani and involving the community and school, emergent properties of ecosystem resilience can arise through the connection to local language, culture, and priorities.

Analysis of plant and soil metrics in the greenhouse sweetgrass provides further measurable, quantitative data on the ecosystem attributes necessary for further adaptability, recovery, and resistance within the community's resilience plan. A major factor in ecosystem resilience loss for the Piikani Nation is the extent of local, native habitat. The Nation is restricted by the boundaries laid out by the Treaty System, which results in local loss of habitat being particularly disruptive to ecosystem functions. Loss of small areas can lead to a rapid loss of important cultural plants and other native grassland species. The soil profile of healthy, greenhouse sweetgrass can be used to help establish plots of sweetgrass that can expand the extent of native populations, providing further resistance to population decline and habitat disturbance. By applying this research model to other important plants, Piikani can increase the extent of biodiversity within native ecosystems.

Sweetgrass and the diversity of other culturally significant plants which grow in the region's threatened habitats can be used as a local form of indicator species to assess environmental conditions and adaptations to local climate impacts such as drought and floods. This project set out to explore what healthy sweetgrass looks like and catalogue the baseline chemical diversity of its interaction with the environment, which can be further used to predict a habitat's resilience to current and future impacts.

It would be beneficial to replicate this process with other plants identified by the community in future studies. Traditional plants and medicines are an excellent candidate for local indicator species, as there is a built-in cultural monitoring system through practical use and knowledge transfer. TEK and language can hold important information on the condition and diversity of local ecosystem populations over time. The inclusion of local knowledge and a variety of traditional plants leads to a more robust and accepted resilience action plan by connecting human motivations to resilience planning. This project's results can be used to justify further native plant inventory and recovery practices on the reserve.

The ability of sweetgrass to sequester carbon is a form of nature-based solution to climate change that serves the added benefit of providing a sustainable cultural resource for the local community. This connects traditional use with modern climate solution applications. Connectivity within an ecosystem is a critical foundation of resilience. Human beings are one of the most impactful keystone species across diverse global environments. Including local cultural perspectives, motivations, and uses around plants alongside published scientific data in the assessment of environmental resilience promotes emergent complex properties of environmental resilience. These properties include ecological recovery, resistance, and adaptability, which are most effective when implemented by engaged locals.

Human interaction within the environment is a net positive within the Piikani context for three reasons: there is a cultural motivation for this specific plant population to recover, there are traditional protocols and increasing tribal land regulations put in place to resist the destruction of sweetgrass habitat, and the built-in adaptability of Piikani to borrow and take technologies into their cultural lens provides creative flexibility for discovering novel and ancient solutions.

Circling the square

"You have proposed this sweetgrass thing as a solution. How is this going to solve climate change?". I quickly tried to stumble out an answer, "Well, no it is a contribution to science from a…" I realized then that I had underestimated both the tension and disconnect between the academies that made up my supervisory committee. "I just don't see the scientific application here. You would need thousands of acres of greenhouses growing sweetgrass to offset the emissions from the energy needed to run them, it's simple stoichiometry!" My mind started generating responses referencing the brick-by-brick method of scientific inquiry, that I must not have been clear in my thesis draft as it attempted to address that very view, that I had seen far less effective solutions meet the criteria of an acceptable thesis, that this was a valid contribution that could branch off into other scientific studies, that it was an example of post-normal science that included diverse views, that the quantitative part of the project had already passed peer review for scientific journal publication, critiques of the replication crisis and the piles of expensive dusty literature containing hypothetical simulations never tested in the real world.

The gravity of my academic predicament hit me. I had been abandoned by my original supervisor, as the community had abandoned them. The University had already celebrated their inclusion in Piikani, the funding cycle had been completed, and my scientific partners had insulated themselves and their published data from further raising the ire of any critics of the colonial nature of someone "like me" doing science on-reserve. I needed to pivot away from communal thinking as, for the first time in the project, I felt alone on an empty, uncharted path. I could only meekly respond, "Completely solving climate change seems like a pretty high expectation for a Master of Science thesis…". As I walked away from the meeting, I racked my brain for how things could have gotten so off-track. Maybe the article I had co-authored was science, but I had to admit that the results of testing the renewable energy greenhouse hypothesis in my thesis read more like anthropology. On top of all that, I can't seem to shake this whole teacher thing. Maybe all of us are just interpreting the value and significance of sweetgrass and Piikani-led science within a school from a completely different lens?

Community hesitance to the idea of a greenhouse was primarily centered around concerns of outside business influence that may want to expand modern agricultural infrastructure across larger plots of land, and questions around how the practice of growing plants from seeds fits into the Blackfoot way of life. William Singer III, a traditional Blackfoot herbalist, announced at the Siksikaitsitapi Agriculture conference and reiterated at the Blackfoot Confederacy Education Conference that "current Blackfoot peoples need to connect with the knowledge of our ancestors, cousins and their historical neighbours, who grew plants from seed and taught the Blackfoot how to harvest specific roots and herbs for food and medicine during tough times. We need to get over the idea that Blackfoot were not plant people!" (Singer III, 2023).

The greenhouse could not be based on a yield-chasing efficiency race, which is the underpinning of many modern environmental pursuits funded by capital interests. It needed to be accepted, adopted, and authenticated through traditional Piikani protocol. It needed to be given a spirit within the Blackfoot paradigm of animate beings and its purpose laid out in the Blackfoot language and through formal connection in ceremony. It was through this process that the project received its name of Supii·ṗo'omaak̇sin, which embodies a cyclical, iterative spirit of planting seeds, transferring to the earth, giving back, or patient reciprocity in balancing our role with the natural world (Big Bull, 2020).

In the olden days, when a request was made for medicine to be harvested, the chosen candidate would go out, make an offering, and select the portion of plants needed for the treatment and perhaps a very tiny surplus for personal use. Collectors and practitioners would often sing to the plants and the insects to help the medicine reveal itself and its powers. The action of taking more than one needs or overharvesting for the hypothetical needs of the future or other people's appetites was akin to a mental illness or compulsion trap that would lead to unhappiness and unproductive disconnect from the ongoing, intimate requests of the present (Big Bull, 2020; Singer, 2023).

This distinguishes Supii·ṗo'omaak̇sin with the Western notion of reciprocity that is founded in contractual obligations, property rights and English Common Law. There is no final accounting of deeds at the End of Days to determine the moral balance, nor holding of negative debt that is prayed away or served salvation in a windfall. It is an ever-present, active relationship with nature that carries immediate and profound consequences when the balance is broken. It requires resilience, sacrifice and above all, an intimate knowledge of shifting natural relationships to live “the right way” on this landscape (Big Bull, 2020). Outside philosophies will only lead to disaster for those stubborn enough to try and make them fit.

In that sense, the Blackfoot ecosemiotic vision of environmentalism is at odds with the Canadian Government’s ecosemiotic vision of Southern Alberta. Generations of state actors have not interpreted an anthropogenic landscape, curated by thousands of years of controlled burning, planting of foods and medicines, and the seasonal round dance between man and bison that comes to a precipice on the northeastern tip of current Piikani territory. European settlers, instead, interpreted a pristine prairie, ploughed by the glacial hand of God, providing a temporary windfall of wild buffalo product which could eventually make room for more docile cattle herds and the large-scale, irrigated, monoculture crops of the future.

In both agriculture and energy, the Western perspective has prioritized ever increasing yields and the debate over who owns the rights to any surplus brought on by conquered land and more efficient technologies. Colonial expansion and the Treaty system offered a brief reprieve from land being the limiting factor to the British Colonies by establishing reserves and marketing the newly available plots to European settlers and resource companies. Technological advancements such as machinery, chemical interventions, and plant breeding were made commercially available.

Despite the limited reserve land, early Indigenous farmers proved quite proficient at maximizing the output of their acres, whether in livestock or produce. However, the government was concerned that technological advancements in agricultural production would afford the Indigenous farmers too much leisure time, which could tempt them back into their cultural practices and away from modernity. In this way, the practices and technology were always intended to lure the Indigenous away from their culture. To borrow the mask of a settler until their old ways were forgotten.

Additionally, many new and established settlers began to complain that it was unfair for them to have to compete with Indigenous farmers at the market since it was their tax money that the government was using to prop up the Indigenous transition to agriculture. This eventually culminated in restrictions, wherein not only were Indigenous farmers forced to use outdated equipment to lower their productivity, but they were also not permitted to operate within the free market for the sales of their goods. These ends were accomplished through informal means, such as the unlawful enforcement of the pass system which prevented the mobility of Indigenous traders, but also through formal legislation such as the Peasant Farm Policy (1889-97) and the Permit System, which was not repealed in law until 1995. To avoid lost profits on spoiled goods or insufficient market access, Indigenous farmers were forced to rely on intermediary agents who would sell and buy on their behalf, often personally pocketing the arbitrage on each trade (Barrons,1988; Carter, 1990). These policies severely disadvantaged the economic and cultural development of reserves, while leaving a lingering distrust of both government and their rural neighbours.

External Partners seeking to engage with Indigenous communities should understand this history of restricting economic competition and regulating a population's ecological interactions through outside implementation of enforcement policies. Educational institutions, environmental policies, and agricultural technologies were all explicitly implemented to destroy the biocultural heritage that existed within Indigenous protocols and replace it. They wanted to “get rid of the Indian problem” (Scott, 1920) and these tools were used in service of that goal. However, this is not to say that Indigenous people did not find their own productive uses of those technologies when given agency over their use.

Modern movements also need to recognize that childbirth is a revolutionary act under colonial genocide, and Indigenous environmentalism is fiercely pro-natalist, as evidenced by statements from "The Climate Baby Dilemma" (Lean, 2022). This supports the findings of this research that youth and the reproduction of culturally significant knowledge, landscapes, and language through students is of pivotal importance to the Piikani Nation when implementing local curriculum that branches to all subjects and operating schools in a way that connects students to culture in every aspect. Anti-human environmental rhetoric does not play the same way among Indigenous crowds as it does with university campus crowds.

Environmental solutions that seek to hinder the Piikani Nation's economic and territorial sovereignty through regulation are also highly suspect and unlikely to find widespread support. While some U.N. sustainability goals may be accepted in Piikani country, others, such as increasing calls for less meat consumption, are locally laughable, culturally insensitive, or eventually tyrannical, depending on the level of enforcement afforded to reach them. Current agricultural and environmental solutions should acknowledge this context. Instead, seek to outfit Indigenous communities with modern technologies to tackle climate changes, while allocating them agency to utilize these technologies under their own local motivations and priorities. Modern technologies could be applied to uplift the Blackfoot language and cultural knowledge by providing healthy, resilient communities with the tools needed to direct their attention away from crisis and focus on revitalizing the practices necessary for the reproduction of their culture across younger generations through their band-operated school system.

Archiving: weaving old practices with new

Hermeneutics as an academic discipline is most associated with textual analysis, emphasizing the interpretation of sacred scripture. However, there now exists a need to apply the same hermeneutic analysis to reading the ecosemiotic language of plants, animals, and landscapes. Much like libraries serve as a refuge for stories threatened to be lost to time through war, torch, or illiteracy, greenhouses serve to shelter the ecological history of plants from habitat destruction, over-harvesting, and geographic isolation. At the most basic, practical level, they allow food to be grown out of season and their acclimatized range. Educationally, they have allowed generations of students to behold and research the specimens of species from across the globe. Culturally, they can draw thousands of tourists as exotic emporium displays of marketed beauty. This project, in both its action and reflection (and reaction and re-reflection) explored how curated landscapes and greenhouse technologies could be used to protect Piikani cultural knowledge and restore native plant populations threatened by habitat loss.

Beyond simply being a place for food production, the greenhouse and surrounding space were envisioned as a cultural and scientific information hub, a living, physical archive for the language, stories, and plants used by the land's original people. Furthermore, this archive can be used to engage with, reflect on and reproduce not only language or scientific learning outcomes, but also repopulate local landscapes with the living plants from which knowledge was traditionally gained. Imagine reading from a book from the Library of Alexandria while the pages were slowly burning away. This is the reality being faced by many Indigenous languages and landscapes today as colonialism and climate change seek to break hundreds of generations engaged in an ecological hermeneutic circle.

The greenhouse space and project partnerships have provided an environmental repository and ecosemiotic reading nook for traditional knowledge, language, and plants to repopulate space in the physical and the academic landscapes, and within our students' bodies and minds. As the infrastructure continues to develop, plans are already in motion to incorporate digital media and archival databases into the learning spaces, connecting and preserving Piikani knowledge in a way that surpasses the necessity for anglicized, written translations. The data garnered from the Sweetgrass project is the first step in establishing a precedent for the Piikani Nation to set the terms of generating, owning, distributing, and communally reflecting on the environmental, agricultural, and mineral research information gathered on their land.

Next steps

This project produced a foundational framework for studying the vital role of traditional plant foods and medicines for the sustainable conservation, restoration, and reclamation of environmental habitats at the local community level. Results obtained have now established a baseline for future analysis at other sites, different growing seasons, and transplants. Future studies will be conducted on elusive wild sweetgrass populations and will branch out to include wild mint, which is also becoming more difficult to harvest locally. However, this initial work was critical to set the stage for a systems-level research platform for advanced plant-soil carbon interactions and publish novel research on the ecological role of sweetgrass in relation to carbon flows. Researchers and locals can use these findings to construct profiles of resilient sweetgrass and sweetgrass environments to be used as a community level indicators of broader ecosystem health. The sweetgrass used in the study will populate sites identified within the Piikani Nation river bottom restoration plan and their effect will continue to be monitored.

Piikani Nation used this project to leverage a position with the Alberta Living Lab Network to pursue academic research to support their land protection goals. This partnership will allow Piikani to play a collaborative role in outlining diverse regenerative agriculture practices and perspectives that can contribute to protecting the biodiversity and productivity of the Alberta landscape. The continuation and growth of these networks allows for Indigenous environmental solutions to play a role in decolonizing space within academic literature and ecological landscapes at a multinational, global level, while maintaining their deeply spiritual connections to their local habitats.

Chapter 4: Conclusion

Over three weeks in August 2024, I was home with family for a total of three hours. Starting with a detour to Dene country and the opportunity to engage with elder guides there on a remote Northern lake, leading into four days of leadership strategic planning in Kananaskis for our division Board Retreat, and ending with the annual weeklong travel with the Blackfoot Confederacy delegation. K'áítél Kuę̨́. Minnewanka. Waterton. Aakíípisskani. Banff. Nose Hill. Blackfoot Crossing. Iniskim Umaapi… The stories, ceremonies, translations and back roads travelled began to blend together. The previous summer, I had taken students into the States, with stops at the Marias Massacre, Fort Benton, Medicine Mountain, and Yellowstone to purview the sacred sites within the southern portion of traditional Blackfoot territory. We heard stories, conducted ceremonies, and explored the repatriation of items from American museums.

This year, we were exploring the Canadian side of Blackfoot territory, and tomorrow, we would be ending our tour East of Cypress Hills, just past Many Berries. This stop was the one I was most excited about, as I had only been in the area once for a wedding. I wanted to expand my context of Blackfoot land claims and stories further East to close my circular, clockwise exploration of the traditional territory, building on the historical and cultural ecology narrative blossoming in my mind over the last 5 years. The only problem was I needed to be in three places at once. There was the continuation of this site tour, a biocultural monitoring overnight camp for my summer camp students that I had set up with the Lands Department and Parks Canada in Waterton, and a group presentation in the final class scheduled for Annette Bruised Head's course on Foundational Knowledge in FNMI Education in Lethbridge.

The first commitment was partially made by me, as I had been directed by my superintendent both summers to arrange our students' participation in the Blackfoot

Confederacy tours, and I was the only teacher willing to dedicate a week straight of overnight supervision and thousands of kilometres in driving over the summer break. No worries, I love museums and National Park road trips, providing students with enrichment opportunities and broadening my own knowledge of Blackfoot History. The second commitment was fully mine: a continuation of our Sweetgrass, greenhouse and Keepers of the Land Project. The initiative's long-term success and sustainability rely on constant deliverables for grant funding and follow-through with external partners like Parks Canada or other outside experts when they offer experiences to our students. The third commitment resulted from the program change to an arts thesis. I required additional coursework in this new program, and this was a suggested course for me to parachute into that could be completed before September's return to school.

Walking down the hill from the Majorville medicine wheel, I worked up the courage to tell the tour organizer, Genevieve Fox, that I would not be rejoining the tour in Saskatchewan tomorrow. I had spent the previous night in the hotel calling in every favour I could think of to get another teacher to finish the final leg with my students. It ended up costing me $500, a truck rental, gas money, and a pleading guarantee that the students with me were of no behavioural concern, but I secured a replacement. I joked with Genevieve that because my replacement was Piikani, they would have a tour delegation without a random white guy for the first time in the last two years. She said she was disappointed I had to depart but understood how leadership priorities in Blackfoot country often spread us thin over geography and time.

I loaded my students and took off to Lethbridge, where I made the transfer at my replacement's house. Once they were off to Medicine Hat, I picked up a student needing a ride from their group home to the Waterton Camp that night. After arriving at the Belly River Camp, I checked in with my students and ensured that the other teachers would be ok overnight, despite *their protest that I wouldn't be staying. After completing a couple photos, catch-ups and divvying out my remaining pack of gum to the students there, I then headed back to Lethbridge with the summer sun setting over the mountains.*

After a quick review of my presentation and final project, I recognized that the sun was already beginning to brighten the northeastern sky. I forced myself into a deep slumber and was greeted with a dream of picking sweetgrass with Annette. She watched carefully as I harvested, giving tips as I went. When I awoke, I scanned the time left until my class and quickly travelled to one of the sites where we had transplanted sweetgrass seedlings from our project. I spent about an hour praying and carefully harvesting the best blades. There were a number of flowering plants that had begun to go to seed. I made sure to pick a few of these as well. I bundled up my harvest, grabbed my laptop, and headed to the university.

After our presentations were complete and we were carouseling our final projects, I presented my offering to Annette as she dramatically followed the aroma to my table. I thanked her for her patience and flexibility in helping me complete the course requirements despite my other commitments. She commended me on the depth of my assignments and indicated that the breadth of my local knowledge of issues and perspectives gained through my lived experience was on the right track and aligned with Blackfoot priorities. Like Genevieve, she acknowledged that I now had empathy for the time and labour requirements of those attempting to stay engaged with culture while succeeding in the off-reserve labour market and academia. I asked if she remembered me from my final practicum as a pre-service teacher when she was Division Principal at Holy Spirit School Division, and I was teaching Biology at Catholic Central.
I was young and eager to improve my teacher craft within the evolving context of new Indigenous requirements and had approached her on including Blackfoot perspectives into my

science curriculum. She put me in contact with her daughter, Diandra (DJ), who was interested in climate science and restoration efforts with her tribe in Kainai. I brought DJ into my class and we bussed CCH students out to the reserve to learn about the Kainai interpretation of Nature, cultural protocols within sacred sites, and I had my students complete a litter pick-up challenge to clean the area around the site she had brought us to.

As I relayed these memories to her, I became aware of a familiar twist in my hermeneutic loop that signified a return to an original context as a new, more in-depth person. It had been Annette who first initiated me into partnerships involving Blackfoot perspectives and Western Science, and now, here we were 6 years later, with her signing off on me finishing a course needed to complete my Masters. I was beginning a new revolution of the loop, still as a student, but now with half a decade of teaching experience. Still seeking guidance, but from a firmer ground of understanding cultivated through a personal commitment to continue the educational path of expanding the horizons first identified back then.

At this moment, she gasped, looking at the sweetgrass bundle and asked, "Are those seeds!?". 4 small seeds had dislodged from the flowers I had picked and were sitting in a circle on the desk. "Yes", I replied, "I wanted to bring you some sweetgrass flowers as well, kind of like a metaphor that this harvest is not the end of something but the continuation of a never-ending life cycle. The proof of our project's success is not the academic papers generated, but the return of this grass each year and the depths of its roots." She hugged me. "These are amazing! My son is just starting out in science at post-secondary this year. I think he is interested in plant technologies. I will give these to him, he is going to love this!"

"You can sway a thousand men by appealing to their prejudices quicker than you can convince one man by logic." - Robert A. Heinlein.

I see this quote in a whole new light after starting this thesis originally in the Department of Environmental Science and Geography and finishing it as a Master of Arts in Education. I used to view this statement as a lamentation on the inability of most men to think objectively, rationally, and engage with others in good faith, free of prejudice in the form of racial, sexual, gender, class, or anthropocentric animus. Logic was the keystone holding up the two walls of my moral archway. One side stacked by religious faith, a gift and familial responsibility transferred from my own elders that imbued a lifelong passion for logos, parables, fables, drama, and the revelatory exploration of the sacred mysteries transcendent across cultures. The other side was constructed carefully with academic rigour, intellectual pride, skepticism, and a burning desire to challenge the universe through testable hypotheses, to be respected as a no-nonsense practitioner, communicator, and educator of the scientific method. I was determined that with that keystone in place, I could play around with the individual bricks of each side, pulling and swapping them as needed to create a cogent mosaic that could withstand the external pressures and scrutiny of attempting to be what Aristotle called a “great-souled man”.

Yet, through my time spent in Piikani as a teacher and administrator, the process of acting in service to the vision of this sweetgrass project, and a period of hermeneutic reflection, I now see this quote more as a Gadamerian prescription for operating in a truly authentic and pragmatic approach to knowledge, persuasion, and creation. It is only through deep engagement with the encounters of our own prejudice (what Gadamer (1989) refers to as the source of our knowledge) and the prejudice of others that we can address the unproductive, recognize the productive, and pursue real Truth over the criteria-based truth of positivism. This was a process of suspending the ends to patiently sit in the means. I was encouraged by Piikani Elders, then forced by the academy, to deconstruct the mask of objectivity I had worn to create a safe space within the birds-eye view of science.

Looking back at the initial proposal question and objectives of the scientific aspect of this thesis, the project took a different, albeit more successful approach to addressing community concerns around climate change impacts and responses. The original operating assumption was that addressing food security through a vegetable greenhouse and promoting renewable energy integration within the school would be a welcome solution to some of the issues being faced by the community through COVID supply-chain disruptions and increases in carbon-related costs.

However, consultations with Elders showed a much more long-term perspective in their insistence that the project focus more on the cultural and technical education of students as the future keepers of Piikani land, and that the project would result in the production of government-approved scientific research that could help them to protect and revive their traditional foods, medicines and landscapes from habitat loss. Therefore, instead of a technical analysis of the energy resources required to supply a commercial greenhouse year-round, the project followed the guidance and permissions of the community to explore the renewable resources that matter most to them: their children and the traditional ecological knowledge encoded through interactions of the animate land with *Niitsi'powahsin* (the original language) and Piikani cultural protocols.

The Piikani Nation successfully produced new scientific literature on the carbon sequestration potential of sweetgrass and developed frameworks towards good practices in Indigenous-led research, which promote Indigenous authorship within the peer-reviewed journal publication process. This work established an interpretive guideline for upcoming studies on other native plants and their role in the protection, restoration, and reclamation of different habitats, including the Old Man Dam River Valley. The protocols and partner structures formed in this project can be employed by the Piikani Nation and other rural communities as a model for weaving scientific research methods with the protection of local traditional knowledge. The use of Sweetgrass as an ecosemiotic indicator of health and environmental connection can be modelled in other communities seeking to have the value of their traditional harvest plants and landscapes recognized and protected. Piikani is well positioned to continue producing scientific knowledge from a position of control rather than subject. This was made possible through the formation of diverse, expert partnerships built through honesty, patience, and communication - braided philosophies, ceremonial bonds, and iterative cycles.

The ongoing relationships between the Piikani school, community departments, and an interdisciplinary team of external researchers and funders serve to add long-term resilience and sustainability to local environmental research projects by lowering the distributive risk, celebrating accomplishments through diversified metrics of success, and building local capacity through the intergenerational and intercultural sharing of environmental knowledge. In the process, I gained firsthand knowledge of the struggles that many Indigenous researchers and educators encounter regularly and what non-Indigenous educators should be active in trying to recognize in both on and off-reserve teaching settings. From juggling the sharing of one's personal experience with culture with the need to keep sacred that which is not yours to share, to intense negotiations with the King's representatives to prevent the Crown from claiming copyright with the stroke of a pen on a contract you barely understand. I learned that the term ally is not a noun one can ascribe to oneself nor a title that can be bestowed upon anyone. It is best understood as a verb, an action one commits to daily to ally oneself with a set of values and priorities. We ally our time and associations. We ally our reflexivity and capacity for growth in good faith. We ally our financial, cognitive and spiritual resources towards a shared goal.

I concluded that as a teacher, it is in good practice to consider the conceptual difference between *aahkoma'to'pa* (that which is borrowed) and *ma'tsi'pa* (that which is taken) outlined by Ryan Heavy Head (2005) when attempting to dialogue with different ecological researchers interventions, practices, and technologies within Traditional Blackfoot Territory. Throughout this project, the Blackfoot's version of the hermeneutic loop - a framework of ongoing Acceptance, Adoption, and Authentication - was employed. Acceptance, in this case, often refers to simply getting a meeting with community elders or representatives to discuss an idea. Most of the Piikani community accepts that food security is an issue that could be solved through a community greenhouse. It is the opening step to a collaborative discussion. Yet potential external collaborators must be prepared to listen. Adoption involves putting the practice or technology into use, although it often may not be in a sustainable way. This could be due to many factors including long-term feasibility, community cultural acceptance, and local ecological or employment capacity. The leasing of Piikani lands for cattle grazing is an example of a practice that is accepted as a modern necessity and adopted at a wide scale. Yet it is fundamentally unsustainable within the ecological carrying capacity of the native grasslands, taking more than is left year after year, which is subsequently incompatible with the Blackfoot perspective of balance and reciprocity.

Therefore, it was observed that the third and most necessary part of integrating environmental practices or solutions is a process of authentication. In this context, it required a commitment to the cultural protocol from all members of the research team. It required original presumptions of the project to be left off reserve and for Piikani cultural motivations to take the lead on naming, developing, and owning the project through a ceremonial approach. As we progress from acceptance to authentication in this framework, practices shift from aahkoma'to'pa to ma'tsi'pa and agency for their use is transferred to local decision-makers.

Large-scale renewable energy or production greenhouse projects may be accepted, and possibly even adopted. However, their long-term sustainable use requires the full cultural backing of the community through this process of authentication within the lens of Piikani Language and Culture. Practices and technologies that are "borrowed" do not inherently align with Piikani cultural values in the way that something which is "taken" does. However, this is not to say that outside practices, partnerships, or technologies are off-limits. This boundary is fluid and carefully negotiated through specific, ongoing conduct.

Heavy Head (2005) uses the example of an automobile being "taken" through its practical application in hauling and traversing long distances in the service of ceremonial duties and pow-wow gatherings. Though aspects of the technology venture into outsider "borrowing" as it is used in ways abrasive to Blackfoot modes of being, such as rushing past a neighbour or abandoning familial duties. Alcohol is similar in the ways it can be accepted and authenticated for specific medicinal purposes through regimented practitioners, though it becomes foreign and unwelcome as it is abused outside of that setting.

Agricultural developments, environmental technologies and academic research aspirations are no different. Historically, these have been used to disrupt and decay Indigenous practices in a process of industrial upgrading reflected within the educational systems of the time. Our fast-paced, Western economic world views acceptance and adoption as the gold standard for crossing a project finish line before it is time for the next funding cycle, one that is separate and distinct from the current cycle. We employ this method in business, government, and our children's education. We do not consider long-term operability, capacity, inheritance, environment, engagement, or true embodiment.

This approach does not leave room for an authentication process which requires substantial buy-in to the local community, semiotic translation between palatable cultural concepts, and at the highest levels, ceremonial transfers validated through evidence of knowledge, such as songs or a genealogy of names. This is not a linear, or check-box approach. It is a hermeneutic practice that is accepted only as valuable as one's commitment to return around the circle once again and provide evidence of an expansion of one's horizon. Projects and practices that fail to meet this standard will not be sustainable or resilient to changes over time. Potential partners that cannot commit to the process will find themselves in the "borrowed" or, often unknowingly, in the "discarded" category, unable to push through widespread acceptance or adoption.

A commercial or high-tech food greenhouse was an acceptable solution to some local issues, and some members of the community were open to adoption. Seeds have been planted, and this project could still blossom into that reality. Being granted the name Supii·ṗo'omaak̇sin, hosting the knowledge sharing ceremony, publishing the scientific research, sharing our project with youth conferences around Alberta, winning the Clean50 2025 Sustainability Top Project of the Year and the practice of using the greenhouse to encourage students, educators and community to have an ongoing, seasonally cyclical, intimate relationship with sipatsimo, *sspóóhtsi* (sky), and *ksaahkomm* (earth) were crucial cultural steps to beginning the authentication process needed for a sustainable, resilient future of cooperative ecological interventions, cultural revitalization and scientific education in Piikani through a shared conceptual symbol of the cycles of carbon and other beings.

Finishing the final course requirement for my new graduate program, I ran into a former student who was now also attending the University. This student had been with me through the entire sweetgrass project, from junior high into high school. As our conversation came around to what I was doing, my student began reflecting on what the sweetgrass project had meant during their time at school. I was taken aback. Although this student had always participated in the project, they were often apathetic and loudly critical of the project's goals and feasibility. Now here they were talking about how proud they were that the project was able to continue going on for so many years, that it showed them that teachers not only cared about staying around, but that they wanted to build something sustainable. That at the beginning of the project they felt insecure in their knowledge of culture and the environment, but by the end they felt like they could hang with the bigger city school kids who also ran eco-action projects and were heading off to post-secondary in the fall. That growing the sweetgrass instilled a growth mindset both physically and mentally, allowing them to gain strength through the labour of the gardening process, but also gain resilience to view not knowing something as an opportunity to learn, rather than check out. Culturally, they mentioned that they had gone on to do a podcast about their relationship with the land and culture after the sweetgrass project. Although they were not overly cultural to begin with, they said that seeing other students from other schools showing interest in the project, the sweetgrass, and Piikani in general allowed them an opportunity to view their own cultural practices as not just a regular day occurrence, but something rare, unique and worth protecting. As we talked, and they went on about how awesome university was, but they wished they had paid more attention in high school, my heart filled with joy. Students empowered to take on the world of education and emboldened to connect with their culture while *they do it. Students seeking to create new third spaces to reproduce their culture into the future and share with a technological, digital world. This was what we had grown in our greenhouse.*

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