What Are the Supports and Challenges of Facilitating an OpenSciEd Unit on Energy at Chief Leschi Schools?

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Abstract

My research question for this qualitative case study is "What are the supports and challenges of facilitating an OpenSciEd unit on energy at Chief Leschi Schools?" Brayboy and McKinley (2005) argue that education in the United States is predominantly focused on mainstream structures, knowledge, and curriculum, and lacks Indigenous approaches and perspectives. Our fourth grade class used complementary methodologies, such as *Etuaptmumk*, Two-Eyed Seeing introduced by Mi’kmaw Elder Albert Marshall (Bartlett et al. 2012; Hatcher et al.; 2009), which accounts for both mainstream and Indigenous perspectives.

During visits to Lake Leschi beginning Nov. 17th, 2025-May 1st, 2026, participation in the elementary salmon program, and a fourth grade OpenSciEd unit on energy students in our fourth grade class documented their learning through photography, video recordings, illustrations, observational notes, and written reflections, resulting in a variety of qualitative data for this case study. Consistent with a wWholistic approach (Absolon, 2022), learning was also documented through reciprocal dialogue in scientist-story circles. Findings demonstrate that CLS students successfully made connections among the natural energy systems at Lake Leschi, the elementary salmon program, and man-made systems that affect natural systems, as presented in the OpenSciEd unit on energy. Findings also indicated that significant support came from others witnessing how our students were benefiting from the restructuring of the OpenSciEd unit on energy to center our students' identities.

Keywords: STEM, Chief Leschi Schools, *Etuaptmumk*, Two-Eyed Seeing, curriculum, access, OpenSciEd, mainstream curriculum, Indigenous Knowledge, Reggio Emilia, Lake Leshi Food Forest

Table of Contents

Acknowledgments

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I am incredibly lucky for your guidance, encouragement, and thoughtful feedback throughout this dissertation. Your guidance prompts me to put this theory into action, then evaluate outcomes that align with the research. In 2014, I remember bringing an idea to Professor Rios. I was working at the Children's Museum of Tacoma at the time as a playgide, and I would go to work and keep looking at this broken-down playground that no one had access to. I wanted to figure out how to get a group of volunteers together with the proper permissions, and I did not know where to start. After explaining everything to Professor Rios, he looked at me, confused, and then said, "Why are you still here? Go! Go do it". I did, and it taught me a great lesson on taking action. This teaching is so powerful, I have used it throughout my teaching to give students autonomy to try, fail, and/or iterate on their approach to get what they want.

Dr. Weinstein's teachings about how each community has funds of knowledge within the community taught me how important it is to include the community in my work. The relationships built have mutual respect for students and families, and they have lasted over 10 years of teaching. My first kindergarten class is now entering high school. Dr. Weinstein strengthened both my scholarship and my confidence as a researcher who is part of the community served.

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Chapter 1: Introduction

This Dissertation in Practice (DiP) was written in the traditional homelands of the Puyallup Tribe, who have stewarded these lands Since Time Immemorial and continue to do so today. I am Natalie Salo, born in Washington, D.C., the descendant of a Jordanian mother and a second-generation Ukrainian father. My mother, Moufida Ghezala Salo, was born in Amman, Jordan, and is from the Jabri tribe/family. My mother was a linguist, translator, poet, and scholar. My father, Ronald Salo, worked for the Peace Corps as a science teacher in Nepal and later worked for the General Accountability Office (GAO) for over thirty years, investigating issues of corruption and fraud. I am currently a doctoral student in the Educational Leadership program at the University of Washington, Tacoma, in partnership with the Muckleshoot Tribal College (UWT/MTC).

I am the product of colonialism. I grew up in Texas for the majority of my life. I did not have the opportunity to fully access my parents' respective Cultures. Both of my parents did not have any ties to a specific community. I know being an effective teacher means I must honor our students' culture and community, because I value the community that I work for and the influence it has in forming a learning identity with our students.

My teaching pedagogy, is best described by Kolb and Kolb (2018, p.8) and follows an Experiential Learning Cycle which follows eight important insights to learning such as:

1. Learning is a recurring cycle. The experiential recurring cycle is imagined as a spiral of exchange between the learner's world and the external environment.
2. Experience is necessary for learning. William James (1977) suggests that the experience be something that is not in the routine and strangeness of something outside of the normal experience. James (1977) calls this "pure experience"

3. The brain is built for experiential learning. James Zull supports this claim in his research in the form of two books, The Art of Changing the Brain (2004) and From Brain to Mind (2011) which found the "learning cycle arises from the structure of the brain (Zull 2004,, Zull 2011)
4. The dielectric poles of the cycle are what motivates learning. This means taking concrete sense learning and abstract learning and using them as tools to motivate next steps in learning as well as balancing active experimentation and analyzing with reflective observation.
5. Learning styles are different ways of going around the learning cycle. This is important because each student has different learning styles and teachers can better facilitate the students' learning if teachers understand how their students' learn.
6. Full cycle learning increases learning flexibility and development where all learning styles are engaged in a wholistic and fluid manner.
7. Teaching around the learning cycle involves four roles: Facilitator, Subject expert, Standard/Setter/Evaluator and Coach.
8. The learning cycle can be a rubric for wholistic assessment. Learners should demonstrate knowledge and skills in their real life context. The outcome of the evaluation is to draw education close to real life.

Figure 1: The Experiential Learning Cycle (Kolb & Kolb, 2018) pg. 8

This experiential learning cycle also aligns with the Reggio approach to teaching and learning, both influences on my pedagogy, and was used to answer the research question about the support and challenges of facilitating an OpenSciEd unit on energy by prioritizing direct experiences for our students, social justice, student autonomy in their classroom, accountability for themselves and others, and the use of restorative practices. This was important because I didn't want our students to bicker with each other instead of coordinating with each other towards achieving their goals.

When I refer to "we" and "us" and "our", I am including students, their siblings, their family, and their respective communities. I cannot speak to each person's individual vision. . I will also be using synonyms in place of the participating real student's name. I have crafted my research question and my DIP to include student access to outdoor learning at Lake Leschi and an elementary salmon program in an inclusive, less restrictive environment, while still meeting the requirement to use the OpenSciEd curriculum.

In chapter one of this DiP, we had a brief introduction to myself and my family background. I will next discuss the research question, "What are the supports and challenges of facilitating an OpenSciEd unit on energy at Chief Leschi Schools?" After that, I will provide a brief background on how the research question was developed and why it emerged so quickly after the elementary STEM program was dissolved at the end of the 2024-2025 school year. I will then outline the purpose of this DiP and my positionality regarding the research question.

In Chapter Two, the literature review, I will describe the research literature as it pertains to access, a thread that connects each part of this DIP to the outcome. As rewarding as it was to see our students access the spaces designed for them, the facilitation itself encountered institutional challenges that might dissuade other teachers from advocating for and providing access.

Sustainability, in the sense of the continuation of these learning experiences that take learning outside of the classroom takes a lot of effort and planning, even then, last-minute things take precedence, and plans need to be adjusted. I hope the experience shared here helps other educators gain greater access to the Lake Leschi Food Forest and the salmon program, specifically for our elementary students. Where they might not have seen opportunities before, I encourage educators to think creatively about how to center in-place learning in their OpenSciEd lessons while honoring their students' respective Cultures.

Research Question

My research question is "What are the supports and challenges of facilitating an OpenSciEd unit on energy at Chief Leschi Schools?" I chose this research question after many discussions with other researchers and professors in the UWT/MTC program, as well as teachers, parents, and students, following the dissolution of the CLS elementary STEM program last school year, 2024-2025. What drove me to this research question is that I had an opportunity to get official support from CLS leadership in writing to continue my DiP after the STEM program was dissolved. I wanted to ensure that our students have access to the Lake Leschi food forest and the elementary salmon program, at least for the fourth-grade students in my classroom. I will now discuss the background leading up to my research question in the next section of this dissertation, in practice, a qualitative case study.

Background of the DiP

Chief Leschi, the man, was a Puyallup leader who lost his life advocating for the rights of Indigenous tribes of the region and advised other tribal leaders who were in similar situations, bargaining with the colonial government in place. Chief Leschi advised other Indigenous leaders to make sure the land they were negotiating for a reservation had access to water. Chief Leschi also advocated for Indigenous people to maintain their rights to hunt and fish in their traditional and accustomed places. This was the foundation of the Medicine Creek Treaty and was supported by the Bolt Decision during the fishing wars (Bill, 2025). This is also the foundation and justification for this DiP. I respect what Chief Leshi did for his people. I respect the people of the Puyallup Tribe and their work with salmon restoration. I also respect the students and families of CLS. I want them all to have access to what was designed for them and be able to advocate for how they want to learn.

The Puyallup Tribe has historically prided itself on its graciousness and generosity. One of the ways I could best reciprocate, as a teacher, was by investing my effort, time, and money in the UWT/MTC leadership program, because in my fourth grade class students should have access to the highest-quality education possible. I strive to better understand how I can improve my practice and learn more.

I wanted to know what Indigenous and non-Indigenous scholars say about what is needed in a tribal school. I wanted to know what parents want for their children in a tribal school. I also wanted our “fourth-grade” scholars to engage with the OpenSciEd unit on energy, give them access to the learning space designed for them and an elementary salmon program, providing a platform to highlight our students' work from those spaces.

Boarding schools were instructed to kill the Indian and save the man, subsequently, many children were murdered for “offenses” such as speaking their language. (Brandon Renyon, Director of Puyallup Tribal Historic Preservation Officer, personal communication, 2019). We all understand that mainstream education has been a tool of assimilation since the time of boarding schools. This is not my assertion. I am in agreement with the Indigenous historians and scholars who have generously shared their knowledge and insights through their academic work.

My research question was developed when the elementary STEM program was dissolved last school year, 2024-2025. Knowing the trajectory of the philosophies employed and advanced at CLS over the past three years. I did not want everything that we accomplished as a community during our STEM program from 2019 through COVID, until 2025, erased and replaced.

Over the past seven years of my employment at CLS, I have witnessed increasing encroachment by mainstream education and rigid scheduling. At the time of this study, instructional opportunities for STEM had changed considerably. What had previously been a dedicated 45 minute STEM block was reduced to 30 minutes and later discontinued when the elementary STEM program was dissolved. As a result, classroom teachers were now responsible for implementing the OpenSciEd curriculum within three 30 minute science periods each week. While the district emphasized implementing the curriculum with fidelity, OpenSciEd is designed as an adaptable instructional framework that encourages teachers to make responsive decisions based on students' needs and local contexts. As an OpenSciEd-certified facilitator, I understood this flexibility to be an important feature of the curriculum. These differing interpretations of curriculum implementation became part of the instructional context in which this study was conducted.

This school year, 2025-2026, OpenSciEd was the adopted curriculum of CLS. I earned a facilitator's certificate in 2024, which allows me to teach other teachers how to facilitate the OpenSciEd curriculum successfully. I prepared for this DiP in many ways, one of which was educating myself about the OpenSciEd curriculum, learning how flexible the units could be, looking for opportunities for experiential learning and going more in depth by examining the NGSS performance standards to which OpenSciEd is aligned.

When I was told that there would be no STEM program, I ensured that my DiP research question also included access to Lake Leschi’s food forest and the elementary salmon program.

The more I could preserve with respect to my research question, the more important this DiP became to me and others who supported this work. My research question became a shield for me, our students, and others who supported this work. The people who gave me support knew exactly what I was doing because they were interested, and I told them.

I understand the impact of what it is like to live in mainstream education where the rigid scheduling feels militaristic or, even worse, like a prison. Just because the political administration that’s in charge of the United States right now is glorifying hate and racism does not justify the people who are giving themselves blank checks to practice the covert and overt racism residing within our communities.

There needs to be some ethical force that pushes back on the assimilative model of learning. Our students’ future lives are not fodder for the front lines of military campaigns or fodder for the school to prison pipeline. The policies, procedures, and politics of mainstream education are still propagating generational trauma and promoting substandard educational practices. In this study, I am modeling what it looks like to centralize our students' identities and their connection to land. I will next discuss the Problem of Practice (PoP).

Problem of Practice

TheOpenSciEd curriculum provides inquiry-based science experiences aligned with the Next Generation Science Standards (NGSS). The OpenSciEd curriculum adoption and full implementation in an Indigenous educational setting raises important questions about how students can access sustained, meaningful, place-based learning, for example walking to Lake Leschi to observe the natural systems of energy transfer with their teacher supervising. The overarching central problem of practice addressed in this DiP was support for student access. Chief Leschi Schools is uniquely situated on sovereign Puyallup land with a first food forest in development with UW Seattle. All CLS students should have access to the educational opportunities showcased to their parents on social media and parents should be included as much as possible. Schools need to create pathways for families to authentically participate alongside school practitioners in creating and implementing plans for their children.

The inclusion of parents is a different mindset for some educators. With the historical trauma of boarding schools and generational systematic challenges at CLS, foundational work should use relational approaches, be made fully transparent and open to revision as families become aware that their words have tremendous value and their participation in their child's learning will help shape the outcome for the future (Detterman et al., 2019).

With some of the parents at CLS there is a frustration of their voice not being heard and being put in a liminal space. I know this because I have picked up those conversations when I've seen the parents' issues dismissed. The parents in our fourth grade classroom supported me in this study with hopes they and their children can have access to learning spaces that were designed for them in balance with Mainstream education. When I say access I am referring to access to outdoor learning spaces such as the Chief Leschi Food Forest, the elementary salmon program, as well as the materials for the hands-on activities in the OpenSciEd unit on energy.

Access requires approval, intentional planning, collaboration, instructional flexibility, leadership support, and a professional, streamlined follow through from administrators. The challenges of this work came from professionals that saw this work, not as research, but as a political threat to the status quo of colonial-settler, mainstream education. Prescribed curricula, rigid schedules, competing priorities, and institutional structures are challenges that limit students' opportunities to engage with places, people, and experiences that make science personal and culturally meaningful. That is why I phrased the research question "What Are the Supports and Challenges of Facilitating an OpenSciEd Unit on Energy at Chief Leschi Schools?" The question aligned with the required CLS curriculum and prompted stakeholders to consider how they can support our students, specifically by providing access and flexibility to ensure they can participate in intentional learning environments like the Lake Leschi Food Forest and our elementary salmon program.

Therefore, this Dissertation in Practice examines the supports and challenges of facilitating an OpenSciEd fourth-grade energy unit through a place-based approach that intentionally protects students' access to meaningful learning spaces that were designed for them. This qualitative case study seeks to inform educational leaders, teachers, and curriculum developers, and most importantly, honor the students of Chief Leschi Schools and the participating families who have contributed to creating equitable, culturally responsive science education that honors Indigenous sovereignty, strengthens relationships with place, and supports student learning.

Purpose

The purpose of this Dissertation in Practice (DiP) is to examine the challenges and supports of facilitating the fourth-grade OpenSciEd Energy unit through sustained access to Lake Leschi and the elementary salmon program. Access and time to access are important factors supporting Indigenous students' science learning while strengthening their relationships with place, community, and Indigenous ways of knowing. Although Chief Leschi Schools is uniquely situated on sovereign Puyallup land, meaningful and sustainable access to these learning environments is not automatic. Participation requires approval, intentional planning, instructional flexibility, collaboration among educators, and leadership support to ensure students can engage with the natural spaces and community resources designed to support their learning. This DiP therefore centers access as both an educational and equity issue, recognizing that opportunities to learn with the land are as important as access to classroom curriculum (Absolon, 2022, Cajete, 2000, 2015, Deloria & Wildcat, 2001).

This DiP recognizes the Lake Leschi Food Forest and the elementary salmon program as an essential learning environment where students observe, experience, and interpret energy transfer through direct interaction with living systems. Students investigated the movement and transformation of energy through the salmon life cycle, ecology, water systems, plants, sunlight, and seasonal changes while engaging with the engineering concepts, models, and investigations required within the OpenSciEd curriculum. These experiences expanded science learning beyond classroom walls and created opportunities for students to connect scientific concepts with their lived experiences, and relationships to the land (Bang & Medin, 2010; Bang & Vossoughi, 2016; Cajete; 2000, Kimmerer; 2013, Rios & Brewer; 2014).

A second purpose of this DiP is to explore how Indigenous place-based pedagogies can extend and enrich a prescribed mainstream science curriculum without replacing its required learning outcomes. OpenSciEd introduces students to human-designed systems for generating, transferring, and storing energy. This study intentionally complements those investigations by providing students with opportunities to observe naturally occurring energy systems and compare them with engineered systems. Through a *Etuaptmumk,* Two-Eyed Seeing perspective, students were encouraged to understand that scientific knowledge can be strengthened when mainstream scientific inquiry is learned in-place, with learning environments designed specifically for experiential learning (Bartlett et al.; 2012; Hatcher et al., 2009; Wilson, 2008).

Ultimately, this DiP seeked to demonstrate that access is not simply a logistical matter of taking students outdoors. Access represents the intentional creation and protection of learning opportunities where Indigenous students can see themselves as scientists, knowledge holders, and future leaders of their communities. By documenting the supports and challenges involved in facilitating this work, this study aims to inform educators and educational leaders about the importance of providing access, protecting learning spaces intentionally designed for Indigenous children and ensuring that curriculum implementation remains responsive to place, relationships, and community priorities (Bang et al., 2014; Brayboy & Castagno, 2008; Gruenewald, 2003; Wilson, 2008).

Positionality

My positionality is tied to my identity as a settler of Jordanian and Ukrainian descent. I live on stolen land and worked on the sovereign land of the Puyallup People. King (2023) emphasizes the importance of knowing ourselves and understanding the progression of discomfort we face as we evaluate and analyze our place in our relationship with Indigenous communities. As King (2023) suggests, I lean into this discomfort, knowing that learning is uncomfortable in part because it is unfamiliar. I was not as informed or exposed to Native American, First Nations, and Indigenous scholarship as I should have been as a human, not at the start of my journey working for CLS or this program.

In 2019, I had never heard of the Medicine Creek Treaty or the Puyallup fishing wars. I was comfortable thinking I was knowledgeable and in allyship by watching movies like Dances with Wolves, until I read the article "Decolonization is Not a Metaphor." Tuck and Yang (2012) call the movie out as supporting themes of White Supremacy because the White man named John McCoy gets to be a better “Indian” than the Native Americans themselves. Tuck and Yang's (2012) "Decolonization is Not a Metaphor" was a radical reading, especially because it calls for the relinquishment of real land.

Brayboy (2005) says, "Colonization is endemic to society,”. How do I take accountability in my teaching practice, knowing that the intent of mainstream knowledge still serves to assimilate? This DiP is extremely important research because it seeks to reveal what happens when science is employed within in-place, experiential learning alongside the mainstream curriculum at Chief Leschi Schools.

I look to other professionals, my professors and colleagues who share a common understanding of access as support. I am not the only educator at CLS that advocates for our students to have access to and time in learning spaces that reinforce the Puyallup Nation's sovereignty, but knowing, planning and pushing for access from leadership was not the biggest challenge. The biggest challenge came from the administration following through on said agreement. This disconnect meant that only one of the twenty-four elementary classrooms at CLS, our class, had official sustained access to Lake Leschi.

There are challenges that come with Indigenous research that should be addressed. One challenge is that the researcher, no matter how objective they want to be, still has a bias that influences the study. This approach usually focuses on problems and and often imposes outside solutions, in contrast to appreciating and expanding on the resources available within Indigenous communities Wilson (2008) I have a bias that believes in access and that meaningful learning takes place outside of the classroom and classrooms in mainstream education are akin to a holding cell. Because of my personal bias, due to access to higher education and knowing what research says from Indigenous scholars. I often advocate for a less restrictive environment for all students. I advocate for access.

Access is widely recognized within Indigenous education as more than physical proximity to educational resources. Indigenous scholars describe access as participation in relationships with land, language, culture, and community (Absolon, 2022, Wilson, 2008). The gap in the literature, and what informs this qualitative case study, is how access to learning environments can create challenges for steadfast educators, students, and families. The true power comes from the Puyallup community who will eventually have the final say. The support I received from the participants and their families, justifying this DiP is an example of what could be for all CLS students. I will next share the literature review for this qualitative case study.

Chapter 2: Literature Review

The following literature review informed and inspired this DiP. The review is organized around connected themes, here they are:

1. Access to Place: Place Based Learning
2. Access to Research for Frameworks and Methodologies
3. Mainstream Education
4. Etuaptmumk, Two-Eyed Seeing
5. Emergent Strategy
6. Reggio Emilia Approach

Each of these themes relate to aspects of access for our students in order to research what the supports and challenges are in facilitating an OpenSciEd unit on energy. This literature review touches on key definitions that can also be found in Appendix ? and Appendix ?

Access to Place: Place-Based Learning

Place-based research approaches are critical for Indigenous students' identities and for co-creating a relevant exchange and negotiation for shaping knowledge (Sievers et al., 2024). Focusing on place-based awareness and consciousness awakens us from the coma of colonial consciousness (Absolon, 2022). Our awakening begins with self-awareness in relation to place, where we observe and experience the interconnectedness of identity, land, and community.

Rios and Brewer (2014) support the practice of outdoor learning experiences to help students develop science content knowledge while fostering environmental awareness. Their research found that outdoor education increases student engagement, supports science achievement, and encourages environmental stewardship by allowing students to investigate phenomena through firsthand experiences. These findings support the importance of providing Indigenous students with access to place-based learning environments, such as the Lake Leschi food forest and the elementary salmon program, where scientific concepts can be learned through meaningful relationships with the land alongside classroom instruction. Teachers play a primary role in developing positive attitudes about the outdoors and curate learning in the process (Rios & Brewer, 2014). In this DiP students observed salmon habitat, explored energy transfer within local ecosystems, and documented their learning through photography, illustrations, and scientist-story circles. These experiences created opportunities for students to connect classroom science concepts with teachings shared by their families, Elders, and community, demonstrating how place-based learning supports the intergenerational transfer of Indigenous Knowledge (Cajete, 2015; Kimmerer, 2013; Little Bear, 2000; Wilson, 2008).

First Nations programs in Canada often incorporate land-based education, where students learn ecological science by participating in seasonal hunting, fishing, and berry harvesting practices guided by elders (Simpson, 2014). Among Indigenous Australians, "on Country" learning involves children and youth engaging with ancestral narratives, astronomy, and ecological care through songlines, weaving, and ceremonial practices (Martin, 2008; Nakata, 2007). Likewise, among Bedouin communities in Jordan, weaving and embroidery are not only aesthetic arts but Indigenous technology with embedded knowledge systems teaching mathematics, design, and knowledge of the land, and informing access to water in desert environments (Abu-Rabia-Queder, 2007; Chatty, 2006). Similar educational principles are evident within Sámi education in northern Norway, Sweden, Finland, and the Kola Peninsula of Russia, where learning centers relationships with land, seasonal cycles, language revitalization, reindeer herding traditions, and community responsibilities. Sámi scholars argue that education should sustain Indigenous identities by integrating IK with contemporary schooling while affirming the rights of Indigenous peoples to maintain their own languages, cultures, and knowledge systems (Keskitalo et al., 2013; Kuokkanen, 2007).

Across these examples of land-focused learning practices, relationality emerges as a collective endeavor in which knowledge is inseparable from ethical responsibilities to the land, ancestors, and future generations. Within these educational approaches, the arts, sciences, and spiritual practices are integrated, positioning education as a means of sustaining language, identity, and tribal sovereignty. These shared elements highlight how Indigenous educational practices resist the compartmentalization of mainstream schooling by positioning learning as a wholistic living practice that is ecological, ever-evolving, and communal. (Marin and Bang, 2018)

Although examples originate from New Zealand, Australia, Canada, and Sámi communities across northern Europe, they reveal educational principles that are shared among many Indigenous communities, including those in the United States. Comparative Indigenous education research demonstrates that land-based learning, relational accountability, intergenerational knowledge transmission, language revitalization, and community participation strengthen student engagement, identity development, and academic learning while supporting respective intergenerational tribal communities (Barnhardt & Kawagley, 2005; Cajete, 2000, 2015; Keskitalo et al., 2013; Kuokkanen, 200;, McCarty & Lee, 2014; Wilson, 2008).

Within the United States, Indigenous scholars similarly argue that meaningful science education is informed through relationships among people, place, language, and community (Bang & Medin, 2010; Bang et al., 2014; Bang et al. 2018; Cajete, 2000; 2015; Kimmerer, 2013). Together, this literature suggests that while each Indigenous Nation maintains distinct histories, languages, and knowledge systems, shared pedagogical principles, including relationality, place-based learning, and reciprocal responsibilities to land and community are foundational. One example is how, Māori educators have developed language programs that braid together science, art, and environmental stewardship through *ako* (reciprocal teaching and learning) and *whanaungatanga* (kinship-based relationships) (Bishop, 1999; Rameka, 2017).

For Chief Leschi Schools, the literature justified this DiP, providing students with sustained access to Lake Leschi, the elementary salmon program, and other culturally significant places where OpenSciEd investigations can be experienced through both IKS and mainstream scientific inquiry. Supportive methodologies researched such as *Etuaptmumk*, Two-Eye Seeing complements the qualitative research used to understand the supports and challenges we faced as a class facilitating an OpenSciEd unit, centering our students as scholars and Indigenous researchers.

The published literature gives insight on Indigenous Peoples' approaches to land based education. These sources will serve as inspiration and comparisons for understanding Indigenous educational practices, particularly those integrating science and art.

Access to Research for Frameworks and Methodologies

Knowledge is power and access to Indigenous research, frameworks and methodologies as a scholar is a privilege and an honor that I take seriously. The work of Absolon (2022), Cajete (2000), Kovach (2009), and Wilson (2008), does not report a single empirical study, instead, their scholarly literature supplied the conceptual frameworks and methodological approaches that shaped every aspect of this Dissertation in Practice, that allowed for me to research the supports and challenges in facilitating an OpenSciEd unit that centers land based educational experiences with our students as co-researchers. Wilson (2008) argues that knowledge is created through relationships and that researchers are accountable to the people, places, and communities involved in the research. Similarly, Kovach (2009) describes Indigenous methodologies as relational, reflective, and supported in story as a legitimate form of knowledge generation, while Absolon (2022) emphasizes wholism, with the claim that Indigenous research cannot separate intellectual inquiry from emotional, spiritual, physical, and relational ways of knowing. The research from these scholars justify the use of different modes of expressing learning such as observation with words and/or illustrations, story circles, photography, and illustrations.

The research also provided the theoretical justification for designing science instruction beyond the classroom. Cajete (2000) argues that Indigenous science emerges through direct relationships with the natural world and that learning occurs through participation with place. Kimmerer (2013) similarly describes ecological knowledge as developing through reciprocity, observation, and long term relationships with land, emphasizing that "knowing" comes from living in relationship with the more-than-human world. For Kimmer, knowing is epistemology. Bang and Medin (2010) builds upon Kimmer’s viewpoint by understanding in science education Indigenous students navigate multiple epistemologies when their cultural knowledge is recognized as an asset instead of viewed as a barrier to scientific learning.

Additional frameworks further informed the design of this DiP. Bartlett et.al. (2012) introduced *Etuaptmumk*, Two-Eyed Seeing as an approach that intentionally brings together the strengths of Indigenous and mainstream knowledge systems without privileging one over the other. Brayboy's (2005) Tribal Critical Race Theory demonstrated that colonization remains endemic within educational systems, providing a lens for examining how curriculum and instructional structures can either constrain or expand Indigenous students' opportunities to learn.

Brown's (1992) design experiment methodology supported iterative refinement of instruction based on ongoing observation, while the Reggio Emilia approach emphasized documentation, the environment as the third teacher, and children's competence as co-constructors of knowledge. Together, these frameworks provided a coherent pedagogical and methodological foundation for creating a place-based, culturally sustaining science inquiry that positioned students as researchers, recognized Lake Leschi and the elementary salmon program as legitimate learning environments, and treated documentation, observation, dialogue, and reflection as essential forms of educational evidence.

Mainstream Education

The research base examining Indigenous education consistently demonstrates that mainstream education has historically privileged mainstream epistemologies while marginalizing Indigenous ways of knowing, doing, and being. Across multiple studies, researchers have found that educational systems often separate learning from relationships with land, language, family, and community, creating barriers for Indigenous learners while privileging mainstream definitions of knowledge and academic success. Instead of suggesting that Indigenous students need to adapt to mainstream education, this body of research argues that educational systems must become more responsive to Indigenous knowledge systems and community priorities.

One of the clearest examples is provided by Bartlett et al. (2012), who documented nearly two decades of collaborative work between Mi'kmaw Elders, university scientists, educators, and community members to develop the Integrative Science program at Cape Breton University. The program was intentionally designed to address the underrepresentation of Indigenous students in science by weaving Indigenous Knowledge and Mainstream science together. During the program's implementation, approximately 100 Mi'kmaw students completed Integrative Science coursework, resulting in 27 Mi'kmaw graduates earning science or science related degrees, compared with fewer than 5 before the program was established. Many graduates became teachers, principals, researchers, nurses, and natural resource professionals within their communities. Bartlett et al. concluded that Indigenous student participation and success increased when Elders were recognized as knowledge holders, Indigenous Knowledge was treated as legitimate science, and students were provided opportunities to learn through both Indigenous and Mainstream knowledge systems.

A second example comes from Bang et al. (2014), who conducted a six year community based design research project with Indigenous youth, families, Elders, educators, and researchers. The researchers redesigned science learning around neighborhood walks, wetlands, and culturally significant places, positioning land as teacher and community members as co-educators. Students investigated ecological phenomena through relationships with local environments and Indigenous community knowledge. The study found that students demonstrated increased scientific understanding, greater engagement, stronger agency, resilience, and educational self-determination when science learning emerged from their relationships with place, culture, and community. These findings illustrate that meaningful science learning occurs when educational experiences are connected to the places and relationships that are significant in students' lives.

A third example is provided by Aikenhead and Michell (2011), who synthesized decades of cross-cultural science education research involving Indigenous learners across Canada. Their review found that Indigenous students were more successful when educators explicitly recognized Indigenous Knowledge alongside mainstream science. They described this process as “cultural border crossing”, arguing that students are better able to navigate scientific concepts when schools intentionally build connections between Indigenous and mainstream knowledge systems. Their synthesis demonstrated that acknowledging multiple epistemologies increased student engagement while reducing the tensions Indigenous learners often experience when school science conflicts with their cultural understandings.

These empirical findings support Brayboy's (2005) argument that mainstream education continues to operate within colonial structures that privilege Mainstream systems of knowledge while positioning Indigenous identities, languages, and epistemologies outside the dominant curriculum. Through the lens of Tribal Critical Race Theory, Brayboy argues that colonization remains endemic to educational institutions, shaping curriculum, pedagogy, and definitions of academic success. Consequently, mainstream education functions as a mechanism for transmitting Mainstream ways of knowing, doing, and being while often disrupting the transmission of Indigenous languages, relationships with first foods, cultural practices, and connections to land.

Instead of rejecting mainstream education entirely, Indigenous scholars advocate for transforming educational practice through relational, place-based, and culturally sustaining approaches. Cajete (2000, 2015) explains that Indigenous education is inherently experiential, relational, and land-based, emphasizing the interconnectedness of ecological knowledge, culture, identity, and community. This aligns with my pedagogy that includes experiential learning and the Reggio approach were the environment becomes the first teacher, echoed in similarity to Kimmer (2013) where she says the world is “our oldest teacher”

Wilson (2008) and Kovach (2009) describe Indigenous methodologies guided by relational accountability, in which knowledge is created through reciprocal relationships with people, place, and community. This perspective is reflected in *Etuaptmumk,* Two-Eyed Seeing, developed by Mi'kmaw Elder Albert Marshall and articulated by Bartlett et al. (2012) and Hatcher et al. (2009), which proposes bringing Indigenous and Mainstream knowledge systems together without positioning either as superior. Collectively, this body of research suggests that meaningful educational change occurs when mainstream educational structures become flexible enough to provide Indigenous students with time, access, and opportunities to learn within culturally meaningful places and alongside their communities. This research provides the foundation for this Dissertation in Practice, which examines how an OpenSciEd curriculum can be adapted to center Indigenous students through increased access to Lake Leschi, the elementary salmon program, and community based scientific inquiry.

***Etuaptmumk*, Two-Eyed Seeing**

Etuaptmumk, Two-Eyed Seeing, introduced by Elder Albert Marshall of the Mi’kmaq Nation, is a guiding framework that approaches learning to see from one eye with the strengths of Indigenous ways of knowing and from the other with the strengths of mainstream scientific knowledge, while using both together for the benefit of all (Bartlett et al., 2012). *Etuaptmumk*, Two-Eyed Seeing, is not designed to homogenize distinct knowledge systems. *Etuaptmumk*, Two-Eyed Seeing, honors each as complete within its own worldview while fostering respectful dialogue across perspectives. The literature provides several examples of how this framework has been implemented in educational and research settings. Bartlett et al. (2012) described the Integrative Science program at Cape Breton University, where Mi'kmaw Elders and university scientists co-developed science courses that presented Indigenous Knowledge and Mainstream science as complementary knowledge systems. Students learned through both Indigenous teachings and conventional scientific inquiry, resulting in increased participation of Mi'kmaw students in science and science related careers. The researchers concluded that successful implementation depended on partnerships with Elders, co-learning, and institutional support.

Similarly, Hatcher et al. (2009) applied *Etuaptmumk*, Two-Eyed Seeing, in K–12 science and mathematics classrooms by engaging Elders as co-teachers and encouraging students to examine scientific concepts through both Indigenous and Mainstream perspectives. The researchers found that students developed a deeper understanding of science while strengthening their cultural identities because each knowledge system was respected within its own worldview. Likewise, Iwama et al. (2009) used *Etuaptmumk*, Two-Eyed Seeing, within community-based health research, demonstrating that collaborative inquiry between Indigenous Knowledge Holders and mainstream-trained researchers produced more culturally relevant interpretations and stronger relationships between researchers and communities. Across these studies, *Etuaptmumk*, Two-Eyed Seeing, functioned not merely as a theoretical concept but as a practical methodology that supported co-learning, reciprocal relationships, and the respectful coexistence of multiple ways of knowing.

These examples illustrate that *Etuaptmumk*, Two-Eyed Seeing, is more than an educational philosophy, it is an evidence-informed framework and methodology for designing learning environments in which Indigenous and mainstream knowledge systems remain complete within their own worldviews while fostering respectful dialogue across perspectives. This approach provides a conceptual foundation for the present Dissertation in Practice, which seeks to adapt the OpenSciEd curriculum by honoring Indigenous relationships with Lake Leschi, salmon, and community while maintaining its scientific integrity, aligned with the NGSS standards.

When employed in this dissertation, this approach creates opportunities for students to engage in scientific inquiry alongside Indigenous Knowledge Systems (IKS) centering relationships with land, community, and lived experience. In this Dissertation in Practice, *Etuaptmumk*, Two-Eyed Seeing, provides the conceptual lens for examining how students navigate OpenSciEd while drawing upon cultural knowledge, family experiences, and place-based relationships with Lake Leschi and the surrounding environment. By valuing multiple ways of knowing without positioning one as superior to another, *Etuaptmumk*, Two-Eyed Seeing, supports a more relational and culturally responsive approach to science learning (Bartlett et al., 2012, Wilson, 2008).

Bang and Vossoughi (2016) also suggest strongly that STEM education benefits from relational approaches in which knowledge is built through interconnected learning across people, places, practices over time.. This means that students engage with learning hands-on in a variety of ways. For example, taking water temperatures and sampling water to observe under the microscope from Lake Leschi over time. It also means the possibility of using a camera to take photos of the plants from the Lake Leschi food forest over time, and sketching and taking observational notes on biodiversity over time.

Emergent Strategy

The work of Adrienne maree Brown (2017) informed the methodological orientation and pedagogy of this Dissertation in Practice by providing a framework for understanding how meaningful educational change develops at the “speed of trust”, through relationships, adaptation, and responsiveness. Drawing upon principles of complexity science, ecological systems, and the speculative writings of Octavia E. Butler, Brown argues that lasting transformation is not achieved through rigid planning or predetermined outcomes. Instead, change emerges through interconnected relationships, iterative learning, and intentional action. Brown contends that systems evolve through countless interactions that collectively shape broader patterns of growth, emphasizing principles such as moving at the speed of trust, building change through small, intentional actions, remaining responsive to what emerges, and recognizing participants as co-creators of knowledge.

These principles informed both the implementation and analysis of this study. Data was analyzed wholistically to identify recurring patterns of interaction, relationships, and learning across multiple forms of evidence, including classroom observations, field notes, student conversations, photographs, illustrations, notice-and-wonder charts, and scientist-story circles. Analysis focused on how students' thinking evolved over time, how relationships with Lake Leschi, salmon, peers, and community influenced scientific understanding, and how new ideas emerged through collaborative inquiry. Consistent with Brown's concept of emergence, meaning was constructed by examining how small moments of curiosity, dialogue, and shared experiences accumulated into broader themes of evaluating access, relational learning, and student agency.

For example, when the Lake Leschi Food Forest awakened from winter, students immediately told me spring is coming and pointed out all of the new cotton buds forming. Several of our students pointed out the little nettles plant growing and they shared what they knew, the UW graduate students shared what they knew and connected that knowledge to what students had previously learned from our elementary culture teacher. The event and experience captured the evolving relationships and patterns that developed throughout the inquiry, allowing findings to emerge inductively from the collective experiences of students, educators, and the community.

The OpenSciEd curriculum, with a fixed sequence of prescribed lessons, was adapted to include energy transfer in nature as well as in man-made systems, instructional decisions evolved in response to students' questions, their relationships with Lake Leschi, opportunities to engage with the elementary salmon program, and conversations with families and Culture teachers. This iterative process allowed the inquiry to remain informed through classroom experiences while honoring the realities of teaching within a dynamic educational setting.

Brown's (2017) principle that "small is good, small is all" further supported the understanding that meaningful educational transformation often begins with seemingly modest instructional decisions that accumulate over time.

This methodological orientation also complements Indigenous research methodologies. Indigenous scholars emphasize that knowledge is relational, emerging through reciprocal responsibilities among people, land, community, and spirit (Absolon, 2022; Kovach, 2009; Wilson, 2008). Brown's conception of emergence similarly recognizes that knowledge and transformation arise through relationships and continual adaptation. Together, these perspectives encouraged a research process that remained flexible, relational, and disciplined to the community throughout the study. This DiP embraced emergence as an intentional methodological stance, allowing understanding of the supports and challenges associated with facilitating an OpenSciEd unit on energy to develop through ongoing engagement with students, place, and community. In doing so, the research honored the iterative nature of learning.

Reggio Emilia Approach in Experiential Learning

The Reggio Emilia approach is an internationally recognized educational philosophy that originated in Italy. The Reggio approach views children as capable, competent, and active participants in constructing their own knowledge (Edwards et al., 2012). Instead of positioning the teacher as the sole source of information, the approach conceptualizes the child as the researcher, scientist, and scholar. Reggio Emilia is also described as a Western educational philosophy that resonates with some Indigenous methodologies, but it should not be presented as Indigenous or as equivalent to Indigenous ways of knowing. The Reggio Emilia Approach emerged in Reggio Emilia, Italy, after the World War II period, and is associated with educator Loris Malaguzzi and community efforts to create democratic, child-centered schools. It views children as capable knowledge constructors and emphasizes relationships, inquiry, documentation, multiple forms of expression, the “hundred languages”, family participation, and the environment as an educator.

Teachers who use the Reggio approach serve as collaborators, facilitators, and researchers, guiding inquiry through observation and curiosity. Central to the Reggio pedagogy is the concept of the environment as the "third teacher," which employs thoughtfully designed learning spaces, natural materials, and open-ended resources to encourage exploration, creativity, and collaborative problem-solving (Edwards et al., 2012). Reggio educators believe in shared control between the teachers and the students. The teacher can help the students uncover their insights through relationships with the other students creating a space where the class can freely discuss their insights.

Edwards et al. (2012) described the Reggio pedagogy as emphasizing that children’s learning unfolds through negotiated processes with teachers, peers, and materials. For example, in a Reggio classroom, a child’s idea for constructing a bridge is not treated as an individual project, but as a collective inquiry in which classmates contribute ideas, the teacher provides scaffolding, and materials “respond” to children’s explorations. The result is a learning experience that values collaboration, curiosity, and shared meaning making. Through this collective inquiry, children came to see knowledge as something constructed in relationship, with one another, with their teacher, and with the materials themselves.

Another defining characteristic of the Reggio approach is pedagogical documentation, whereby teachers systematically collect photographs, student work, observations, and transcribed conversations to make learning visible, document children's thinking, and inform future instruction. These forms of documentation were essential to this approach because they captured learning as it naturally unfolded through relationships, dialogue, observation, and experiences in place. Using multiple forms of documentation allowed students to express their thinking in ways that extended beyond written language, making their learning visible through words, artwork, photographs, conversations, and shared stories with themselves as the main characters.

A challenge of collecting and analyzing these varied forms of documentation was that they generated large amounts of qualitative data that were often interconnected and context dependent. The data was interpreted collectively, looking for recurring patterns, relationships, and themes across data sources to develop a wholistic understanding of students' experiences and meaning making. All evidence presented in this DiP was approved by our students over a duration of several scientist-story circles.

These principles emphasize learning as an emergent, relational, and inquiry-driven process in which children actively construct understanding through interactions with their peers, teachers, materials, and the environment. These characteristics resonate with the work of this DiP and many Indigenous educational approaches that similarly emphasize experiential learning, relationships with place, and knowledge construction through observation, Some Indigenous communities have adapted Reggio practices into their own contexts. Ringney et al. (2020) highlighted how Indigenous early childhood programs in Australia integrate Reggio's project-based methods with cultural protocols, ensuring that children's inquiries are tied to "Country" and community responsibilities. "On Country" learning involves children and youth engaging with ancestral narratives, astronomy, and ecological care through songlines, weaving, and ceremonial practices. The outcome was so positive and significant that the program is looking to expand.

Similarly, Smith Gilman (2015) highlighted Indigenous educators' use of Reggio-inspired approaches to foreground storytelling, family engagement, and ecological learning. Documentation is viewed as a pedagogical tool that makes children's thinking visible, supports collaborative interpretation, and guides the emergence of future curriculum (Rinaldi, 2006). For this DiP, access time was limited, so students could not experience the space as authentically as I would have liked. Learning about the implementation of the Reggio pedagogy in other tribal schools demonstrates effectiveness with the support they were given, one of which was adequate time. The rigid scheduling was one challenge we faced when attempting to access the Lake Leschi food forest.

Conceptual Foundations: Culture, IK,

Understanding mainstream and Indigenous educational definitions is important to this Dissertation in Practice because OpenSciEd, and mainstream research can often be found to be extractive if students are researched "on" instead of "with". For this section of the DiP I will establish some definitions from the research that were selected to best fit this work. One challenge within Indigenous education research is that foundational concepts and definitions such as culture and research paradigms and Indigenous Knowledge are often treated as universally understood despite carrying fundamentally different meanings in said research.

Culture

The word culture comes up in many instances of Indigenous research. In this study I employ Banks' (2016) conceptualization of culture as a dynamic and socially constructed framework encompassing shared beliefs, values, traditions, languages, behaviors, symbols, and lived experiences that shape how individuals interpret the world and engage with others. Banks explains that culture is acquired through participation in families and communities and continually evolves in response to historical, political, and social contexts. Research from Banks is used throughout this DiP, so it is logical to use the same definitions as it is expressed in Bank's research.

Banks' (2016) encompassing definition of culture is essential to establish for this DiP because it informs how student experiences were interpreted, and how data was analyzed through an Indigenous lens with students leading discussions and ensuring their culture is being honored. Banks (2016) argues that educators must recognize the cultural backgrounds students bring to the classroom and understand how these experiences shape learning, identity, and participation. This perspective positions culture as a significant factor in creating equitable learning environments and informs the development of culturally responsive teaching practices that acknowledge and value the diverse experiences of all students (Banks, 2016). Next we will describe an Indigenous research paradigm according to Wilson (2008).

Research paradigm According to Wilson (2008)

Similar to how the word culture needs to be explicitly stated, so must a research paradigm be defined. Wilson (2008) conceptualized a research paradigm as a framework that shapes how researchers understand reality, develop knowledge, interpret meaning, and communicate what and how they come to know. A research paradigm encompasses beliefs about reality and the nature of an object (ontology), how knowledge is acquired (epistemology), how knowledge is gathered (methodology), and the ethics and responsibilities that guide the research process (axiology). Within an Indigenous research paradigm, these elements are inseparable and informed by relational accountability, recognizing that knowledge is created through relationships with people, communities, the natural world, and the spiritual world. Consequently, research honors relationships and fulfilling reciprocal responsibilities to those who share their knowledge (Wilson, 2008).

Next I will share how our research supports the claim that Indigenous Knowledge, IK is epistemology, which is the way of doing and being built through cultural experiences such as salmon fishing, weaving and gathering with family and community.

Indigenous Knowledge, IK as an Epistemology

Wilson (2008) explains that Indigenous Knowledge (IK) exists within relationships. Cajete (2000) describes IK as emerging through generations of observation, participation, experimentation, and reciprocal engagement with ecological systems. For example, knowledge about salmon is developed through generations of observing migration patterns, seasonal changes, water quality, spawning cycles, harvesting practices, and the reciprocal responsibilities required to sustain salmon populations.

Closely connected to the concept of culture in education Indigenous Knowledge. IK is frequently misunderstood within mainstream education as information, instead of something that encompasses the entire being of a person. For some students IK is a lifestyle, for other students IK is ceremonial, and for other Indigenous students the colonial influence and mainstream options supersedes tradition and subsequently slowly withdraw generationally from Indigenous practices, ceremonies, and community cultural activities. Historical and ongoing effects of colonization, including assimilation policies and limited access to traditional lands, languages, and cultural practices, have disrupted the intergenerational transmission of Indigenous Knowledge for many families, resulting in varying levels of participation and connection across generations (Cajete, 2015; Kimmerer, 2013; Wilson, 2008)

IK is continually refined as each generation contributes new observations while honoring the experiences and teachings of those who came before. Similarly, knowledge of local plants, medicines, and seasonal indicators is gained by spending time on the land, learning from Elders and community members, and participating in cultural practices that connect people to place. IK is therefore iterative, continuously refined through lived experience and collective responsibility (Cajete, 2000; Wilson, 2008).

Indigenous scholars describe IK as an epistemology of a wholistic way of seeing, knowing, and being. The first viewpoint commodifies knowledge and the other viewpoint lives knowledge. Consequently, IK should not be supplemental curriculum content. I will next discuss how Indigenous students should have access to IK

Access and IK

Access is often interpreted as physical entry into classrooms, curriculum, or educational opportunities. Within Indigenous education, however, access extends far beyond physical presence. Students may have access to science curriculum while simultaneously lacking meaningful access to experiential learning experiences, Lake Leschi’s food forest has numerous Indigenous Knowledge Systems (IKS) created for our CLS students, within their own communities that foster identity, belonging, and cultural continuity (Cajete, 2000; Wilson, 2008). By visiting spaces where IKS can be found, especially Lake Leschi, and Swan Creek, students and families experienced energy transfer as it exists in nature through engagement with places such as Lake Leschi’s food forest and swan creek. These experiences represent ways of knowing that connect scientific understanding with relationships to land, and the mandatory OpenSciEd curriculum (Bang et al., 2014; Kimmerer, 2013).

The importance of culturally meaningful access is well established in educational literature. Research on culturally relevant, culturally responsive, and culturally sustaining pedagogies demonstrates that students learn more effectively when they see their identities, histories, languages, and cultural knowledge reflected and valued within the curriculum (Gay, 201; Ladson-Billings, 1995; Paris & Alim, 2017). This concept of refocusing on IK extends across historically marginalized and minority communities, where students benefit from educational experiences that honor their cultural backgrounds as strengths (Funds of knowledge citation here). When the curriculum reflects students' lived experiences and community knowledge, it supports greater engagement, academic investment, positive identity development, and a stronger sense of belonging (Gay, 2018; Paris & Alim, 2017).

For Indigenous students, access carries an additional dimension because of the enduring effects of settler colonialism, which has disrupted relationships among Indigenous peoples, their lands, languages, lifestyle and knowledge systems (Brayboy, 2005; Tuck & Yang, 2012). Within this context, access is not inclusion within existing educational structures but the opportunity to learn through Indigenous ways of knowing alongside mainstream science. This is consistent with *Etuaptmumk,* Two-Eyed Seeing, (Bartlett et al., 2012) conceptualizes access as students' opportunities to engage with surrounding nature, for example, Lake Leschi, the elementary salmon program, and other place-based learning experiences where Indigenous Knowledge and mainstream science coexist. By expanding access to these outdoor learning environments, students are provided opportunities to strengthen both mainstream scientific understanding and IK while seeing themselves, their communities, and their knowledge reflected within their science education.

Bang et al. (2014) found that community-designed, land-based science education supported outcomes that extended beyond students' acquisition of scientific content. By involving elders, teachers, families, and other community members in the design of learning experiences, the research project created space for educational self-determination and for IK to guide both curriculum and instruction through experiential learning.

Bang et al. (2014) centered on learning relationships within Chicago's wetlands, ancestral village sites, medicinal and edible plants, and the effects of ecological change, allowing students to understand science through relationships among land, water, history, community, and identity. For example, the curriculum reframed the mainstream scientific term "invasive species" as "plants that people lost their relationships with," shifting students' attention from classification and control toward migration, colonialism, responsibility, and relationality. Teachers also shifted their planning from indoor meetings to neighborhood walks and wetlands, developing a pedagogical vision in which the“land was our teacher” and students were coached and supported in building respectful relationships with the land. These practices helped participants recognize the historical restructuring of Chicago’s wetlands, observe the reemergence of plants and water in restored spaces, and understand land as alive and instructive.

As a result, the authors, Bang et al. (2014) reported meaningful effects on learning, agency, and resilience among urban Indigenous youth and families and described the project as strengthening Indigenous identity, survival, sovereignty, and relationships with place. These findings demonstrate that culturally focused and community-based methods can produce both academic and relational outcomes by helping Indigenous students see their identities, communities, and knowledge systems represented as central to science learning. The pedagogy and findings of Bang et al. (2014) is an example I wanted to emulate with our students’ time at Lake Leshi.

Connection to the Research Question

The literature reviewed in chapter two establishes an understanding that meaningful science learning for Indigenous students is strengthened when the mainstream curriculum (OpenSciEd) allows for centering relational, place-based, culturally responsive, focusing on in-place experiences with land and community. The operational definitions presented in this study provide a shared understanding of the key concepts that guided the design, implementation, and analysis of this research. These definitions served as the conceptual bridge between the literature review and the methodological choices described in the next chapter, ensuring alignment between the research questions, theoretical frameworks, methodologies and findings. A complete list of operational definitions and the supporting research literature is provided in Appendix B.

Chapter 3: Methodologies

This Dissertation in Practice employed a qualitative case study methodology to examine the supports and challenges of facilitating an OpenSciEd fourth-grade unit on energy at Chief Leschi Schools. A qualitative case study was selected because it provides an in-depth examination of a contemporary educational phenomenon within its real-world context, allowing the researcher to investigate the complexity of teaching and learning as they naturally occur (Creswell & Poth, 2018; Merriam & Tisdell, 2016; Stake, 1995). A qualitative case study aims to develop a rich, contextualized understanding of a bounded scope by examining multiple forms of evidence within the environment in which the phenomenon naturally occurs (Stake, 1995; Merriam & Tisdell, 2016). Qualitative inquiry seeks to understand the meanings participants construct from their experiences while recognizing the influence of context, relationships, culture, history, and environment on human understanding (Creswell & Poth, 2018; Maxwell, 2013; Patton, 2015).

Creswell and Poth (2018) explain that qualitative research is grounded in an interpretive framework in which researchers seek to understand how individuals make sense of their lived experiences within specific social, cultural, and historical settings. Similarly, Merriam and Tisdell (2016) describe qualitative inquiry as an approach that emphasizes understanding how people interpret their experiences and construct meaning within natural settings, while Denzin and Lincoln (2018) characterize qualitative research as an interpretive, naturalistic approach that seeks to understand the meanings people assign to their experiences through multiple forms of evidence. Collectively, these scholars recognize that qualitative inquiry values the complexity of human experience, acknowledges that multiple realities exist simultaneously, and positions the researcher as the primary instrument for collecting and interpreting data while engaging reflexively with participants and the research setting (Cajete, 2015; Creswell & Poth, 2018; Denzin & Lincoln, 2018; Merriam & Tisdell, 2016).

This orientation aligned with my dual role as the classroom teacher and researcher, allowing me to document instructional decisions, classroom interactions, observations, and evolving understandings that emerged throughout the implementation of the OpenSciEd energy unit.

According to Creswell and Poth (2018), case study research is particularly appropriate when researchers seek an in-depth understanding of a bounded scope through multiple sources of information. Stake (1995) argues similarly that case study research seeks to understand the uniqueness and complexity of a particular case within its real-life context. Patton (2015) emphasizes that qualitative inquiry relies on detailed naturalistic data to understand phenomena as they unfold in authentic settings. These sources may include observations, discussions, field notes, participant-produced materials, photographs, videos, documents, and other forms of evidence that together provide a comprehensive description of the case study (Creswell & Poth, 2018; Patton, 2015). Accordingly, this study employed scientist-story circles, reflective field notes, photographs, videos, student illustrations, notice-and-wonder charts, consensus models, and ongoing reflections to understand how instructional supports and challenges influenced students' engagement with scientific inquiry.

The scope of this qualitative case study was bound to one fourth-grade classroom at Chief Leschi Schools during the implementation of the OpenSciEd fourth-grade energy unit which

took place throughout the year. This included access to learning environments where students observed natural forms of energy transfer. The study centered on how students experienced scientific inquiry through classroom investigations, repeated visits to Lake Leschi, participation in the elementary salmon program, and opportunities to connect scientific concepts with place-based learning. Examining this bounded qualitative case allowed for a detailed understanding of the interactions among curriculum, pedagogy, place, relationships, and culture that shaped students' learning experiences (Stake, 1995; Creswell & Poth, 2018).
Consistent with the constructivist perspectives described by Creswell and Poth (2018), Merriam and Tisdell (2016), and Maxwell (2013), this study recognized that knowledge is socially constructed through interactions among individuals, communities, and environments.

Aligning coincidentally with Cajete's work (2015, 2000), Maxwell (2013) further explains that qualitative research seeks to understand students' meanings, actions, and experiences within the contexts in which they naturally occur. Students were therefore viewed as active researchers in meaning-making. Our students' questions, observations, drawings, and scientist-story circles are valuable forms of evidence that contributed to understanding how scientific knowledge developed throughout the study.

While the qualitative case study served as the overarching methodological framework, the study was informed by several complementary methodological orientations that aligned with the research question and the educational context at Chief Leschi Schools. These included *Etuaptmumk*, Two-Eyed Seeing, Emergent Strategy, the Reggio Emilia approach, and experiential learning. These perspectives provided complementary lenses for understanding how knowledge develops through relationships, observation, participation, reflection, and experiences with people, place, and community. Together, these methodological orientations supported a wholistic examination of the supports and challenges of facilitating an OpenSciEd unit on energy.

The four complementary pedagogical methodologies in this DiP are : *Etuaptmumk,* Two-Eyed Seeing, emergent theory, experiential learning, and the Reggio Emilia Approach. Together, these pedagogical methodologies recognize in theory and practice that knowledge develops through relationships, lived experience, participation, and reflection within a particular environmental context of comparing the natural systems of energy transfer and manmade systems. *Etuaptmumk,* Two-Eyed Seeing brings together the strengths of Indigenous and Mainstream knowledge systems without privileging one over the other, allowing multiple ways of knowing to inform scientific inquiry (Bartlett et al., 2012). Emergent theory acknowledges that understanding develops through observation, interaction, reflection, and responsiveness to participants and place instead of rigid predetermined outcomes (Brown, 2009).

Experiential learning emphasizes that knowledge is created through concrete experiences followed by reflection, conceptualization, and application (Kolb & Kolb, 2018; Zull, 2002, 2011). The Reggio Emilia approach complements experiential learning by positioning children as capable researchers whose learning becomes visible through documentation, dialogue, and multiple forms of expression (Edwards et al.; 2012). Collectively, these methodologies supported the qualitative research design by positioning the teacher as an active participant in the learning and teaching community, recognizing students as co-researchers whose experiences shaped both instruction and the research process.

Emergent Theory

Emergent theory acknowledges that understanding develops through observation, interaction, reflection, and responsiveness to participants and place (Brown, 2009). How we chose to document our time in our outdoor spaces emerged from a scientist-story circle where the students picked how we were going to collect observational data. Our use of scientist-story circles positioned the students and I as equals in evaluating our research findings together which allowed for responsiveness in adapting our investigations. Some students wanted to draw, some wanted to take notes, others wanted cameras to take photos. During our field studies at Lake Leschi and Swan Creek, students were encouraged to observe, question, wonder, and identify patterns of energy transfer within natural and human-made systems. Dewey (1938) argues that education begins with meaningful experience, while Kolb and Kolb (2018) takes it a step further, claiming that observation and reflection are central components of experiential learning. Cajete (1999, 2000) also describes observation as a foundational Indigenous learning process through which knowledge is acquired. The Indigenous perspectives understand that observation in field study is an active process that utilizes the five teachers we carry with us all the time: sound, taste, touch, sight, and smell.

Throughout the implementation of the OpenSciEd energy unit, students conducted in person observations in the classroom, around the school campus, and at Lake Leschi. They observed energy transfer, biodiversity, weather conditions, salmon habitats, and human interactions with natural systems. These data from these experiences documented the emergence of interest in specific questions the students had. As the co-researcher, I engaged in observation with our students listening to their insights by documenting student conversations, behaviors, collaboration, instructional adaptations, and emerging understanding, adding to our body of qualitative evidence of student learning. Data that emerged from our field studies allowed us to capture the complexity of classroom interactions while remaining actively engaged in the learning process.

***Etuaptmumk,* Two-Eye Seeing**

Etuaptmumk, Two-Eyed Seeing, provided philosophical lenses through which research was conducted with the students of my fourth-grade class at CLS. Originally articulated by Mi'kmaw Elder Albert Marshall, *Etuaptmumk,* Two-Eyed Seeing encourages individuals to learn to see with one eye the strengths of Indigenous ways of knowing and with the other the strengths of mainstream knowledge systems, bringing both together for the benefit of all (Bartlett et al., 2012), *Etuaptmumk*, Two-Eye Seeing recognizes that each offers unique contributions to understanding complex phenomena.

Within this DiP, students investigated scientific concepts presented through OpenSciEd while simultaneously exploring Indigenous understandings of energy through relationships with salmon, cedar, water, plants, and the ecosystems surrounding Lake Leschi, hence utilizing *Etuaptmumk*, Two-Eye Seeing . Students examined energy transfer not only as a scientific process described through NGSS performance standards but also as a living relationship observed through seasonal cycles, ecological stewardship, and reciprocal responsibilities to the land. These opportunities allowed students to connect classroom science circles with our learning journeys, lived experiences and cultural knowledge, demonstrating that scientific understanding can be strengthened when multiple knowledge systems are valued equally (Bang & Medin, 2010; Cajete, 2015,2000; Kimmerer, 2013).

Qualitative research aligns naturally with *Etuaptmumk*, Two-Eyed Seeing because both methodologies emphasize relationships, context, and learning through participation. Instead of positioning Indigenous Knowledge as supplemental or informational to mainstream science, this methodological approach recognized both as legitimate systems for investigating natural phenomena. My role as teacher-researcher required continual reflection on how instructional decisions either expanded or limited students' opportunities to engage with both perspectives. This reflexive process became an important component of this qualitative analysis and supported the development of culturally responsive science instruction with our fourth-grade students.

Experiential Learning

Experiential learning recognizes that meaningful understanding develops through direct engagement with experiences followed by reflection, conceptualization, and application (Kolb & Kolb, 2018). Zull (2002, 2011) further explains that learning changes the brain most effectively when individuals actively engage with meaningful experiences that require reflection and adaptation. These experiences closely align with qualitative research because both emphasize participation in contexts instead of studying learning in isolation.

Throughout this DiP, students learned about energy by interacting directly with the environments they were studying. Instead of limiting investigations to classroom simulations, students explored energy transfer by observing flowing water, the sunlight-plant relationship, wind, decomposers of natural systems such as nursing logs, salmon habitats, food webs, and other ecological relationships at the Lake Leschi food forest. Students generated questions from these experiences before returning to the classroom to test explanations using OpenSciEd investigations.This movement between classroom inquiry and field experiences created multiple opportunities for students to refine their scientific thinking while grounding abstract concepts in familiar places.

Experiential learning also strengthened the qualitative case study research approach because I participated as both a teacher and researcher, alongside students throughout our investigations. Shared experiences created opportunities for reciprocal dialogue, collaborative meaning making, and ongoing reflection that would not have emerged through observation alone. These interactions became valuable data documenting how students constructed scientific understanding through experience, conversation, and reflection.

The Reggio Approach

If experiential learning were a supermarket, the Reggio Emilia Approach would be the specialized artisanal shop filled with imagery of learning in action. While experiential learning provides the broad theoretical foundation that knowledge is constructed through direct experience, reflection, and application (Kolb & Kolb, 2018; Zull, 2002, 2011), the Reggio Emilia Approach offers an intentional framework for making that learning visible. Reggio educators view children as competent, capable, and naturally curious researchers whose ideas are worthy of careful documentation and study (Edwards et al., 2012). Learning is expressed through the "hundred languages of children," including drawing, photography, writing, scientist-story circles and artistic expression.

The Reggio Emilia approach aligned with student choice of modalities of expressing knowledge, documentation in the form of a wholistic capture of the experience, the students' work, and their thoughts. Reggio Emilia still remains a European educational philosophy arising from a particular Italian social, political, and cultural history, not as relational as Indigenous methodologies. Its similarities to Indigenous methodologies do not make it Indigenous.

Within this DiP, the Reggio Emilia approach complemented the qualitative research approach by emphasizing documentation as both a pedagogical practice and a research method. Students selected from multiple ways to document and display their observations during field investigations at Lake Leschi and throughout the OpenSciEd energy unit, including photography, scientific illustrations, written field notes, Notice and Wonder charts, and scientist-story circles. These varied forms of documentation made students' thinking visible while honoring individual strengths and preferred ways of communicating scientific understanding. Documentation became evidence of how students were centered and were able to construct meaning through their relationships with place, one another, and the natural world.

The Reggio concept of the environment as the "third teacher" aligned closely with the qualitative research design of this study. Lake Leschi, the elementary salmon program, the school grounds, and the classroom itself were not simply locations for instruction but active participants in the learning process. These environments continually invited curiosity, observation, and dialogue, allowing students to revisit ideas, ask new questions, and widen their understanding of energy transfer through repeated interactions with phenomena. The Reggio emphasis on the students' visible learning, student agency, and documentation strengthened the qualitative research by capturing their understanding of natural and manmade energy transfer emerged over time through lived experience and relationships (Cajete, 2000; Edwards et al.; 2012, Kimmerer, 2013). The Reggio approach does not treat Indigenous knowledge as a universal pedagogical category, therefore not the primary methodology employed in this study. The Reggio influence can be seen in our student displays for their parents, twice a year for family conferences. CLS is a closed campus school so parents have limited access to view in person the displays outside our classrooms and the format of the displays puts the parent within the experience with a combination of photos, student quotes, and student work that represents what their child has learned.

Design of the Study

This Dissertation in Practice employed a qualitative case study research design informed by practitioner inquiry, Indigenous methodologies, relational accountability, and place-based education. A qualitative case study was selected because the purpose of this study was to examine the supports and challenges associated with facilitating the OpenSciEd fourth-grade energy unit at Chief Leschi Schools while intentionally expanding students' access to Lake Leschi and the elementary salmon program. This Dissertation in Practice (DiP) is a qualitative, bounded case study, conducted in one fourth-grade classroom at Chief Leschi Schools (CLS) engaged in implementing a single OpenSciEd instructional unit within an educational setting, with in place learning experiences that allowed for access to the Lake Leschi Food Forest and the Elementary Salmon Program. A qualitative case study was appropriate because it allows researchers to investigate a contemporary educational phenomenon within its real-world context while drawing upon multiple sources of evidence to develop an understanding of the case (Creswell & Poth, 2018; Merriam & Tisdell, 2016; Yin, 2018).

Qualitative inquiry also seeks to understand how participants construct meaning from their experiences while recognizing that learning is shaped by social, cultural, historical, and environmental contexts (Cajete, 2015, 2000; Creswell & Poth, 2018; Merriam & Tisdell, 2016). Within this study, our fourth grade classroom, Lake Leschi, and the elementary salmon program functioned as interconnected learning environments where students investigated energy transfer through classroom instruction, outdoor experiences, and the prescribed OpenSciEd curriculum.

As both the classroom teacher and researcher, I served as the primary instrument for data collection and interpretation. Throughout the implementation of the unit, I documented instructional decisions, lesson adaptations, classroom observations, reflective field notes, student conversations, and instructional responses as they naturally occurred. Consistent with practitioner inquiry, the study positioned classroom practice as a site of scholarly knowledge generation, allowing instructional decisions to evolve in response to students' questions, observations, and emerging understandings while remaining focused on the research question (Brown, 2017).

Checks and balances included systematic documentation, triangulation across multiple data sources, and consistent alignment of instructional decisions with the research question. These practices strengthened credibility by ensuring that emerging interpretations were supported by documented student evidence rather than relying solely on my perspective as the teacher-researcher (Creswell & Poth, 2018; Merriam & Tisdell, 2016).

The design was further informed by research methodologies, which understand knowledge as relational and emphasize accountability to people, place, and community (Absolon, 2022; Kovach, 2009; Smith, 1999; Wilson, 2008). Students were recognized as researchers and active contributors to knowledge generation instead of passive participants. Students documented their learning through written notes, drawings, photographs, consensus models, and scientist-story circles. This provided multiple opportunities for students to communicate their thinking, honored diverse ways of knowing, and acknowledged that scientific understanding can be expressed through oral, written, artistic, and collaborative forms of representation. Within this study, Reggio Emilia was therefore used as a pedagogical influence rather than as an Indigenous methodological framework. Two-Eyed Seeing provided a way to place approaches in respectful conversation without collapsing their epistemological differences. Bartlett et al. (2012). This orientation situated commonalities among Reggio Emilia, experiential learning, and Indigenous relational methodologies, recognized while maintaining their distinct intellectual and cultural origins (Bartlett et al., 2012; Wilson, 2008).

Data Analysis and Coding Process

Data analysis occurred concurrently with data collection and followed an iterative process of inductive thematic analysis within a qualitative case study design (Braun & Clarke, 2022; Creswell & Poth, 2018; Merriam & Tisdell, 2016). Evidence was collected as students engaged in classroom and outdoor investigations. Repeated experiences with the OpenSciEd Curriculum, time at the Lake Leschi Food Forest, and participation in the elementary salmon program allowed for more student data in different modalities that demonstrated emerging understandings over time while remaining focused on the research question examining the supports and challenges of implementing the OpenSciEd fourth-grade energy unit.

Organizing the Data

Following each lesson and field investigation, data were organized first by context and location. Sources of evidence included photographs, illustrations, notice and wonder charts, videos, field notes, and scientist-story circle discussions; each source used in this study was dated, labeled, and organized chronologically to preserve the context in which it was collected, which followed the timeline in Appendix: F. The student data with its' first round of coding located in Appendix:A, with the related assigning of themes in Appendix: B. Maintaining organized files supported transparency throughout the analytic process and strengthened the study's dependability (Yin, 2018). For example, for our scientist-story circle to take place, student data collected after our trips to the Lake Leschi Food Forest was readily available from the previous day for class review using a chronological and location organizational system. The organizational system started from location, chronologically into first round coding in Appendix: A, to themes Appendix: B, to Appendix: C and F, which is the "collected evidence" and "Timeline" in respective order.

Familiarization with the Data

The first stage of analysis involved repeated engagement with the complete dataset. Field notes were reread, photographs and videos were reviewed, and student work was examined multiple times. During this process, my notes documented initial observations, emerging questions, recurring events, and noteworthy interactions among students, teachers, and the learning environment. This stage allowed patterns to emerge naturally while encouraging reflexivity regarding my dual role as teacher and researcher (Creswell & Poth, 2018).

First-Cycle Coding

The first cycle of coding remained intentionally close to the data. Using descriptive coding, meaningful words, phrases, actions, and interactions were assigned concise labels that represented what participants were doing, saying, creating, or demonstrating (Saldaña, 2021). Codes were developed inductively, allowing students' experiences to guide the analysis. Examples of first-cycle codes can be found in Appendix A: First Cycle Code Family and Pattern

Codes Code Family. These descriptive codes remained closely connected to participants' language and classroom experiences while avoiding premature interpretation.

Living with the Evidence

As coding progressed, each new piece of evidence was continuously compared with previously coded data. Similar observations, student responses, and artifacts were examined across multiple lessons, classroom discussions, and outdoor investigations to determine whether they represented recurring patterns or unique events. This constant comparative process refined the consistency of coding while identifying similarities and differences across participants and settings (Merriam & Tisdell, 2016).

Development of Pattern Codes

Following first-cycle coding, related descriptive codes were synthesized into broader pattern codes that captured recurring concepts across the dataset (Saldaña, 2021). Pattern coding reduced numerous descriptive codes into meaningful analytical categories that explained how learning occurred throughout the case. Pattern codes are located in Appendix A: First Cycle Code Family and Pattern Codes Code Family. These categories represented recurring patterns observed across multiple forms of evidence.

Triangulation

Each developing pattern was examined across multiple sources of evidence before being interpreted as a finding. Observations recorded during classroom instruction and outdoor investigations were compared with student photographs, videos, scientist-story circles, consensus models, written reflections, and researcher field notes. Patterns were considered credible only when supported by several independent sources of evidence (Creswell & Poth, 2018; Merriam & Tisdell, 2016). Triangulation strengthened the credibility of the analysis by demonstrating that findings were consistently represented across diverse forms of documentation.

Theme Development

Pattern codes were compared and refined through repeated review of the complete dataset. Relationships among the categories were examined to determine how they collectively addressed the study's research questions. Through this iterative process, four interconnected themes emerged inductively from the evidence:

1. Building a Relational Learning Community
2. Access to Place-Based Learning
3. Multiple Ways of Knowing and Demonstrating Learning
4. Developing Scientific Identities

Each theme represented a recurring pattern of meaning supported by multiple data sources (Braun & Clarke, 2022). You can find the pattern codes that led to the finding's themes in Appendix B: Crosswalk of Pattern Codes and Themes

Interpretation

The final stage of analysis involved interpreting the themes through the study's conceptual and methodological frameworks. Findings were considered through the lenses of relational accountability (Wilson, 2008), *Etuaptmumk,* Two-Eyed Seeing (Bartlett et al., 2012), Indigenous methodologies (Absolon, 2022; Kovach, 2009), place-based education (Cajete, 2015; Gruenewald, 2003), experiential learning (Kolb & Kolb, 2018), and the Reggio Emilia approach

(Edwards et al., 2012; Rinaldi, 2006). These frameworks informed interpretation without predetermining the findings, ensuring that themes remained grounded in participants' experiences while being understood within broader educational and cultural contexts.

Ensuring Trustworthiness

Several strategies enhanced the trustworthiness of the analysis. Data were collected from multiple sources over time, allowing for prolonged engagement within the research setting. Triangulation across observations, student work, visual documentation, and classroom discourse strengthened credibility. During our Scientist-Story circles, our students confirmed our findings. For example, the day after our first field trip to the Lake Leschi Food Forest, our class had a scientist-story circle where we viewed photos and students' work. Each student presented one thing that came from the visit. For some students it was explaining a photo with other students confirming they saw something similar, for others it was sharing their notice and wonder chart. Our Scientist-story circles were a method for confirming as a class what was important for this DiP to demonstrate that they learned from their experiences. Finally, maintaining a reflexive journal supported awareness of my positionality as both classroom teacher and researcher, helping ensure that interpretations remained grounded in the evidence while honoring relational accountability and the lived experiences of participants.

To make my thought process as transparent as possible. First-cycle codes were developed inductively from experiences, participant observations, field notes, student work, photographs, videos, scientist-story circles, and classroom documentation. Related descriptive codes were synthesized into pattern codes using constant comparison (Merriam & Tisdell, 2016; Saldaña, 2021). Pattern codes were then organized into four themes through inductive thematic analysis (Braun & Clarke, 2022). For more details on First-cycle codes please see Appendix: A

Chapter Four: Findings

The preceding chapters established the theoretical, methodological, and contextual foundations for this Dissertation in Practice. For this DiP, the fourth-grade students and I used an overarching qualitative case study research methodology that positioned our class as researchers working in collaboration. Complementary methodologies and frameworks for understanding science learning in Indigenous educational settings were selected to support the overarching research methodology. The literature review examined Indigenous access to Indigenous Knowledge Systems (IKS), place-based education, experiential learning, and methodologies such as *Etuaptmumk*, Two-Eyed Seeing, and Reggio Emilia. The methodology chapter described the Qualitative case study and Indigenous research methodologies used to investigate the supports and challenges of implementing an adapted OpenSciEd fourth-grade energy unit at Chief Leschi Schools centering access to outdoor learning spaces for students to observe and understand natural systems of energy transfer, while learning about man made systems of energy transfer presented in the OpenSciEd curriculum, emphasizing relational accountability, participant observation, and collaborative meaning making (Absolon, 2022; Creswell & Poth, 2018; Kovach, 2009; Wilson, 2008).

As the classroom teacher-researcher, I participated alongside our students throughout the implementation of the OpenSciEd energy unit. I became part of a collaborative student learning community in which instruction, inquiry, and documentation evolved in response to students' questions, observations, lived experiences, and relationships with one another and the land

(Absolon, 2022; Bang & Vossoughi, 2016; Rinaldi, 2006; Wilson, 2008). Through observation, journaling, photographs, scientist-story circles, notice-and-wonder charts, concept and consensus models, the findings emerged through our shared experiences as we investigated energy transfer in both natural and human-made systems (Braun & Clarke, 2022, Dewey, 1938; Edwards et al., 2012).

This chapter addresses the central research question: What are the supports and challenges of facilitating an OpenSciEd fourth-grade unit on energy at Chief Leschi Schools? Using the overarching qualitative research design of the DiP, and allowing for additional Indigenous methodologies and employing collaborative inductive thematic analysis, patterns emerged across student selected representations of learning (Braun & Clarke, 2022; Creswell & Poth, 201). Themes were interpreted during scientist-story circles with students centered in relationships, place, and shared experiences. (Archibald, 2008; Bartlett et al., 2012; Wilson, 2008).

Four interconnected themes emerged from the data. The first theme, “Building a Relational Learning Community”, examines how classroom relationships, scientist-story circles, negotiated expectations, and student agency established the conditions necessary for meaningful scientific inquiry. This theme demonstrates that trust, reciprocity, and shared responsibility formed the foundation for learning as students engaged with scientific concepts (Caxaj, 2015; Kirkness & Barnhardt, 1991; Wilson, 2008).

The second theme, “Access to Place-Based Learning”, explores how regular access to Lake Leschi, the food forest, and the elementary salmon program supported students' scientific inquiry while also revealing logistical, structural, and institutional barriers to implementing outdoor learning. These findings illustrate that meaningful access involves more than physical presence, it requires sustained relationships with place, and opportunities for repeated engagement, (Bang et al.; 2018; Brayboy & Castagno, 2008; Cajete, 2015; Gruenewald, 2003; Simpson, 2014).

The third theme, “Multiple Ways of Knowing and Demonstrating Learning”, examines how students documented and communicated their thinking through photography, illustration, scientific discussion, notice-and-wonder charts, concept maps, consensus models, scientist-story circles, and other student-selected representations of learning. This theme highlights Indigenous, experiential, and Reggio Emilia approaches that recognize learning is multimodal, relational, and socially constructed (Edwards et al., 2012; Kolb & Kolb, 2018; Rinaldi, 2006).

The fourth and final theme, “Developing Scientific Identities” as researchers and scholars, examines how students increasingly viewed themselves as scientists, researchers, and scholars contributing to a positive self-identity and creating and contributing to knowledge creation. As students took on greater responsibility in the classroom and outside they took on greater responsibility in their learning. Students demonstrated growing confidence in their ability to ask questions, construct explanations, organize data over time, and contribute meaningfully to scientific inquiry. These findings support research suggesting that scientific identity develops through participation, collaboration, and relationships with meaningful phenomena (Bang & Medin, 2010; Cajete, 2015; Erickson, 1986; Kolb & Kolb, 2018).

The findings that follow illustrate how these interconnected elements influenced both the implementation of the curriculum and students' engagement with scientific inquiry. I will next describe the organization of the findings.

Organization of the Findings

To provide a clear and coherent presentation of the findings, each of the four themes is organized using the same structure. This organization maintains alignment with the study's research question, qualitative research practices and, and complementary methodologies that, when used together, provide a wholistic research experience for our fourth-grade scholars, while allowing for each theme to be examined systematically.

The first section, “vinette”, introduces each theme in a snapshot story and summarizes the recurring pattern that emerged from the data during implementation of the OpenSciEd fourth-grade energy unit. Followed by “Analysis of the vignette and Evidence from the Data, presents examples drawn from participant observations, reflective field notes, photographs, videos, student illustrations, notice-and-wonder charts, consensus models, scientist-story circles and student work products that demonstrate how the theme emerged across multiple sources of evidence (Emerson et al., 2011; Pink, 2021; Merriam & Tisdell, 2016).

The fourth section, “Connection to the Literature and Research Question”, situates each finding within the literature review presented in Chapter Two and explains how the theme contributes to answering the study's research question: What are the supports and challenges of facilitating an OpenSciEd fourth-grade unit on energy at Chief Leschi Schools? This consistent organizational structure demonstrates alignment among the literature review, methodology, findings, and implications, providing a coherent structure for understanding how the data collected informs both educational practice and future research. The fifth section of each theme is the future implications which will also be summarized in the conclusion. We will now discuss theme one, building a relational learning committee.

Theme One: Building a Relational Learning Community

Description of the Finding

During breakfast, I made my rounds of greeting students and started with a very simple question that sounded exactly like this "Where does energy come from? You don't have to answer it now and I just want to know what you think, not what is right or wrong, so I don't want you to stress, just keep it in the workshop in the back of your mind and when you're bored, think about it. We are going to have a really interesting discussion on it later." I wanted our students to remember the initial question of where energy came from throughout the day so that they can ponder and observe with a purpose for their day, also so that when we make the transition to our circle that had yet to be named the "scientist-story circle", students would not be surprised at our discussion.

I frontloaded with students that were part of my studies at UWT/MTC. I was happy to see that they were all excited about this too. That afternoon when we all sat down we started with the student on the right. I began with the big question that hopefully our students had been thinking about throughout the day. I began our scientist circle with a very simple question "Where does energy come from?" George said "electricity", to which Kevin said "That's the same thing!", to which Justice said "You are both wrong!". There was no organization to this banter at the beginning, but I wanted the students to problem solve how we could have this type of interaction without confusion, so the students, with me facilitating, established what respectful contributions would look like in our classroom and in our circle. We all agreed that we needed to take turns and listen to what the previous person said. The format went something like this: Student A would say something, then Student B would repeat what Student A said before their contribution.

Students caught on fast and I exclaimed “This is fantastic! Listen to yourselves! You are talking so much better than scientists I have heard communicate.” We then discussed how they perceived “scientists” and “scholars”. The imagery conveyed from the students' were misconceptions and stereotypes that the students saw in movies and cartoons. For scientists, the students’ described a trope of a man with white hair, disorganized, but really a genius, making medicines in laboratories. When I asked about Marine Biologists as scientists because that conflicted with their conception. Our students had to re-evaluate what they thought.

The connection to our daily question “Where does energy come from?” had us collectively re-establishing our students as researchers and scholars. George is a brilliant student who is very inquisitive and makes sense of things for himself. George comes from a basketball family and everything has to get done for basketball to happen, so George is very disciplined in character. George also enjoys playing Call of Duty (Infinity Ward, 2003) along with many of the students in the class. The perception of who and what scientists and researchers are and what they do is important because George wants to be famous and rich and he knows that basketball is his ticket, which may very well be the case. During breakfast the morning after our first circle, George asked “Can scientists be famous like basketball players?” To which I replied “If you cured cancer which would matter more, helping the people you love or being famous?” George then told me all of the scientists he had been watching on TikTok who were cool because they blow stuff up. I asked, “What does good science look like?” And George said, “you know the scientists blowing up stuff”. To which I replied, “Is that science or spectacle? Or both?”

The following day we discussed more about “Where does energy come from?” to get a baseline of what the students knew already. When I asked “Where does energy come from?” I started taking notes. Kevin said “Aliens!” with his friend Clair that watches Ancient Aliens as well and texts about it back and forth, outside of school. Kim suggested that the sun is plugged in and the police turn it on and off. This was serendipitous because after three or four ridiculous answers, which included the Spider-man multiverse sending us energy from another dimension, I was encouraging it to get thoughts out. Just writing this brings a giant grin to my face because this was the beginning of how our class got organized and focused. I knew enough about the students in our classroom and that they had the problem solving skills to time manage, but I let them run amuck until Justice, my go to helper, demanded all of us to take this seriously, and follow the protocol we agreed to the previous day. Later on Justice and several students used their tech time to come up with a student checklist for our scientist-story circles. .

By the third day of school we had routines down and planned for our introductory lesson "Is it alive or is it dead?" The third day we had a running list on butcher paper "things that were alive and things that were dead." Students took turns adding to this list by coming up to the main computer and "inputting the data." This was all inclusive and students helped each other come up with ideas in pairs at first, then small groups, then the whole class.

Consistent with a wholistic approach (Absolon, 2022; Deloria & Wildcat, 2001; Merriam & Tisdell), learning is validated through reciprocal dialogue, which began on the first day with with my first question posed to our students from the OpenSciEd curriculum. "Where does energy come from?" In the context of this DiP we are using methods of reciprocal dialogue and rename the term "scientist-story circles" so it doesn't alienate the participants and observers. Academic Language disengages people so effectively that I've seen people "in the academic world" use it as a form of intellectual superiority, which it is not, to crush the self-esteem of some of the most intelligent people I have met. Academic language can create a barrier for participation because it represents an unknown term, so we created one that was understood by our students and kept the space open and flexible,so every student can participate. As a class we found out that a story can encompass a lot of science that people in the mainstream viewpoint might not consider science.

For our first scientist circle our students got lost in their imaginative explanations and my designated “co-teacher” named Justice became frustrated and called the other students out for not taking the lesson seriously enough. I explained to the class what reciprocal dialogue was in theory and got blank stares. We then decided as a class to rename our “ reciprocal dialogue” time, which was an academic term our students did not want to use, so came the inception of the “Scientist-story circles”, a term that came out of our collaborative classroom discussions, because it makes it easier to explain to ourselves and their families.

For the purpose of this DiP it was critical that the language used in the classroom was relatable to our students and families. I’m fifty-two this year so I had to re-evaluate my language. For example, “rad” is not a term our students know, and “bitchin” as in the cool meaning, is totally inappropriate for the classroom and this day and age. So I “leveled up”, “Stood on business” and tapped into the infamous “67” mid sentence or during a lesson on the “down low” to see who was listening. Using appropriate student language made me more relatable to our students as a teacher.

As researchers our class was focused on centering Indigenous identities in learning, forming meaningful relationships to land. Place based experiential learning such as weaving in the classroom as a free choice activity was allowed after the student completed their worksheets. Our rich classroom environment and discussions in our scientist-story circles provided opportunities for students to co-construct meaning, reflect on their observations, and express their ideas with other students the same age, subsequently increasing confidence in others and themselves. Students were incredibly gracious giving time for each student to highlight their forms of evidence and their rationelle for selecting that particular medium.

Students also followed protocols we agreed to as a class at the start of the year that provided parameters for respectful dialogue that was a great support to our collective learning. Students modeled each other to respond to the other students' ideas and story before sharing , then choosing to build upon or disagreeing respectfully. This format prevents some students from throwing off the collaborative nature of the activity with random things that did not relate. Several of our students watched Ancient Aliens and conspiracy theories and random Schrodinger's box scenarios that they saw on social media reels that distract from the purpose of the DiP, tangents emerged through conversations, and had to be redirected to the common theme of energy transfer. Once reminded they could geek out with knowledge from social media with their friends some other time, our students would refocus on the central themes we had committed to as a group.

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Building a relational learning community emerged as one of the primary supports for implementing the OpenSciEd fourth-grade energy unit at Chief Leschi Schools. Before students investigated energy transfer, they first established relationships with one another, with me as the teacher, all of us as researchers, and with the learning environments inside and outside of the classroom. These relationships developed through daily classroom circles, collaborative projects that brought us together, such as designing and creating a classroom corn maze, a classroom haunted house, repeated experiences at Lake Leschi and through the elementary salmon program. Every time we returned from an excursion, or completed a task, we felt an extreme sense of accomplishment.

Funds of knowledge are the historically accumulated and culturally developed bodies of knowledge, skills, practices, and ways of understanding that individuals and families develop through their everyday experiences, work, community participation, and cultural traditions (González et al., 2005). Our students contributed their funds of knowledge by making connections between walking outside and time with their relative tribal experiences, such as gathering and fishing for salmon. Students during our science time sat together and learned collectively as a whole, from each other in smaller groups and as pairs. Our Scientist-Story circles also allowed for practices such as “think-pair-share”, which is an important practice because it allows for every students’ voice to be heard.

Almost every afternoon, before we lined up for buses, we conducted a short scientist-story circle to review “Where does energy come from?” and later on “How does energy transfer?” to build upon connections they made throughout the day. For example one student contributed to the scientist-story circle that manmade energy transfers that take place in the school cafeteria to prepare food for a natural system, our bodies. Scientist-story circles were short, to the point, and often helpful in managing classroom behaviors because they allowed for change, movement and collaboration in reviewing students' evidence and creating meaning from it.

Together as a class, we created an environment in which students were comfortable sharing ideas, respectfully disagreeing, building on one another's thinking, and revising explanations as new evidence emerged. Students frequently referenced observations made during previous investigations, experiences from home, seasonal changes, and knowledge shared by classmates, demonstrating that learning developed through relationships. The original question “Where does energy come from”, then evolved to naming sources of energy in natural systems and man-made. This progression towards understanding was relational. For example, we theorized that the sun was the source of all energy. Once we established that as reality, we could introduce scientific phenomena that support that theory such as gravity and how Earth orbits the Sun and the Moon orbits the Earth, and the Moon's gravity holds enough energy to move the ocean in tides, and how the movement of the oceans and tide impacts the Earth's surface over time.

As the school year progressed, collaboration became increasingly student directed. Students naturally sought partners during investigations, shared responsibilities during investigations and negotiated explanations while constructing concept and consensus models. Classroom discussions reflected collective meaning making. This relational environment served as the foundation for scientific inquiry throughout the OpenSciEd energy unit on energy.

Evidence from the Data

Evidence supporting Building a Relational Learning Community emerged consistently across multiple forms of documentation collected throughout the study. Key data is located in Appendix: C. Daily photographs, and written work in various forms contributed to the development of student collaborative learning behaviors, such as pairing up and staying within the given boundaries of safety. .

A description of our initial field trip to Lake Leschi is in Appendix H. From that experience, the students in our fourth-grade class returned with photos. Unfortunately, some of the cameras we were given did not account for movement while taking photos, and many of their images came back blurry. Some of the students became very upset and asked if they could use their phones next time. A few students learned over time to hold their cameras still or used my camera, trading it off with other students, but the overall frustration came from equipment that was inferior, but looked legitimate.

Over the duration of the 2025-2026 school year, students demonstrated increasing confidence when contributing to whole-group discussions and small-group investigations. During our scientist-story circles, which were 10-15 minute check-ins to see where everyone was at in their work and reciprocal storytelling was used to create meaning, students frequently connected current investigations with previous outdoor observations, experiences at the salmon tank, or personal experiences with energy in their homes and communities. Think-Pair-Share time and scientist-story circles revealed that students often revised their initial explanations after paired up and collaborative discussions took place. Student concept maps, located in Appendix: C highlight how ideas evolved through group negotiation over time.

Each task documented on the timeline of events found in Appendix: F called for students working cooperatively to make observations, collect evidence, construct models, and explain scientific phenomena. Field notes consistently described students encouraging one another, asking clarifying questions, and building shared explanations during investigations. These recurring patterns across multiple sources of evidence in Appendix C indicated that collaborative relationships supported both engagement and scientific reasoning throughout the DiP.

Interpretation Through the Methodology

These findings reflect the methodological approaches from chapter three that supported this Dissertation in Practice. Through this qualitative case study I participated alongside students as both teacher and researcher, documenting classroom interactions while remaining actively engaged in the instructional process. I learned alongside students as we investigated energy transfer in classroom and outdoor settings. This allowed me to understand how relationships influenced student engagement and scientific inquiry within the natural context of classroom and out-of-classroom life (Merriam & Tisdell, 2016; Wolcott, 2008)).

The findings also reflect the principles of inductive thematic analysis (Braun & Clarke, 2022; Merriam & Tisdell, 2016) . Building a relational learning community became evident because it consistently appeared across multiple forms of evidence and instructional settings. Recurring patterns emerged naturally across observations, conversations, photographs, and student documentation. *Etuaptmumk*, Two-Eyed Seeing, also informed the interpretation of these findings by recognizing that scientific understanding developed through relationships among multiple knowledge systems (Bang & Medin, 2010; Bartlett et al., 2012; McCarty & Lee, 2014). Students regularly integrated classroom OpenSciEd science with observations from Lake Leschi, experiences with the elementary salmon program, family knowledge, and peer discussions. Illustrations were put into their journals. I let some students take them home and some students donated their work for this DiP, found in Appendix:C.

Experiential learning was evident as students moved through repeated cycles of concrete experience, reflective observation, abstract conceptualization, and active documentation during classroom and outdoor investigations (Kolb & Kolb, 2018). Kolb and Kolb (2018) emphasize that learning is a continuous, iterative process in which learners construct knowledge by transforming experiences through reflection and application. Building on this learning theory, Morris (2020) argued that experiential learning is strengthened when experiences are contextually rich, reflection is intentional, and conceptual understanding is demonstrated in thoughtful settings where learners have opportunities to apply their new understandings to meaningful problems. High value, direct experiences such as Morris (2020) describes as experiences out of the normal day that have a great meaning and impact on students are more memorable than routine experiences and calls for a variety of experiences. “The belief that all genuine education comes about through experience does not mean that all experiences are genuinely or equally educative.” (Dewey, 1938).

At Chief Leschi Schools, students engaged in this experiential cycle through repeated investigations at Lake Leschi, participation in the elementary salmon program, and OpenSciEd inquiry activities, where firsthand, in-person, in-place experiences provided a wholistic understanding of energy transfer in natural and man-made systems while strengthening connections to place, community, experiential learning, and scientific inquiry. Beyond that spectacular serendipitous moments came from nature just at the same time we were there to provide excitement. Finding live worms, feathers, and butterflies to our students was of major excitement and students insisted that those moments were captured in this DiP. This felt so much better than then encouraging students to complete seemingly endless worksheets and packets.

The classroom environment further reflected the principles of the Reggio Emilia approach, in which learning was made visible through ongoing documentation, collaborative dialogue, and shared reflection. Student questions, models, notes, and classroom displays became living documents that students continually revisited to refine their thinking, illustrating the environment's role as an active participant in learning (Edwards et al., 2012). After each learning cycle, our students had the autonomy to display their work and thoughts as an ongoing narrative. Outside of the classroom, there is space to display student work. Our students took the display work on their own after we showed them what a learning display looks like using the Reggio approach. They made it beautiful and many other students had questions and positive comments.

Connection to the Literature and Research Question

These findings directly address the study's primary research question by identifying the building of a relational learning community as a foundational support for facilitating the OpenSciEd fourth-grade energy unit at Chief Leschi Schools. Before students could meaningfully investigate energy transfer, they first developed trusting relationships with classmates, their teacher, and the learning environments in which scientific inquiry occurred. These relationships created conditions that supported collaboration, curiosity, and sustained engagement throughout the unit.

The finding aligns closely with the literature reviewed in Chapter Two. Merriam and Tisdell (2016) describe qualitative inquiry as seeking to understand participants' experiences through multiple sources of evidence, a principle reflected in the diverse forms of documentation collected throughout this study. Wilson's (2008) concept of relational accountability explains that knowledge is created through relationships among people, place, and community, while Bartlett et al. (2012) argue through *Etuaptmumk*, Two-Eyed Seeing, that learning is strengthened by respectfully bringing together multiple knowledge systems. Barnhardt and Kawagley (2005) likewise argue that meaningful science education is strengthened when Indigenous and Mainstream knowledge systems are viewed as complementary. Bang and Medin (2010) and Bang et al. (2014) further contend that science learning becomes more meaningful when instruction builds upon Indigenous epistemologies, local ecological knowledge, and students' lived relationships with place.

Kolb and Kolb's (2018) experiential learning theory further supports these findings by demonstrating that learning develops through cycles of experience, reflection, conceptualization, and application, while the Reggio Emilia approach emphasizes collaboration, documentation, and the environment as an active participant in children's learning (Cadwell, 2003; Edwards et al., 2012).

Together, these findings demonstrate that a relational learning community was a foundational condition that supported the successful facilitation of the OpenSciEd energy unit on energy. Students' relationships with one another, with me, and with their learning environments created opportunities for scientific inquiry that honored multiple ways of knowing while centering collaboration, reflection, and shared meaning making. This relational foundation also supported the subsequent themes of access to place-based learning, integration of Indigenous Knowledge, experiential investigations, and student agency that emerged throughout the study. Next we will discuss the Implications for Practice.

Implications for Practice

The findings from Theme One suggest that intentionally nurturing a relational learning community is an instructional support that strengthens students' participation in scientific inquiry. Ongoing scientist-story circles, collaborative investigations, and opportunities for shared reflection modeled a classroom environment where students felt respected, heard, and confident contributing their ideas. These relational practices established the trust necessary for students to engage in scientific discourse, ask questions, revise their thinking, and collaboratively construct explanations of energy transfer in natural environments and in man-made systems.

For Indigenous students at Chief Leschi Schools, relationship-centered learning is also aligned with Indigenous pedagogies that understand knowledge as emerging through relationships with people, place, and community (Cajete, 2000; Wilson, 2008). The findings suggest that OpenSciEd implementation is strengthened when relational accountability is intentionally embedded within classroom expectations, routines, and procedures. Consistent with the Reggio Approach, these universal practices created space for students to respectfully contribute multiple ways of knowing as they participated in NGSS-aligned scientific investigations (NGSS Lead States, 2013).

These findings revealed student-centered learning environments increase engagement, belonging, and academic participation (McCarty & Lee, 2014; Gay, 2018; Hammond, 2015). Our learning community implemented phenomenon-based science and should first establish collaborative classroom communities where students recognize themselves as valued contributors to scientific knowledge. Within this study, these relational structures served as foundational supports that enabled students to investigate scientific phenomena at Lake Leschi, participate confidently in science discussions, and develop their personal identities as scientists and researchers.

The implication for educators is that successful implementation of OpenSciEd in Indigenous educational settings depends on the intentional development of relationships that honor students' voices, cultural identities, and lived experiences. Investing instructional time in community-building practices should therefore be viewed as an essential component of science instruction. These relational foundations create the conditions for meaningful scientific inquiry, collaboration, and responsive teaching.

Theme Two: Access to Place-Based Learning

Description of the Finding

For six years I was an Elementary STEM teacher at CLS. The same day that the STEM program was dissolved was the same day CLS "officially" broke ground on the Lake Leschi Food forest. I say “officially” because that work has been going on in the wetland space every year since my employment. I accepted a job as fourth grade teacher for 2025-2026 at CLS with agreements in place that I would be allowed to continue my DiP with access to the lake Leschi Food Forest and the Elementary Salmon program in partnership with the Foss Waterway Seaport.

I knew that the Mainstream education curriculum did not allow for outdoor excursions and that access was critical for the work I had originally planned. The research question of this DiP “What are the supports and challenges of facilitating an OpenSciEd unit on energy at Chief Leschi Schools” I knew that access had to be official and in writing and was incredibly grateful to have received permission. When I arrived to work for Professional Development at the start of the 2025-2026 year, I asked the fifth grade team if they could take on the fifth grade salmon program, which was previously an all grade program. I developed the program in partnership with the Foss Waterway Seaport. The fifth grade teachers turned it down so I asked if I could just keep the tank in my room, like originally planned, to this I was told there would be no more Elementary salmon program. I was also told that I was not allowed to have any type of fishtank in my room, while several other teachers did. I went to leadership and they said their hands were tied, and they couldn’t do anything about it. I went ahead and set up one of the salmon tanks in the elementary library and one in the secondary science classrooms. When I was confronted with what I did. I told the truth “It’s part of my dissertation”. I showed the letters of approval.

The Puyallup Tribe has long been recognized as the Salmon People, with a cultural, ecological, and spiritual relationship with salmon that extends across generations. Within this context, sustaining an elementary salmon program is neither an insurmountable nor overly complex undertaking when institutional commitment and collaborative leadership and administration are ethically above board. This vignette illustrates how institutional failures can emerge through unequal distributions of power, access, and privilege. When decision making and follow through rests with individuals who are not committed to equitable, relational, collaborative and culturally responsive leadership, programs that support students' connections to place, community, and Indigenous Knowledge become vulnerable to neglect or discontinuation.

Access to place-based learning emerged as one of the most significant instructional supports and challenges for facilitating the OpenSciEd fourth-grade energy unit at Chief Leschi Schools. Challenges to access did arise despite approvals from CLS leadership, for example, after our initial field trip, our access to Leschi Lake and the food forest was only available during our “regular science schedule”. Only our class’ “regular science schedule” was subjected to several additional schedule changes throughout the year. Our OpenSciEd kit for our energy unit did not reach my classroom until March 5th due to institutional challenges. Institutional barriers and scheduling changes for our class increased over the year. During this time, our class became very tightly knit with purpose. I took lots of notes from our scientist-story circles and listened.

The frustration of the schedule changes upset our students who were looking forward to the moments when they could be researchers. I assured them that they are scholars and researchers in all spaces, just like on Monday morning, when school leadership would recite a mantra that all of us are scholars. The most astute students in our fourth grade class are the contrarians. The rebellious nature of critical analysis is so natural with our students, one student came back with “yeah, well they say that so we're good, you're the one taking us outside to learn”.

I met with all the parents in my class, either in person or by phone throughout the year, and explained transparently and humbly that I was in a program at UWT and my research question was to document the support and challenges of facilitating an OpenSciEd unit on energy transfer. I told them about some of the scheduling challenges we were facing, asked if their child had appropriate outerwear, assured them they would be supervised, and promised that this was a great opportunity for student voice that could make a difference. For example, our students do not like worksheets and packets, they thrive on experiential learning and project work. I also found that many of our parents had attended Chief Leschi Schools and agree that worksheets and packets are substandard compared to experiential, hands-on learning. The parents were more fully aware of the historic institutional challenges at CLS than I was. Their stories encouraged me that the work we were doing in our fourth-grade classroom mattered to all of us.

I received tremendous support from the families of the students in our fourth-grade class. Notes of encouragement and donations of snacks and materials conveyed visible support and made it to my desk. Permission slips to participate in the DiP started to come in, students wanted to sign their own too, so both consent and student assent forms were sent out and collected demonstrating a firm commitment to this work. Students lined up faster, and when visitors came into our classroom, our fourth-graders were excited and proud to share what they had experienced and learned during their field studies. Whether it was a photo, a sketch or written notes, our fourth-graders were proud of the work they had done because it was meaningful to them. The time we had to access Leschi Lake was supported by two University of Washington graduates who, along with others, built the Lake Leschi Food Forest. The Foss Waterway Seaport supported our elementary salmon program and vertical alignment with secondary students.

As we all became familiar with the learning landscape, students increasingly demonstrated confidence in making observations, asking questions, identifying patterns, and proposing evidence-based explanations. The elementary salmon program further strengthened these experiences by providing a living example of energy transfer within aquatic ecosystems and man-made ecosystems of the salmon tank in the elementary library. Students observed salmon development, discussed habitat temperatures, checked ammonia levels, examined food webs, and connected classroom investigations with real-world ecological processes. Together, Lake Leschi and the salmon program created meaningful opportunities for students to explore scientific phenomena while developing stronger relationships with the natural environment.

Evidence from the Data

Evidence supporting this theme emerged consistently across participant observations, field notes, photographs, student illustrations, notice-and-wonder charts, concept and consensus models, and scientist-story circles. During outdoor investigations, students routinely applied science and engineering practices introduced in previous STEM instruction and reinforced through OpenSciEd, which the students noticed was similar. I already knew it was similar because OpenSciEd uses universal practices for inquiry. I also use universal practices for scientific inquiry. Students carefully observed natural phenomena, recorded field notes and sketches, photographed evidence, generated questions, collected data collaboratively, and discussed possible explanations returning to the classroom. Students identified multiple examples of energy transfer by observing how the sun is directly and indirectly the center of life. We also witnessed how life comes from the water. We studied macroinvertebrates in different waters to evaluate if the natural salmon habitat was ideal or polluted.

During scientist-story circles, students referenced earlier visits to Lake Leschi, family fishing experiences, seasonal weather changes, ecological observations, and previous investigations with the salmon tank. The students and I refined their explanations following repeated outdoor observations, concept and consensus models reflected increasingly sophisticated scientific reasoning developing from firsthand evidence. Field notes also documented changes in student participation. Students who were often quieter during classroom discussions became highly engaged outdoors, asking investigative questions and encouraging classmates to share their evidence. These recurring patterns across multiple forms of documentation suggested that access to meaningful outdoor learning environments increased participation while supporting scientific inquiry. Student work is in Appendix: Future

Interpretation Through the Methodology

The prominence of place-based learning emerged through the qualitative research case study. As the teacher-researcher, I observed students in both classroom and outdoor settings while participating alongside them in investigations. This dual role allowed me to document how students interacted with one another, with the land, and with scientific phenomena as learning naturally unfolded (Brown 2008; Kimmer 2013; Merriam & Tisdell, 2016).

Inductive thematic analysis revealed recurring patterns across multiple sources of evidence demonstrating that regular access to Lake Leschi and the elementary salmon program consistently supported engagement, collaboration, and scientific reasoning. This theme emerged through repeated observations documented across photographs, field notes, student notes, and scientist-story circles.

The findings also reflected the methodological frameworks that guided this Dissertation in Practice. Through *Etuaptmumk*, Two-Eyed Seeing, students investigated scientific phenomena while recognizing that multiple knowledge systems could coexist and contribute to understanding the natural world (Bartlett et al., 2012). Experiential learning was evident as students cycled through concrete experiences outdoors, reflected on their observations during classroom discussions, developed scientific explanations, and returned to the field to refine those ideas (Kolb, 2018; Morris 2020). Likewise, the Reggio Emilia approach was reflected in the environment, which served as an active teacher, and Lake Leschi itself became a living knowledge space that provoked curiosity, inquiry, documentation, and collaborative meaning-making (Cadwell, 2003; Edwards et al., 2012; Kolb & Kolb, 2018).

Connection to the Literature and Research Question

This finding directly addresses the study's research question by identifying access to place-based learning as a major instructional support for facilitating the OpenSciEd fourth-grade energy unit at Chief Leschi Schools. Students' repeated opportunities to investigate energy transfer at Lake Leschi and through the elementary salmon program strengthened engagement, supported scientific reasoning, and enabled students to connect classroom concepts with observations in their local environment.

These findings align with the literature reviewed in Chapter Two. Merriam and Tisdell (2016) and Creswell and Poth (2018) emphasize that qualitative inquiry is centered in understanding participants' experiences within their natural contexts. Accordingly, data were collected in the settings where learning naturally occurred, including the classroom, Lake Leschi, and the elementary salmon program, allowing students' scientific understandings to be documented as they developed through experiences, collaborative inquiry, and relationships with place.Wilson's (2008) concept of relational accountability suggests that knowledge develops through reciprocal relationships among people, place, and community, while Bartlett et al. (2012) argue that *Etuaptmumk,* Two-Eyed Seeing, provides opportunities to respectfully bring together Indigenous and mainstream ways of knowing. Kolb's (2018) experiential learning theory explains that meaningful understanding develops through repeated cycles of experience, reflection, conceptualization, and experimentation, all of which were evident as students investigated energy transfer across multiple visits to Lake Leschi.

These findings also support the work of Cajete (2000, 2015), who argues that Indigenous science education is focused on direct relationships with the natural world, and Kimmerer (2013), who emphasizes that ecological knowledge develops through sustained observation, reciprocity, and respect for place. Similarly, Rios and Brewer (2014) found that outdoor learning environments increase student engagement, strengthen science achievement, and foster environmental stewardship by allowing students to investigate phenomena firsthand.

While these studies demonstrate the educational value of place-based learning, this study extends the literature by showing that consistent access to place supported the implementation of OpenSciEd, an inquiry-based science curriculum. At Chief Leschi Schools, Lake Leschi and the elementary salmon program were integral components that supported the OpenSciEd learning unit on energy. Students developed scientific understanding through repeated interactions with outdoor environments, investing in relationships to place. These findings suggest that sustained access to ecologically significant places can strengthen inquiry-based science instruction while honoring Indigenous relationships with land, community, and multiple ways of knowing.

Implications for Practice, Leadership, and Ethical Accountability

The findings of this Dissertation in Practice extend beyond instructional practice and raise broader implications for educational leadership, organizational culture, and ethical accountability. Implementing inquiry-based science instruction, place-based learning, and Indigenous-centered pedagogies requires educators to exercise professional judgment, adapt curriculum to meet students' needs, and build meaningful partnerships with community and place. These practices are supported by research demonstrating that culturally responsive and experiential approaches increase student engagement, strengthen scientific understanding, and affirm students' identities (Gay, 2018; González et al., 2005; Kolb, 2015; McCarty & Lee, 2014).

Meaningful instructional innovation depends upon organizational environments in which educators can engage in reflective practice without fear of professional retaliation, interpersonal hostility, or undue interference. Educational leaders have an ethical responsibility to cultivate cultures of trust where professional dialogue, thoughtful questioning, and evidence-based instructional adaptation are viewed as strengths.

When educators experience that innovative practices or advocacy for students result in punitive responses, opportunities for instructional improvement and collaborative problem-solving are diminished. Such conditions supporting the school’s power structure through fear-based tactics ultimately affect not only teachers but also the quality of educational experiences available to students.

This implication is particularly significant within Indigenous educational contexts. Indigenous education scholars know that students thrive when schools recognize and honor their cultural identities, relationships with community, and Funds of Knowledge instead of positioning Indigenous perspectives as supplemental to mainstream curriculum (Cajete, 2015; Gay, 2018; González et al., 2005; Moll et al., 1992; Wilson, 2008). When curriculum centers only dominant educational perspectives while Indigenous Knowledge remains peripheral, students struggle to see themselves reflected as capable contributors to scientific inquiry. Such practices can unintentionally reinforce deficit-oriented assumptions, weaken students' sense of belonging, and overlook the cultural knowledge, experiences, and strengths they bring to the classroom.

The findings also imply that ethical leadership requires accountability at individual, organizational, and community levels. Accountability should extend beyond instructional compliance to include examining whether school leadership practices and workplace relationships foster a positive environment in which educators can advocate for students and engage in collaborative inquiry. Professional ethics include creating conditions in which agreements are honored, concerns can be raised respectfully without retaliation, and administrative mistakes are recognized, publicly acknowledged, and fixed. The implications of this DiP revealed the support and challenges in implementing an OpenSciEd unit on energy. For tribal schools and tribally supported educational systems, these findings underscore the importance of ensuring that investments in culturally responsive education are accompanied by leadership structures that reflect values of relational accountability, respect, reciprocity, and community responsibility.

The implications raised by this research and experience would include investigating more in-depth and reimagining the status quo of leadership practices at CLS. I have witnessed the facade of CLS's social media posts, which do not give an accurate picture of the realities at CLS. Tribes that invest significant resources in the education of their youth have a vested interest in ensuring that governance, leadership, and ethical oversight consistently support educational environments where Indigenous students flourish academically, culturally, and personally.

Finally, this study implies that ethics committees, governing boards, and educational leaders should look beyond procedural compliance when evaluating organizational effectiveness at CLS. Ethical leadership is demonstrated not only through adherence to policy but also through the willingness to examine organizational culture, address systemic barriers to innovation, respond constructively to professional concerns, and ensure that educators are supported in implementing research-informed practices that benefit students. Sustaining inquiry-based learning, Indigenous Knowledge integration, and culturally responsive science education requires leadership that embraces continuous reflection, transparency, and accountability in service of students and the communities schools are intended to serve.

Theme Three: Multiple Ways of Knowing and Demonstrating Learning

Description of the Finding

I saw Kevin with a *Warriors* book, a series of young adult novels that are very popular. I asked him questions about the book as as the questions continued I realized Kevin can't read. I asked him why he had the book on his desk and I asked why. Kevin said so that the other students wouldn't know. I am happy to say that he is reading now, still needing special support. Kevin is not alone in his literacy skills. Most students came into our fourth grade at a second grade level and even though some students made tremendous gains with some students, several of our students are pulled from the class because their reading math levels are so low they can't access the grade level material yet.

After thinking about this I remembered several teachers from the past who said to demonstrate learning using multiple modes of learning. These were my favorite types of assignments because it tapped into my creativity. So what I learned from the literature review was that this was a preferred method for teachers of Indigenous students. I had no reservations on what is a demonstration of learning. My format included discussion of key points within the curriculum such that I asked Kevin to draw out the biodiversity during a trip to Lake Leschi and paired him with another student who knew how to read and write. With peer support Kevin and his partner enthusiastically shared their concept maps. Kevin in particular was very proud of his work because he was able to write the words his partner and he agreed upon, supporting his wholistic growth through choosing the mode in which he demonstrated his knowledge

Knowing your students and knowing how to scaffold discreetly and allow for peer tutoring, Kevin grew in his confidence and as his reading skills improved he would take his “risk” at making a mistake in his work because he knew that making mistakes was okay and not punitive. I collaborated intensely with the Lap program and in class and by the end of the year he was contributing in whole class lessons in English Language Arts (ELA) and Math. Student agency emerged as a significant support for implementing the OpenSciEd fourth-grade energy unit by providing students with multiple opportunities to investigate, represent, and communicate their scientific understanding. Instruction intentionally offered multiple pathways for participation that reflected students' individual strengths, interests, and preferred ways of expressing knowledge. Students communicated their thinking through oral discussions, field notes, illustrations, notes, and photographs. This flexibility recognized that students learn differently and that scientific understanding can be demonstrated in many forms.

Some students in our fourth grade class preferred writing detailed observations in their journals, while others expressed their ideas more confidently through drawings, model construction, or reciprocal dialogue. Science-story circles created opportunities for students who were less comfortable with written expression to verbally explain their observations and build scientific explanations alongside their classmates. Several of our students did not know how to read written words, but still wanted to participate. Those students had an amazing recall of every lesson and who said what. When I asked them the differences between man made and natural energy their insights were on par with the other students that could both read and write at their level or beyond.

OpenSciEd is flexible enough to allow for oral conversations of understanding the knowledge and concepts presented to be visual infographics and spoken word. It is the teacher's responsibility to adapt and scaffold towards written evidence in words, but I know that it is more important to teach to all students and that choice has eventually given me written results without unnecessary power struggles. From my mainstream education I knew that my value was in test scores and not seen as a person. I make a tremendous heartfelt effort so our students never feel that way.

As the DiP progressed, students increasingly took ownership of their learning. Making folders and little books that they wanted to share with family. In addition to creating their own formats to showcase their learning over time, students independently generated questions, proposed investigations, documented observations, revised explanations, and suggested additional visits to Lake Leschi's Food Forest and suggested more time to access the salmon program, in response to the supporting lessons from the Foss Waterway Seaport being cut because of institutional decisions.This was disappointing because the scientists teachers who visited up at CLS were legitimate scientists and teachers. Thankfully our students were allowed in pairs to go to the elementary salmon tank in the library to check the temperature, feed and go through the checklist we collectively created for our data clipboards during a scientist-circle.

Evidence from the Data

Evidence supporting this theme of multiple choices for modes of demonstrated knowledge. Student work included, student illustrations, photographs, notice-and-wonder charts, consensus models, science-story circles, participant observations, and other types of student work that can be seen in Appendix: future

Students provided considerable variation in how they documented scientific thinking. Some students relied heavily on written observations, while others incorporated labeled illustrations, arrows, symbols, and visual models to explain energy transfer found in nature. One student followed their narrative of Gary the stick. Originally found in a pile of compost at the food forest at Lake Leschi, the student came up with a story about how the stick wound up in the compost pile to begin with and then traced the branch from the tree it came from. Other students witnessed this item-observation activity and emulated the first student by picking thighs up and asking themselves, where did they come from before. Students compared their items to other students' items and the ones that had similar items decided it was good to come together and share out what they knew, what they observed and how would their senses, the five teachers describe it.

Within our qualitative case study on the supports and challenges of facilitating an OpenSciEd Unit on Energy and also employing pedagogical methodologies, for example, the Reggio Emilia approach, and emergent theory, we produced concept maps of the biodiversity of Lake Leschi's food forest and the energy transfer we witnessed within natural eco-systems. Because of the qualitative research nature of this DiP I explained at an age appropriate manner the ways we would research would honor their input as co-researchers. The connections reflected our learning. One student in our scientist-story circle said it felt weird that we were going into nature to look for natural things and taking pictures with cameras and a phone. Another student wanted to know what the solar panel by the dock was making energy for. Accessing these outdoor learning spaces honored student inquiry and learning by recognizing that understanding can be communicated through experience by utilizing oral language, artistic expression, writing, modeling, and movement (Absolon, 2022; Edwards et al., 2012; Wilson, 2008).

Classroom photographs documented students' points of view, which included their peers learning alongside them. Unfortunately, many of the student photos were blurry because the cameras used looked like good cameras, but in reality were of inferior quality for elementary students, who want to point and click like they would with their phones.

Scientist-study circles provided additional evidence of student agency. Students regularly built upon one another's ideas, respectfully questioned evidence, revised explanations, and encouraged classmates to contribute observations. During consensus modeling activities, students negotiated shared explanations by combining multiple perspectives. Each student in our fourth grade class practiced listening to the previous student who spoke and repeated what they said before they could disagree or build upon what the original student said.

Field notes documented increasing student independence throughout the study. Students began initiating investigations, selecting different tools for documentation, assigning collaborative roles within groups, such as a timekeeper, and identifying evidence they believed was important to collect. Many students who initially participated minimally during whole-group instruction became active contributors when provided opportunities to communicate through visual representations and outdoor investigations.

Across multiple forms of documentation, recurring patterns demonstrated that providing student choice supported greater participation, richer scientific discussions, and more comprehensive demonstrations of understanding.

Interpretation Through the Methodology

As the teacher-researcher, I observed how students responded when given flexibility in documenting and communicating their learning. Creswell & Poth (2018) state that qualitative research conducted in natural settings is intended to understand participants' experiences. We documented learning across multiple forms of participation, allowing patterns of engagement and understanding to emerge naturally through observations, conversations, photographs, student notes, and illustrations (Merriam & Tisdell, 2016; Smith 1999).

Inductive thematic analysis revealed that student agency consistently appeared across the data regardless of instructional setting. Whether students were investigating at Lake Leschi, participating in classroom discussions, constructing engineering models, or documenting observations in notebooks, they demonstrated greater engagement when allowed to choose how to represent and communicate their learning.

These findings also reflected the qualitative case study design allowed for multiple methodological pedagogical practices to support the overarching research approach. For example, *Etuaptmumk*, Two-Eyed Seeing supported the recognition that knowledge can be expressed through multiple legitimate ways of knowing and communicating (Bang et al. 2014, Bartlett et al., 2012). Wilson's (2008) concept of relational accountability further suggests that learning develops through reciprocal relationships in which every participant contributes knowledge to the collective understanding, researched in community with each other.

Experiential learning was evident as students continually cycled through observation, reflection, conceptualization, and application while selecting documentation methods that best represented their learning (Kolb, 2015). Similarly, the Reggio Emilia approach emphasizes documentation as a means of making children's thinking visible while recognizing the "hundred languages of children," acknowledging that students communicate understanding through drawing, speaking, writing, movement, construction, and artistic expression (Edwards et al., 2012; Rinaldi, 2006). The variety of documentation collected throughout this study reflected these principles by honoring multiple forms of scientific communication.

Connection to the Literature and Research Question

This finding directly addresses the study's primary research question by identifying student agency through multiple ways of knowing and demonstrating learning as a key instructional support for implementing the OpenSciEd fourth-grade energy unit at Chief Leschi Schools. Providing students with meaningful choices in how they investigated, documented, and communicated scientific understanding increased participation, strengthened collaboration, and created more inclusive opportunities for students to engage in scientific inquiry.

These findings align with the literature reviewed in Chapter Two. Merriam and Tisdell (2016) emphasize the importance of understanding participants' experiences through multiple sources of evidence, an approach reflected in the diverse forms of student documentation collected throughout this study. Wilson (2008) argues that knowledge is relational and co-constructed through reciprocal participation, while Bartlett et al. (2012) describe *Etuaptmumk*, Two-Eyed Seeing as recognizing the value of multiple ways of knowing and understanding the world. Barnhardt & Kawagley (2005) encourages researchers to respectfully pull from multiple knowledge systems without requiring one specifically to dominate.

The findings also support experiential learning theory, which suggests that learners construct understanding through active participation, reflection, and application (Kolb, 2015). Likewise, the Reggio Emilia approach positions children as capable, competent learners whose thinking becomes visible through multiple forms of documentation and expression (Edwards et al., 2012; Kolb & Kolb, 2018). These perspectives align with Indigenous methodologies that honor oral traditions, visual representations, observation, artistic expression, and scientist-story circles as legitimate ways of constructing and sharing knowledge (Absolon, 2022; Kovach, 2009; Wilson, 2008).

This DiP demonstrates that student agency is not simply about offering choice in classroom activities but about recognizing multiple epistemological pathways through which students construct and communicate scientific understanding. When students were provided opportunities to represent their learning through methods that reflected their strengths and experiences, they became more active participants in scientific inquiry and contributed more fully to the collective learning community. These findings suggest that honoring multiple ways of knowing and demonstrating learning can strengthen inquiry-based science instruction while supporting culturally sustaining educational practices within Indigenous school communities.

Implications for Practice

The findings from Theme Three suggest that providing students with multiple ways of knowing and demonstrating learning is not an accommodation for a select group of learners but an instructional practice that benefits all students. Student agency emerged when learners were given meaningful opportunities to investigate scientific phenomena, communicate their thinking, and select methods of documentation that reflected their strengths while working toward common learning goals. Offering multiple pathways for participation increased engagement, encouraged collaboration, and ultimately strengthened students' scientific reasoning.

For educators, Meyer et al. (2014) reinforces the importance of Universal Design for Learning (UDL) and culturally sustaining pedagogies that recognize oral language, visual representation, artistic expression, movement, and collaborative dialogue as legitimate demonstrations of scientific understanding. Students who struggled with conventional reading and writing nevertheless demonstrated sophisticated scientific thinking through scientist-story circles, illustrations, observations, and reciprocal dialogue. As students gained confidence through these entry points, many became increasingly willing to incorporate written documentation into their work, suggesting that student choice can serve as a bridge toward traditional academic literacy.

Within Indigenous educational settings, these findings also suggest that educational systems should reconsider narrow definitions of assessment that privilege written products above all other forms of evidence. Indigenous methodologies recognize that knowledge is communicated through relationships, observation, oral traditions, artistic expression, storytelling, and shared experiences (Absolon, 2022; Kovach, 2009; Wilson, 2008). Expanding opportunities for students to demonstrate learning through multiple forms of evidence honors these epistemological traditions while remaining consistent with the scientific practices emphasized in the NGSS and OpenSciEd curriculum.

The findings further imply that school leaders have a responsibility to create instructional environments in which teachers are supported in exercising professional judgment when adapting curriculum to meet students' diverse learning needs. Effective implementation of inquiry-based science requires flexibility, responsiveness, and trust in educators' expertise. Leadership practices that emphasize compliance over professional decision-making may unintentionally limit opportunities for teachers to implement evidence-based, culturally responsive instruction that reflects the strengths of their students.

Finally, this study implies that student agency should be understood as a central component of rigorous science instruction. When students were trusted to ask questions, choose methods of investigation, document observations in multiple ways, and contribute to collective scientific understanding, they became more engaged, more collaborative, and increasingly identified themselves as capable scientists and researchers. These findings indicate that honoring multiple ways of knowing not only strengthens inquiry-based science instruction but also contributes to educational environments that affirm students' identities, recognize their Funds of Knowledge, and create more equitable opportunities for participation in scientific learning (González et al., 2005; Moll et al., 1992).

Theme Four: Developing Scientific Identities as Researchers and Scholars

Description of the Finding

During our fifth trip to Lake Leschi, several students walked around the space with their clipboards and pencils to create either a notice and wonder or illustration.“Look!” George called to a classmate, pointing toward the nursing log decomposing. “That’s energy transfer too!” Another student leaned closer, compared the observation with their own drawing, and added to the explanation by stating “Yes, but more is happening, you forgot the moss, the moss is also absorbing the nutrients from the log while the sun is helping the moss grow too.” I stood nearby, listening rather than inserting myself into the peer tutoring taking place.

The student’s conversations moved naturally between what they saw, what they remembered from OpenSciEd, and what they knew about First Foods, salmon and the solar panel close to the lake. Students observed, questioned, interpreted, and taught one another. Most importantly they stayed on task. This was during our fifth visit to the Lake Leschi Food Forest. Students at this point of the year were following expectations and taking more autonomy in the classroom, so for the next day’s scientist-story circle Justice was the "teacher" and ran the Scientist-Circle with a partner who was taking notes on the whiteboard. Our fourth grade classroom of students were beginning to see themselves as the scientists, helping each other by explaining what they saw and how it related to energy transfer.

One of the most significant outcomes of implementing the OpenSciEd fourth-grade energy unit was the development of students' scientific identities as researchers and scholars. Throughout the study, students increasingly viewed themselves as active co-researchers in scientific inquiry. As the unit progressed, students demonstrated greater confidence in asking investigable questions, making careful observations, collecting evidence, revising explanations, and communicating their thinking with classmates. Scientific inquiry became something they participated in.

Repeated opportunities to investigate phenomena at Lake Leschi and through the elementary salmon program contributed significantly to this transformation. Students approached each visit with increasing curiosity and independence, often identifying observations before I prompted them or suggesting additional questions for future investigations. As they became more familiar with scientific practices, students increasingly relied upon evidence gathered through observation. They frequently debated explanations, such as what the solar panel at Lake Leschi was powering and pondered how we could tell if it was even operational. Researchers compared observations on where they believed the nest for the bird that we heard were located. Students interested in researching the biodiversity at Swan Creek during our salmon release made a game of listing out their examples of biodiversity like a scavenger hunt, revised consensus models, and defended their ideas using evidence collected with photography, which I facilitated during this experience. Students also demonstrated increasing confidence in communicating scientific thinking through multiple forms of expression. This was apparent when anyone asked them what they were doing irrespective of the place of experiential learning. Some students preferred to explain their observations orally during scientist-story circles, while others communicated most effectively through student notes, scientific illustrations, photography, diagrams, or collaborative model building. Providing multiple opportunities to demonstrate understanding reflected the diversity of learners within the classroom while reinforcing that scientific thinking can be expressed through many different forms of communication.

Perhaps most importantly, students began viewing themselves as researchers and contributors to scientific knowledge. During investigations, students regularly shared discoveries with classmates, pointed out changes in the environment, identified new species, and encouraged one another to verify observations before reaching conclusions. One memorable example occurred during a visit to Lake Leschi when a butterfly landed on a student's finger. The excitement quickly spread throughout the class as students gathered to observe, photograph, and discuss the butterfly's behavior. Students immediately began asking questions about pollination, habitats, seasonal changes, and the butterfly's role within the ecosystem. What began as a spontaneous encounter became a scientific investigation initiated entirely by the students.

As the teacher-researcher, I also experienced a shift in my professional identity throughout the study. I increasingly worked alongside students as a co-investigator. Our classroom became a community of learners where students' observations, questions, and experiences informed subsequent investigations. This collaborative approach strengthened both the learning environment and the quality of the research by positioning us as active participants in knowledge construction.

Evidence from the Data

Evidence supporting this theme emerged consistently across participant observations, field notes, student illustrations, classroom discussions, scientist-story circles, consensus models, photographs, notice-and-wonder charts, and student work products. Throughout the study, students demonstrated increasing independence in initiating observations, asking scientific questions, and documenting evidence without relying solely on teacher direction. Student evidence can be found in Appendix: D.

Student's explanations revealed increasingly sophisticated scientific thinking as they refined explanations over time. Early notebook entries often consisted of isolated observations or simple sketches. As the unit progressed, students incorporated labels, detailed illustrations, written explanations, comparisons across investigations, and references to previous observations at Lake Leschi. These artifacts illustrated that students were constructing scientific explanations by integrating evidence collected over multiple investigations.

Consensus models further illustrated students' developing identities as researchers. Students routinely revised models after classroom discussions, outdoor investigations, and collaborative analysis of evidence, sometimes in a different color to observe the change over time. Scientist-story circles provided additional evidence as students respectfully questioned one another's observations, offered alternative explanations, and built collective understandings through dialogue. These conversations increasingly reflected scientific argumentation highlighted in evidence.

Field notes documented numerous examples of students independently noticing ecological changes, identifying relationships among organisms, and connecting classroom investigations to personal experiences outside of school. Students frequently referenced observations made during previous visits to Lake Leschi, family experiences with fishing, gathering traditional foods, or caring for natural resources. These recurring patterns suggested that students increasingly viewed scientific inquiry as an ongoing process extending beyond individual classroom lessons.

Photographs and student illustrations also documented growing confidence in scientific observation. Students intentionally photographed organisms, habitats, and evidence of energy transfer while creating increasingly detailed drawings that highlighted patterns they considered scientifically significant. Visual artifacts in Appendix:D demonstrated that students were learning to observe the natural world with the curiosity and attention characteristic of practicing scientists.

Interpretation Through the Methodology

These findings emerged through qualitative case study research. Participant observation allowed me to document how students' identities as researchers developed gradually through sustained participation in scientific inquiry. Observing students across classroom investigations, outdoor experiences, collaborative discussions, and reflective activities provided a comprehensive understanding of how scientific identity evolved over time (Creswell & Poth, 2018; Merriam & Tisdell, 2016; Morris 2020).

Inductive thematic analysis revealed recurring patterns demonstrating that students increasingly assumed ownership of the scientific process. indicators of scientific identity, themes emerged across multiple forms of documentation, including field notes, classroom discussions, photographs, student illustrations, and consensus models (Braun & Clarke, 2022). Collectively, these data demonstrated that students' confidence, curiosity, and scientific agency strengthened through repeated participation in investigations.

Experiential learning provided an important interpretive approach for understanding these findings. Students continually moved through cycles of concrete experience, reflective observation, conceptual understanding, and active experimentation as they investigated Lake Leschi, returned to previous observations, revised explanations, and tested new ideas (Kolb, 2015; Kolb & Kolb, 2018; Morris, 2020). These repeated cycles allowed students to experience science as an active process of inquiry.

The Reggio Emilia approach also informed interpretation by emphasizing children as competent, capable protagonists in their own learning (Edwards et al., 2012; Rinaldi, 2006). Documentation practices, such as drawings, photographs, consensus models, and scientist-circles made students' thinking visible and heard, while positioning their ideas as valuable contributions to collective knowledge construction. Instruction created opportunities for students to investigate, collaborate, revise their thinking, and communicate discoveries through multiple symbolic languages.

Etuaptmumk, Two-Eyed Seeing provided an additional interpretive lens by recognizing that students developed scientific identities while drawing upon both Indigenous Knowledge and

Mainstream scientific inquiry (Bartlett et al., 2012). Wilson's (2008) principle of relational accountability was evident as students constructed knowledge through reciprocal relationships with classmates, teachers, families, community members, salmon, and Lake Leschi. Scientific identity emerged not as an individual accomplishment but as a relational process utilized in collaboration, responsibility, and shared inquiry.

Connection to the Research Question and Literature

This finding directly addresses the study's primary research question by demonstrating one of the most meaningful outcomes of implementing the OpenSciEd fourth-grade energy unit at Chief Leschi Schools. The instructional supports identified throughout this study, including access to Lake Leschi, the elementary salmon program, Indigenous Knowledge, experiential learning, collaborative inquiry, and responsive teaching, collectively fostered students' development as scientists, researchers, and scholars. Students increasingly demonstrated confidence in asking questions, collecting evidence, revising explanations, communicating findings, and contributing to the classroom's shared understanding of scientific phenomena. These findings suggest that successful implementation of OpenSciEd extends beyond content acquisition to support students' scientific identities, curiosity, and agency as lifelong learners.

These findings closely align with the literature reviewed in Chapter Two. The National Research Council (2012) and NGSS Lead States (2013) argue that students develop scientific proficiency through participation in the practices of science, including asking questions, planning investigations, analyzing data, developing models, and communicating explanations. Similarly, experiential learning theory suggests that learners construct enduring understanding through repeated cycles of experience, reflection, conceptualization, and application (Kolb, 2015; Kolb &

Kolb, 2018; Morris, 2020). Reggio Emilia scholars describe children as competent researchers whose ideas become visible through documentation, dialogue, and collaborative inquiry (Edwards et al., 2012; Rinaldi, 2006). Indigenous scholars further emphasize that meaningful learning develops through reciprocal relationships with land, community, culture, and lived experience (Wilson, 2008; Bartlett et al., 2012; Cajete, 2015; Bang et al., 2014; Kimmerer, 2013). McCarty and Lee (2014) likewise argue that culturally sustaining educational practices strengthen both academic learning and students' identities by affirming their cultural knowledge and community relationships. González et al. (2006) similarly demonstrate that recognizing students' funds of knowledge positions their lived experiences as valuable intellectual resources for learning. Collectively, these perspectives support the findings of this study by demonstrating that students developed scientific identities because they were invited to participate in place-based scientific inquiry that honored both Indigenous and Mainstream ways of knowing. This study contributes to the growing body of scholarship demonstrating that culturally responsive, phenomenon-based science instruction can strengthen not only scientific understanding but also students' confidence, sense of belonging, and identity as capable scientists and scholars.

Implications for Practice

The findings from Theme Six suggest that one of the most significant outcomes of implementing the OpenSciEd fourth-grade energy unit was not simply students' acquisition of scientific knowledge but the development of their identities as scientists, researchers, and scholars. As students repeatedly engaged in investigations at Lake Leschi, participated in the elementary salmon program, collaborated with classmates, and documented their thinking through multiple forms of expression, they increasingly viewed themselves as capable researchers and scholars contributing to scientific understanding. Weinstein's (1995) ethnographic study of science education demonstrates the usefulness of examining science learning in relation to students' identities and the cultural contexts surrounding their participation. These findings indicate that inquiry-based science should be designed not only to teach scientific concepts but also to cultivate students' confidence, curiosity, agency, and sense of belonging within the scientific community.

For classroom educators, these findings reinforce the importance of providing students with opportunities to engage in the full process of scientific inquiry. Students developed scientific identities because they were trusted to ask questions, collect evidence, revise explanations, communicate findings, and collaborate with peers over an extended period of time. Instruction that emphasizes investigation, reflection, documentation, and student discourse allows learners to experience science as something they actively do. Providing multiple opportunities for students to communicate their thinking through oral language, scientific illustrations, writing, photography, model building, and collaborative dialogue further recognizes that scientific understanding can be demonstrated in diverse and meaningful ways (CAST, 2024; Edwards et al., 2012; Meyer et al., 2014).

The findings also have important implications for educational leadership. School leaders influence whether students have sustained opportunities to develop scientific identities by supporting inquiry-based instruction, protecting time for investigations, investing in outdoor learning experiences, and recognizing multiple forms of student achievement. Leadership that values curiosity, collaboration, and student agency creates learning environments where children are encouraged to see themselves as researchers whose observations and ideas contribute to collective understanding. Supporting teachers in implementing phenomenon-based science through professional learning, collaborative planning, and access to community partnerships strengthens both instructional quality and student engagement.

Within Indigenous educational settings, these findings suggest that scientific identity develops most meaningfully when students can investigate scientific phenomena while remaining connected to their culture, community, and place. Students in this study naturally integrated family experiences, observations of Lake Leschi, relationships with salmon, and classroom investigations into their construction of scientific explanations. This reflects *Etuaptmumk*, Two-Eyed Seeing, in which Indigenous Knowledge and Mainstream science each contribute to understanding the natural world while maintaining the integrity of both knowledge systems (Bartlett et al., 2012). Scientific identity therefore emerged as a relational process involving reciprocal relationships with classmates, teachers, families, community members, and the land, consistent with Wilson's (2008) principle of relational accountability.

These findings also suggest that educational policy and curriculum development should move beyond evaluating science instruction solely through content mastery or standardized assessment. Students demonstrated growth as researchers through their curiosity, persistence, collaborative problem solving, scientific argumentation, and willingness to revise explanations based on evidence. These characteristics represent important outcomes of science education and align closely with the vision of the National Research Council (2012) and NGSS Lead States (2013), which emphasize engaging students in the practices of science.

Finally, this DiP suggests that educational systems should intentionally create learning environments where every student has opportunities to develop a positive scientific identity. Students became researchers because they experienced science as meaningful, culturally relevant, collaborative, and connected to their lives. Educational leaders who prioritize place-based learning, culturally sustaining pedagogies, Indigenous Knowledge Systems, and inquiry-based instruction create conditions in which students develop not only scientific understanding but also the confidence to view themselves as lifelong learners, knowledge holders, and future scientists. Such learning environments support educational equity by recognizing students' diverse strengths and positioning every learner as capable of contributing to scientific knowledge and the stewardship of their communities.

Chapter Five: Conclusion

This Dissertation in Practice examined the supports and challenges of facilitating an OpenSciEd fourth-grade unit on energy at Chief Leschi Schools while providing students opportunities for experiential, in-place science learning through visiting the Lake Leschi Food Forest, the elementary salmon program, and Swan Creek. Students increasingly saw themselves as scientists, researchers, and leaders, capable of contributing knowledge to their classroom and community. This final chapter brings together the study design, literature, methodology, findings, and implications. I will first revisit the design of the study, then I will quickly write about the study's connection to the literature, then I will speak to a synthesis of the findings, after that I will discuss students as scientists, researchers, and for closure responding to the research question. Next we will revisit the purpose and the design of the study.

Returning to the Purpose and Design of the Study

The study asked: "What are the supports and challenges of facilitating an OpenSciEd fourth-grade unit on energy at Chief Leschi Schools?" This case study highlighted what became possible when students could investigate science through multiple modalities, different locations on campus, The Lake Leschi Food Forest, the elementary salmon program, and Swan Creek. I am exceedingly grateful for the opportunity to follow the guidance of the Indigenous scholarship taking place, being documented, globally through the educational leadership program at school of education at the University of Washington, Tacoma in partnership with the Muckleshoot Tribal College. This unique program has transformed me as an educator and researcher.

A Dissertation in Practice is a scholarly investigation of a significant problem of practice that integrates research, theory, and professional knowledge to develop understanding and inform improvement within a specific educational context. The constructed research question of "What are the supports and challenges is facilitating an OpenSciEd unit at Chief leschi Schools. The qualitative case study design allowed for experiences to be examined within the complexity of an actual fourth-grade classroom (Creswell & Poth, 2018; Merriam & Tisdell, 2016). Practitioner inquiry, relational accountability, and *Etuaptmumk*, Two-Eyed Seeing further supported an approach in which students guided their own learning journey (Bartlett et al., 2012; Wilson, 2008).

Data included observations, field notes, student illustrations, notice-and-wonder charts, photographs, videos, and student-written work. Inductive thematic analysis and triangulation provided a systematic process for identifying patterns while maintaining attention to context and relationships (Braun & Clarke, 2022; Creswell & Poth, 2018). Next I will speak about the connection to literature.

Connection to the Literature

The literature establishes learning as relational, experiential, culturally situated, and connected to place. Experiential learning emphasizes relationships among experience, reflection, conceptualization, and application (Dewey, 1938/1997; Kolb, 2015; Kolb & Kolb, 2018; Morris, 2020). Place-based and Indigenous scholarship further recognizes learning through relationships among people, land, community, and knowledge systems (Bang et al., 2018; Barnhardt & Kawagley, 2005; Cajete, 2015; Wilson, 2008).

These ideas became visible throughout the study. At Lake Leschi and through the salmon program, students investigated energy through water, movement, plant growth, animal habitats, biodiversity, salmon, and other living systems. Students also engaged with the scientific concepts and practices of OpenSciEd while also investigating through multiple lenses of relationships, community knowledge, and place, and also recognizing what each could contribute to wholistic understanding (Bartlett et al., 2012). Next I will provide a synthesis of the findings.

Synthesis of the Findings

Across the findings, meaningful science learning was supported by relationships, access to place, student agency, multiple modalities, repeated experiences, and opportunities to connect scientific concepts with identity and community. These conditions worked together.

Relationships supported intellectual risk-taking. Multiple modalities allowed students to demonstrate knowledge in different ways. Scientist-story circles supported collective meaning-making, and Lake Leschi Food Forest, salmon, and Swan Creek provided natural and manmade phenomena students could investigate.

One of the most significant outcomes was the development of students' scientific identities. Students observed, questioned, modeled, analyzed, and interpreted evidence, communicated findings, reconsidered explanations, and made connections across experiences. Their drawings, models, notebooks, conversations, and observations demonstrated that rigorous scientific understanding could be expressed through multiple modes.

Our students also demonstrated the benefits of experiential and in-place learning. Their investigations connected energy with salmon, water, habitat, biodiversity, environmental conditions, and human actions. Scientific concepts became interconnected instead of compartmentalized, allowing students to examine biodiversity more wholistically. Next I will discuss students as scientists and researchers.

Students as Scientists and Researchers.

Students supported their own learning as they increasingly took leadership in their own education. Students contributed evidence, asked questions, shared observations, selected ways to communicate their understanding, and participated in constructing meaning from their experiences. Their work contributed directly to this Dissertation in Practice and subsequently contributed to a larger scholarly conversation about science education.

The students in our 2025-2026 fourth grade class at Chief Leschi Schools raised 150 salmon that they released at Swan Creek. This demonstrates how scientific learning could move from experience to knowledge toward responsibility. Students recognized themselves as people capable of contributing to those systems and their restoration. Next I will speak to the research question.

Answering the Research Question in this Case Study

To answer the question “What Are the Supports and Challenges of Facilitating an OpenSciEd Unit on Energy at Chief Leschi Schools?” it is necessary to center students and experiential, in-place learning. OpenSciEd became most meaningful when students could connect its scientific concepts and practices with the Lake Leschi Food Forest, salmon, Swan Creek, biodiversity, their identities, their experiences, and one another. Students supported their journey by demonstrating their interest in the Lake Leschi Food Forest. Students were able to observe nature carefully, ask questions, analyze and interpret evidence, construct explanations, communicate through multiple modes, make connections across systems, and contribute to collective knowledge. Despite challenges involving time, schedules, and access, our fourth graders saw themselves increasingly as scientists and researchers who made a significant contribution to each other's knowledge and ability to communicate with one another productively and respectfully over the 2025-2026 school year. There were many seen and unseen supports that made this case study worthwhile and I have enormous gratitude for our student's participation and using multiple perspectives and modalities of learning, showcasing their talents.

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Appendix A: First Cycle Code Family and Pattern Codes

Examples of First Cycle Codes	Pattern Code	Supporting research
listening, sharing ideas, trust, collaboration, community participation Scientist-story circles	Relational learning	Wilson (2008); Kirkness & Barnhardt (1991); Caxaj (2015); Rinaldi (2006)
Making observations, asking questions, predicting, collecting evidence, testing ideas, constructing explanations Scientist-story circles	Scientific Inquiry	Creswell & Poth (2018); Merriam & Tisdell (2016); NGSS Lead States (2013)
Recording data, comparing observations, identifying patterns, supporting claims with evidence Scientist-story circles	Evidence-Based Reasoning	Braun & Clarke (2022); NGSS Lead States (2013); Merriam & Tisdell (2016)

Walking to Lake Leschi, observing salmon, investigating habitats, Scientist-story circles	Place-Based Learning stewardship, outdoor exploration	Cajete (2015); Gruenewald (2003); Bang et al. (2014); Simpson (2014); Barnhardt & Kawagley (2005)
Hands-on investigation, reflection, applying learning, experiences Scientist-story circles	Experiential Learning	Dewey (1938/1997); Kolb (2015); Kolb & Kolb (2018); Morris (2020)
Scientist-story circles, family knowledge, cultural knowledge, reciprocity, relationship with land	Indigenous Knowledge;	Wilson (2008); Kovach (2009); Absolon (2022); Bartlett et al. (2012); Cajete (2015); Smith (1999)
Drawing, photography, oral explanation, concept mapping, consensus models, student choice Scientist-story circles	Multiple Ways of Knowing Student Agency	Bartlett et al. (2012); Edwards et al. (2012); Rinaldi (2006); Bang & Medin (2010)
Curiosity, excitement, persistence, confidence,	Student Engagement	Kolb & Kolb (2018); Morris (2020); Edwards et al. (2012);

ownership of learning		Zull (2002, 2011)
Scientist-story circles, photography; written reflections, illustrations, Notice and Wonder charts, OpenSciEd worksheet packet Scientist-story circles	Communication of Learning	Rinaldi (2006); Edwards et al. (2012); Merriam & Tisdell (2016)
Taking student leadership, asking questions, presenting evidence, student voice, confidence Scientist-story circles	Scientific Identity	Bang & Medin (2010); Bang et al. 2018; Cajete (2015); Erickson (1986); McCarty & Lee (2014)
Scaffolding, probing questions, adapting instruction, documenting learning Scientist-story circles	Teacher Facilitation	Creswell & Poth (2018); Edwards et al. (2012); Merriam & Tisdell (2016);
Access to Lake Leschi, time constraints, scheduling,	Supports and Challenges	Creswell & Poth (2018); Merriam & Tisdell (2016);

resources, administrative barriers		Yin (2018)
Reflective journaling, instructional adjustments	Reflective Practice	Creswell & Poth (2018); Merriam & Tisdell (2016); Saldaña (2021)

Appendix B: Crosswalk of Pattern Codes and Themes

First Cycle Code	Pattern Code	Theme
Scientist-story circles, building trust, classroom routines	Relational Learning	Building a Relational Learning Community
Partner work, peer collaboration, small-group discussion, consensus building	Collaborative Learning	Building a Relational Learning Community
Student leadership, student choice, shared responsibility, ownership of learning	Student Agency	Building a Relational Learning Community

First Cycle Code	Pattern Code	Theme
Family participation, community knowledge, salmon program, tribal resources	Community Partnerships	Building a Relational Learning Community
Scientist-story circles, classroom discussion, asking questions	Communication of Learning Reflective Practice	Building a Relational Learning Community
Walking to Lake Leschi, outdoor investigations, observing salmon, food forest exploration Hands-on Investigations, field observations, repeated experiences	Place-Based Learning	Access to Place-Based Learning
Biodiversity mapping, energy transfer illustrations,	Environmental Systems Thinking Experiential	Access to Place-Based Learning

First Cycle Code	Pattern Code	Theme
OpenSciEd unit on energy covers manmade systems for comparison and discussion	Learning	
Caring for place, environmental responsibility, respect for salmon, restoration activities	Stewardship and Responsibility	Access to Place-Based Learning
Outdoor access, repeated site visits, investigations, learning in contex	Access to Learning Opportunities	Access to Place-Based Learning
Storytelling, Photography, Written concept maps Utilization of the OpenSciEd Packets multiple perspectives	Multiple Ways of Knowing	Multiple Ways of Knowing and Demonstrating Learning
Photography, illustrations, diagrams, written reflections	Multimodal Documentation	Multiple Ways of Knowing and Demonstrating Learning

First Cycle Code	Pattern Code	Theme
Concept maps, consensus models, labeled illustrations	Visual Thinking	Multiple Ways of Knowing and Demonstrating Learning
Presentations, evidence sharing, explaining reasoning, peer discussions Recording observations, comparing evidence, identifying patterns, supporting claims	Scientific Communication	Multiple Ways of Knowing and Demonstrating Learning
Scientist story circles,	Evidence-Based Reasoning Developing Scientific Identities	Multiple Ways of Knowing and Demonstrating Learning
Confidence, leadership, asking questions, presenting findings	Scientific Identity Development	Developing Scientific Identities

First Cycle Code	Pattern Code	Theme
Making observations, predicting, collecting evidence, testing ideas, revising explanations	Scientific Inquiry	Developing Scientific Identities
Curiosity, persistence, excitement, participation, ownership of learning	Student Engagement	Developing Scientific Identities
collaborative problem solving	Problem Solving	Developing Scientific Identities
Scaffolding inquiry, asking probing questions, providing feedback, documenting learning	Teacher Facilitation	Developing Scientific Identities

Appendix: C: Figure Names, Student Data and Assigned Codes

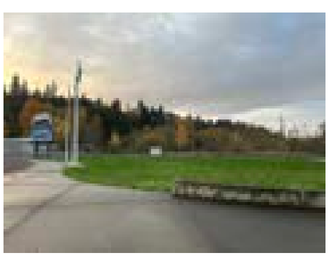
Figure Name	Context/Location First Cycle Codes	and Pattern Codes	Appropriate Finding Theme
 Figure 1	Making observations, asking questions, predicting, collecting evidence, testing ideas, constructing explanations	Teacher Facilitation	Multiple Ways of Knowing and Demonstrating Learning
 Figure 2	Walking to Lake Leschi, observing salmon,	Student Engagement; Place-Based Learning stewardship, outdoor exploration; Experiential learning;	Building a Relational Learning Community; Access to Place-Based

Figure Name	Context/Location First Cycle Codes	and Pattern Codes	Appropriate Finding Theme
	investigating habitats; Hands-on investigations, field observations, repeated experiences, learning; Scientist-story circles		Learning; Developing Scientific Identities
 Figure 3	Walking to Lake Leschi, observing salmon, investigating habitats; Hands-on investigations,	Student Engagement; Place-Based Learning stewardship, outdoor exploration	Building a Relational Learning Community; Access to Place-Based Learning; Developing Scientific Identities

Figure Name	Context/Location First Cycle Codes	and Pattern Codes	Appropriate Finding Theme
	field observations, repeated experiences, learning; Scientist-story circles		
 Figure 4	Walking to Lake Leschi, observing salmon, investigating habitats; Hands-on investigations, field observations, repeated	Student Engagement; Place-Based Learning stewardship, outdoor exploration	Building a Relational Learning Community; Access to Place-Based Learning; Developing Scientific Identities

Figure Name	Context/Location First Cycle Codes	and Pattern Codes	Appropriate Finding Theme
	experiences, learning; Scientist-story circles		
 Figure 5	Walking to Lake Leschi, observing salmon, investigating habitats; Hands-on investigations, field observations, repeated experiences, learning; Scientist-story circles	Student Engagement; Place-Based Learning stewardship, outdoor exploration	Building a Relational Learning Community; Access to Place-Based Learning; Developing Scientific Identities

Figure Name	Context/Location First Cycle Codes	and Pattern Codes	Appropriate Finding Theme
 Figure 6	Walking to Lake Leschi, observing salmon habitat, investigating natural forms of energy Scientist-story circles	Student Engagement; Place-Based Learning stewardship, outdoor exploration	Building a Relational Learning Community; Access to Place-Based Learning; Developing Scientific Identities
 Figure 7	Walking to Lake Leschi, observing salmon habitat, investigating natural forms of energy	Student Engagement; Place-Based Learning stewardship, outdoor exploration	Building a Relational Learning Community; Access to Place-Based Learning; Developing Scientific Identities

Figure Name	Context/Locati on First Cycle Codes	and Pattern Codes	Appropriate Finding Theme
	Scientist-story circles		
 Figure 8	Walking to Lake Leschi, observing salmon habitat, investigating natural forms of energy Scientist-story circles	Student Engagement; Place-Based Learning stewardship, outdoor exploration	Access to Place-Based Learning

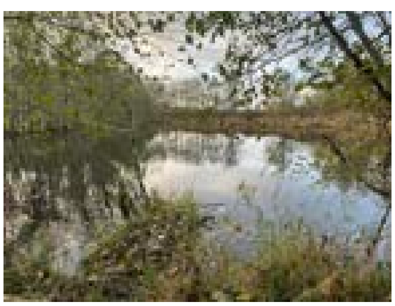
Figure Name	Context/Location First Cycle Codes	and Pattern Codes	Appropriate Finding Theme
 Figure 9	Walking to Lake Leschi, observing salmon habitat, investigating natural forms of energy Scientist-story circles	Student Engagement; Place-Based Learning stewardship, outdoor exploration	Access to Place-Based Learning
 Figure 10	Walking to Lake Leschi, observing salmon habitat, investigating natural forms of energy,	Student Engagement; Student Agency; Place-Based Learning stewardship, outdoor exploration	Access to Place-Based Learning; Multiple Ways of Knowing and Demonstrating Learning; Developing Scientific Identities

Figure Name	Context/Location First Cycle Codes	and Pattern Codes	Appropriate Finding Theme
	student photography Scientist-story circles		
 Figure 11	Walking to Lake Leschi, observing salmon habitat, investigating natural forms of energy, student photography Scientist-story circles	Student Engagement; Place-Based Learning stewardship, outdoor exploration	Access to Place-Based Learning; Multiple Ways of Knowing and Demonstrating Learning; Developing Scientific Identities

Figure Name	Context/Location First Cycle Codes	and Pattern Codes	Appropriate Finding Theme
 Figure 12	Scaffolding, probing questions, adapting instruction, documenting learning; Making observations, asking questions, predicting, collecting evidence, testing ideas, constructing explanations; Scientist-story circles	Student Engagement; Place-Based Learning stewardship, outdoor exploration; Teacher facilitation	Building a Relational Learning Community; Access to Place-Based Learning; Multiple Ways of Knowing and Demonstrating Learning; Developing Scientific Identities

Figure Name	Context/Location First Cycle Codes	and Pattern Codes	Appropriate Finding Theme
 Figure 13	Scaffolding, probing questions, adapting instruction, documenting learning; Making observations, asking questions, predicting, collecting evidence, testing ideas, constructing explanations; Scientist-story circles	Student Engagement; Place-Based Learning stewardship, outdoor exploration; Teacher facilitation; Access to learning opportunities in Place	Building a Relational Learning Community; Access to Place-Based Learning; Multiple Ways of Knowing and Demonstrating Learning; Developing Scientific Identities

Figure Name	Context/Location First Cycle Codes	and Pattern Codes	Appropriate Finding Theme
 Figure 14	Hands-on investigations, field observations, repeated experiences, learning; Scientist-story circles	Student Engagement; Place-Based Learning stewardship, outdoor exploration	Access to Place-Based Learning; Multiple Ways of Knowing and Demonstrating Learning; Developing Scientific Identities
 Figure 15	Hands-on investigations, field observations, repeated experiences, learning; Scientist-story circles	Student Engagement; Place-Based Learning stewardship, outdoor exploration	Access to Place-Based Learning; Multiple Ways of Knowing and Demonstrating Learning; Developing Scientific Identities

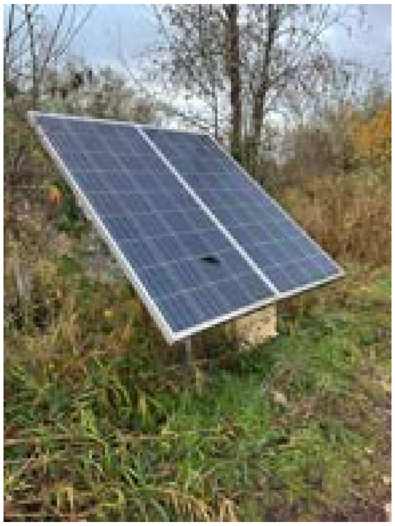
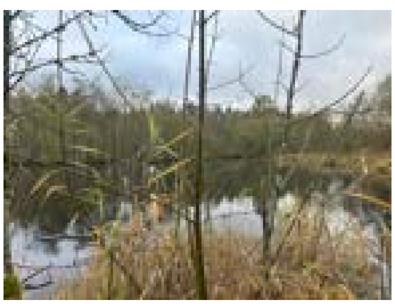
Figure Name	Context/Location First Cycle Codes	and Pattern Codes	Appropriate Finding Theme
 Figure 16	Scientific Inquiry	Student Engagement; Place-Based Learning stewardship, outdoor exploration	Access to Place-Based Learning
 Figure 17	Multiple Ways of Knowing Student Photograph	Student Engagement; Place-Based Learning stewardship, outdoor exploration	Access to Place-Based Learning; Multiple Ways of Knowing and Demonstrating Learning; Developing Scientific Identities;

Figure Name	Context/Location First Cycle Codes	and Pattern Codes	Appropriate Finding Theme
 Figure 18	Scientific Inquiry Place Based Learning	Student Engagement; Place-Based Learning stewardship, outdoor exploration	Access to Place-Based Learning
 Figure 19	Multiple Ways of Knowing Student Photograph of a nursing log	Student Engagement; Place-Based Learning stewardship, outdoor exploration	Access to Place-Based Learning

Figure Name	Context/Location First Cycle Codes	and Pattern Codes	Appropriate Finding Theme
 Figure 20	Student leadership, student choice, shared responsibility, ownership of learning	Student Agency	Building a Relational Learning Community; Access to Place-Based Learning; Developing Scientific Identities
 Figure 21	Student leadership, student choice, shared responsibility, ownership of learning	Student Agency	Building a Relational Learning Community; Access to Place-Based Learning; Developing Scientific Identities

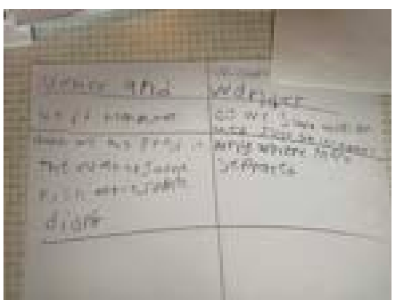
Figure Name	Context/Location First Cycle Codes	and Pattern Codes	Appropriate Finding Theme
 Figure 22	Hands-on investigations, field observations, repeated experiences, learning; Scientist-story circles	Student Engagement	Building a Relational Learning Community; Access to Place-Based Learning; Developing Scientific Identities
 Figure 23	Scientist-story circles, photography; written reflections, illustrations, Notice and Wonder charts,	Student Engagement; Communication of Learning	Multiple Ways of Knowing and Demonstrating Learning; Developing Scientific Identities;

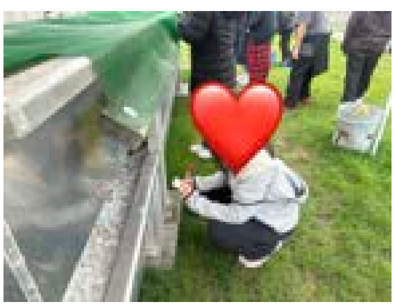
Figure Name	Context/Location First Cycle Codes	and Pattern Codes	Appropriate Finding Theme
 Figure 24	Hands-on investigation, reflection, applying learning, experiences; Reflective Practice during Scientist-story circles;	Student Engagement	Building a Relational Learning Community; Access to Place-Based Learning; Multiple Ways of Knowing and Demonstrating Learning; Developing Scientific Identities;
 Figure 25	Hands-on investigation, reflection, applying learning, experiences;	Reflective Practice during Scientist-story circles; Student Engagement	Building a Relational Learning Community; Access to Place-Based Learning; Multiple Ways of Knowing and Demonstrating

Figure Name	Context/Location First Cycle Codes	and Pattern Codes	Appropriate Finding Theme
			Learning; Developing Scientific Identities
 Figure 26	Curiosity, excitement, persistence, confidence, ownership of learning	Reflective Practice during Scientist-story circles; Student Engagement	Access to Place-Based Learning
 Figure 27	Hands-on investigation, reflection, applying learning, experiences;	Student Engagement	Multiple Ways of Knowing and Demonstrating Learning; Developing Scientific Identities

Figure Name	Context/Location First Cycle Codes	and Pattern Codes	Appropriate Finding Theme
 Figure 28	Hands-on investigation, reflection, applying learning, experiences;	Student Engagement	Access to Place-Based Learning; Multiple Ways of Knowing and Demonstrating Learning; Developing Scientific Identities
 Figure 29	Scientist-story circles, photography; written reflections, illustrations, Notice and Wonder charts	Reflective Practice during Scientist-story circles; Student Engagement; Communication of Learning	Access to Place-Based Learning; Multiple Ways of Knowing and Demonstrating Learning;

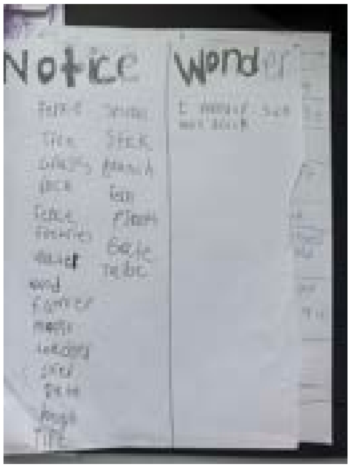
Figure Name	Context/Location First Cycle Codes	and Pattern Codes	Appropriate Finding Theme
 Figure 30	Scientist-story circles, photography; written reflections, illustrations, Notice and Wonder charts	Reflective Practice during Scientist-story circles; Student Engagement	Access to Place-Based Learning; Multiple Ways of Knowing and Demonstrating Learning;
 Figure 31	Scientist-story circles, photography; written reflections, illustrations, Notice and Wonder charts	Reflective Practice during Scientist-story circles; Student Engagement.	Access to Place-Based Learning; Multiple Ways of Knowing and Demonstrating Learning;

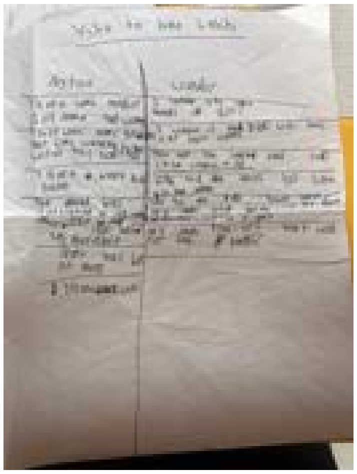
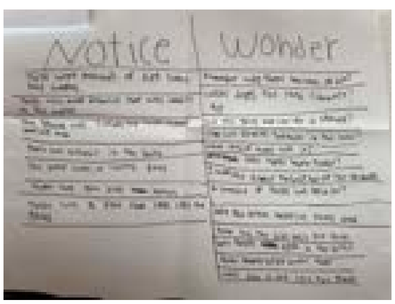
Figure Name	Context/Location First Cycle Codes	and Pattern Codes	Appropriate Finding Theme
 Figure 32	Scientist-story circles, photography; written reflections, illustrations, Notice and Wonder charts	Reflective Practice during Scientist-story circles; Student Engagement	Access to Place-Based Learning; Multiple Ways of Knowing and Demonstrating Learning;
 Figure 33	Scientist-story circles, photography; written reflections, illustrations, Notice and Wonder charts	Reflective Practice during Scientist-story circles; Student Engagement	Access to Place-Based Learning; Multiple Ways of Knowing and Demonstrating Learning;

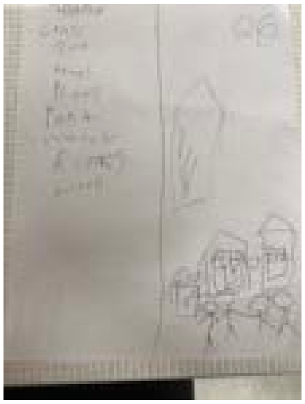
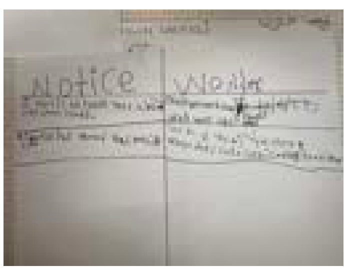
Figure Name	Context/Location First Cycle Codes	and Pattern Codes	Appropriate Finding Theme
 Figure 34	Scientist-story circles, photography; written reflections, illustrations, Notice and Wonder charts	Reflective Practice during Scientist-story circles; Student Engagement	Access to Place-Based Learning; Multiple Ways of Knowing and Demonstrating Learning;
 Figure 35	Scientist-story circles, photography; written reflections, illustrations, Notice and Wonder charts	Reflective Practice during Scientist-story circles; Student Engagement.	Access to Place-Based Learning; Multiple Ways of Knowing and Demonstrating Learning;

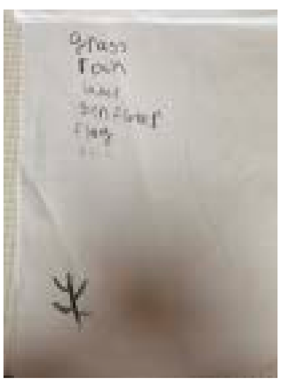
Figure Name	Context/Location First Cycle Codes	and Pattern Codes	Appropriate Finding Theme
 Figure 36	Scientist-story circles, photography; written reflections, illustrations, Notice and Wonder charts	Reflective Practice during Scientist-story circles; Student Engagement	Access to Place-Based Learning; Multiple Ways of Knowing and Demonstrating Learning;
 Figure 37	Scientist-story circles, photography; written reflections, illustrations, Notice and Wonder charts	Reflective Practice during Scientist-story circles; Student Engagement	Access to Place-Based Learning; Multiple Ways of Knowing and Demonstrating Learning;

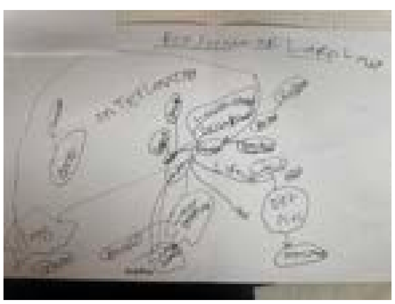
Figure Name	Context/Location First Cycle Codes	and Pattern Codes	Appropriate Finding Theme
 Figure 38	Concept maps, consensus models, labeled illustrations	Student Agency; Reflective Practice during Scientist-story circles; Student Engagement; Visual Thinking	Building a Relational Learning Community;Access to Place-Based Learning; Multiple Ways of Knowing and Demonstrating Learning; Developing Scientific Identities
 Figure 39	Concept maps, consensus models, labeled illustrations	Student Agency; Reflective Practice during Scientist-story circles; Student Engagement; Visual Thinking	Building a Relational Learning Community;Access to Place-Based Learning; Multiple Ways of Knowing and Demonstrating Learning; Developing Scientific Identities

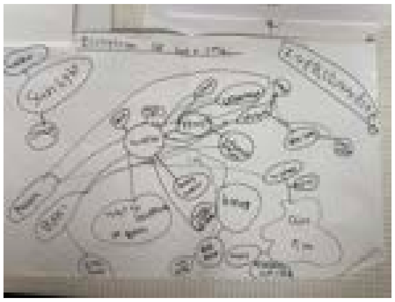
Figure Name	Context/Location First Cycle Codes	and Pattern Codes	Appropriate Finding Theme
 Figure 40	Concept maps, consensus models, labeled illustrations	Student Agency; Reflective Practice during Scientist-story circles; Student Engagement; Visual Thinking	Building a Relational Learning Community;Access to Place-Based Learning; Multiple Ways of Knowing and Demonstrating Learning; Developing Scientific Identities
 Figure 41	Concept maps, consensus models, labeled illustrations	Student Agency; Reflective Practice during Scientist-story circles; Student Engagement; Visual Thinking	Building a Relational Learning Community;Access to Place-Based Learning; Multiple Ways of Knowing and Demonstrating Learning; Developing Scientific Identities

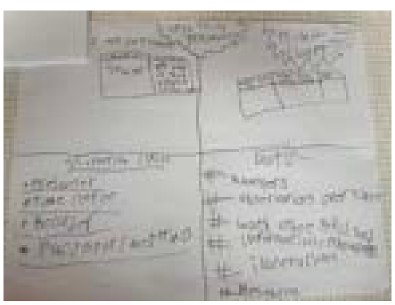
Figure Name	Context/Location First Cycle Codes	and Pattern Codes	Appropriate Finding Theme
 Figure 42	Making observations, asking questions, predicting, collecting evidence, testing ideas, constructing explanations	Reflective Practice during Scientist-story circles. Collaborative Learning; Scientific Inquiry in the context of gathering information and universal procedures	Building a Relational Learning Community; Multiple Ways of Knowing and Demonstrating Learning; Developing Scientific Identities
 Figure 43	Making observations, asking questions, predicting, collecting evidence, testing ideas, constructing	Reflective Practice during Scientist-story circles. Collaborative Learning	Building a Relational Learning Community; Multiple Ways of Knowing and Demonstrating Learning; Developing Scientific Identities

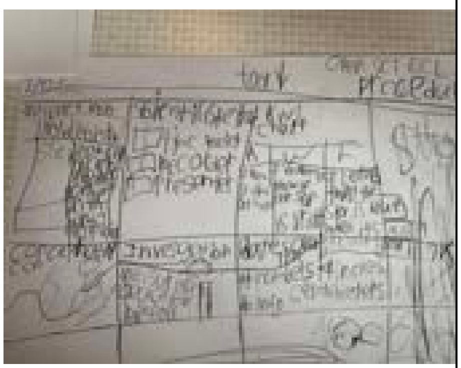
Figure Name	Context/Location First Cycle Codes	and Pattern Codes	Appropriate Finding Theme
	explanations		
 Figure 44	Making observations, asking questions, predicting, collecting evidence, testing ideas, constructing explanations	Reflective Practice during Scientist-story circles. Collaborative Learning	Building a Relational Learning Community; Multiple Ways of Knowing and Demonstrating Learning; Developing Scientific Identities

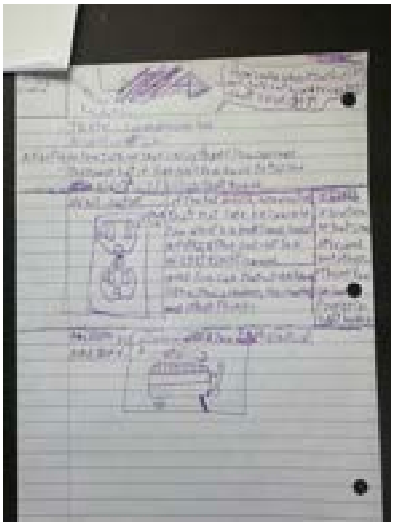
Figure Name	Context/Location First Cycle Codes	and Pattern Codes	Appropriate Finding Theme
 Figure 45	Recording data, comparing observations, identifying patterns, supporting claims with evidence Scientist-story circles Recording data, comparing observations, identifying patterns, supporting claims with	Reflective Practice during Scientist-story circles; Evidence-Based Reasoning	Access to Place-Based Learning; Multiple Ways of Knowing and Demonstrating Learning; Multiple Ways of Knowing and Demonstrating Learning; Developing Scientific Identities

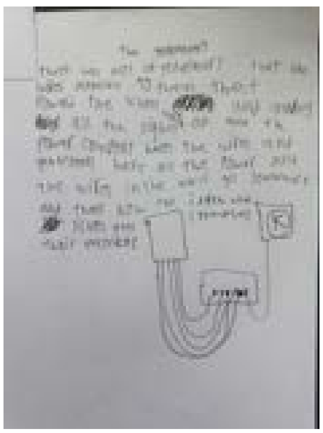
Figure Name	Context/Location First Cycle Codes	and Pattern Codes	Appropriate Finding Theme
	evidence Scientist-story circles		
 Figure 46	Recording data, comparing observations, identifying patterns, supporting claims with evidence Scientist-story circles Recording data, comparing observations, identifying	Reflective Practice during Scientist-story circles. Evidence-Based Reasoning	Access to Place-Based Learning; Multiple Ways of Knowing and Demonstrating Learning; Multiple Ways of Knowing and Demonstrating Learning; Developing Scientific Identities

Figure Name	Context/Location First Cycle Codes	and Pattern Codes	Appropriate Finding Theme
	patterns, supporting claims with evidence Scientist-story circles		
 Figure 47	Recording data, comparing observations, identifying patterns, supporting claims with evidence Scientist-story circles Recording data,	Reflective Practice during Scientist-story circles.	Access to Place-Based Learning; Multiple Ways of Knowing and Demonstrating Learning; Multiple Ways of Knowing and Demonstrating Learning; Developing Scientific Identities

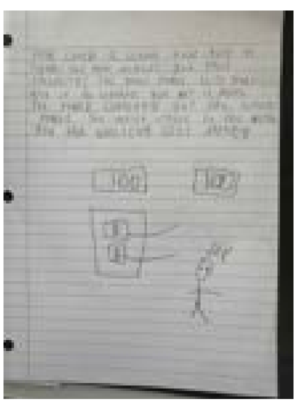
Figure Name	Context/Location First Cycle Codes	and Pattern Codes	Appropriate Finding Theme
	comparing observations, identifying patterns, supporting claims with evidence Scientist-story circles		
 Figure 48	Recording data, comparing observations, identifying patterns, supporting claims with evidence	Reflective Practice during Scientist-story circles.	Access to Place-Based Learning; Multiple Ways of Knowing and Demonstrating Learning; Multiple Ways of Knowing and Demonstrating

Figure Name	Context/Location First Cycle Codes	and Pattern Codes	Appropriate Finding Theme
	Scientist-story circles Recording data, comparing observations, identifying patterns, supporting claims with evidence Scientist-story circles		Learning; Developing Scientific Identities

Figure Name	Context/Location First Cycle Codes	and Pattern Codes	Appropriate Finding Theme
 Figure 49	Recording data, comparing observations, identifying patterns, supporting claims with evidence Scientist-story circles Recording data, comparing observations, identifying patterns, supporting claims with	Reflective Practice during Scientist-story circles.	Access to Place-Based Learning; Multiple Ways of Knowing and Demonstrating Learning; Multiple Ways of Knowing and Demonstrating Learning; Developing Scientific Identities

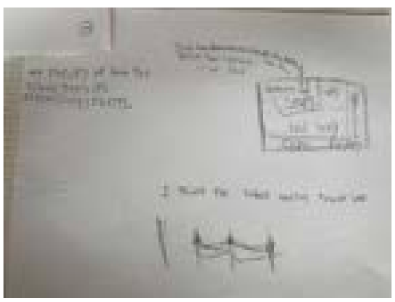
Figure Name	Context/Location First Cycle Codes	and Pattern Codes	Appropriate Finding Theme
	evidence Scientist-story circles		
 Figure 50	Recording data, comparing observations, identifying patterns, supporting claims with evidence Scientist-story circles Recording data, comparing observations,	Reflective Practice during Scientist-story circles.	Access to Place-Based Learning; Multiple Ways of Knowing and Demonstrating Learning; Multiple Ways of Knowing and Demonstrating Learning; Developing Scientific Identities

Figure Name	Context/Location First Cycle Codes	and Pattern Codes	Appropriate Finding Theme
	identifying patterns, supporting claims with evidence Scientist-story circles		
 Figure 51	Recording data, comparing observations, identifying patterns, supporting claims with evidence Scientist-story circles	Reflective Practice during Scientist-story circles.	Access to Place-Based Learning; Multiple Ways of Knowing and Demonstrating Learning; Multiple Ways of Knowing and Demonstrating Learning; Developing Scientific Identities

Figure Name	Context/Location First Cycle Codes	and Pattern Codes	Appropriate Finding Theme
	Recording data, comparing observations, identifying patterns, supporting claims with evidence Scientist-story circles		

Figure Name	Context/Location First Cycle Codes	and Pattern Codes	Appropriate Finding Theme
 Figure 52	Recording data, comparing observations, identifying patterns, supporting claims with evidence Scientist-story circles Recording data, comparing observations, identifying patterns, supporting claims with	Reflective Practice during Scientist-story circles.	Access to Place-Based Learning; Multiple Ways of Knowing and Demonstrating Learning; Multiple Ways of Knowing and Demonstrating Learning; Developing Scientific Identities

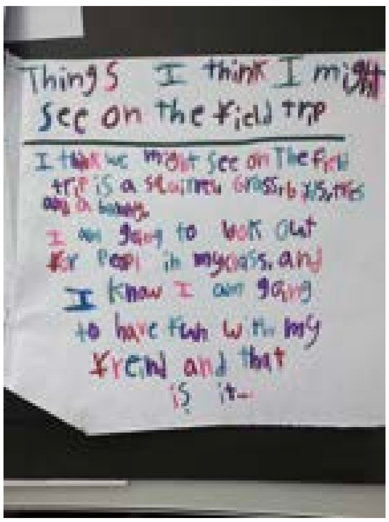
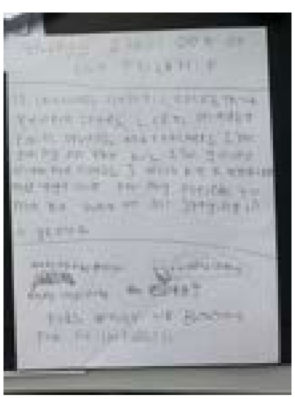
Figure Name	Context/Location First Cycle Codes	and Pattern Codes	Appropriate Finding Theme
	evidence Scientist-story circles		
 Figure 53	Curiosity, excitement, persistence, confidence, ownership of learning	Reflective Practice during Scientist-story circles.	Building a Relational Learning Community; Developing Scientific Identities
	Curiosity, excitement, persistence, confidence, ownership of learning	Reflective Practice during Scientist-story circles.	Building a Relational Learning Community; Developing Scientific Identities

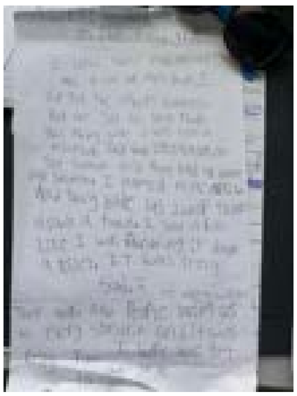
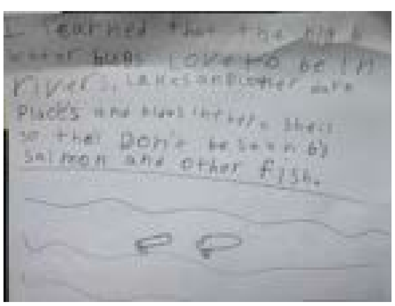
Figure Name	Context/Location First Cycle Codes	and Pattern Codes	Appropriate Finding Theme
Figure 54			
 Figure 55	Written Reflections	Reflective Practice during Scientist-story circles. Communication of Learning.	Building a Relational Learning Community; Access to Place-Based Learning; Multiple Ways of Knowing and Demonstrating Learning; Developing Scientific Identities
 Figure 56	Written Reflections	Reflective Practice during Scientist-story circles.Communication of Learning.	Building a Relational Learning Community; Access to Place-Based Learning; Multiple Ways of Knowing and Demonstrating

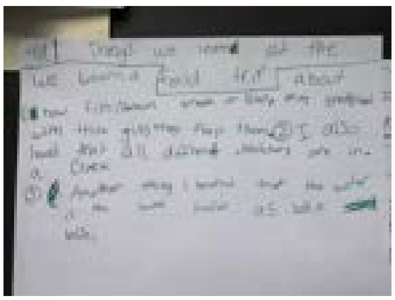
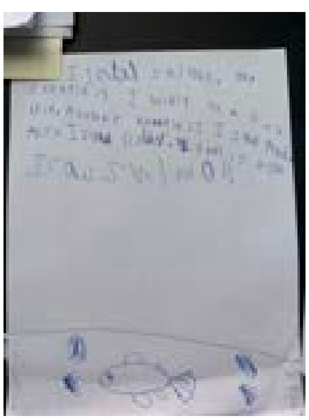
Figure Name	Context/Locati on First Cycle Codes	and Pattern Codes	Appropriate Finding Theme
			Learning; Developing Scientific Identities
 Figure 57	Hands-on investigation, reflection, applying learning, experiences;	Reflective Practice during Scientist-story circles.	Building a Relational Learning Community; Access to Place-Based Learning; Multiple Ways of Knowing and Demonstrating Learning; Developing Scientific Identities
 Figure 58	Written reflection	Reflective Practice during Scientist-story circles. Communication of Learning.	Building a Relational Learning Community; Access to Place-Based Learning; Multiple Ways of Knowing and Demonstrating

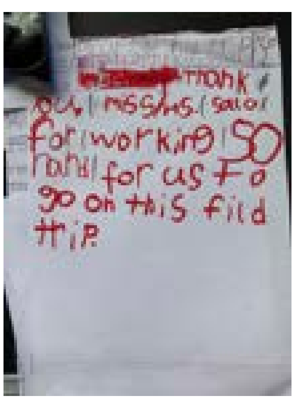
Figure Name	Context/Location First Cycle Codes	and Pattern Codes	Appropriate Finding Theme
			Learning; Developing Scientific Identities
 Figure 59	Written reflection	Reflective Practice during Scientist-story circles; Communication of Learning	Building a Relational Learning Community; Access to Place-Based Learning; Multiple Ways of Knowing and Demonstrating Learning; Developing Scientific Identities;
 Figure 60	Written reflection	Reflective Practice during Scientist-story circles Communication of positive learning community	Building a Relational Community. Access to Place-Based Learning; Developing Scientific Identities

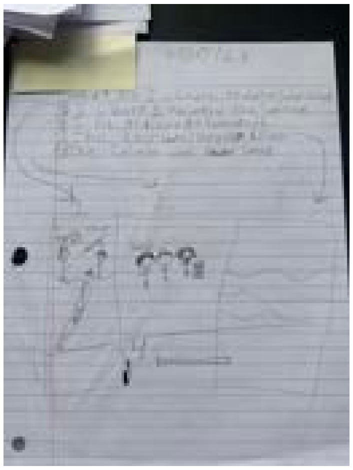
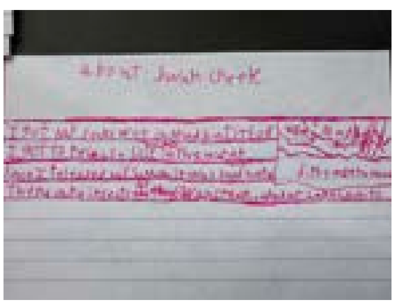
Figure Name	Context/Location First Cycle Codes	and Pattern Codes	Appropriate Finding Theme
 Figure 61	Hands-on investigation, reflection, applying learning, experiences	Reflective Practice during Scientist-story circles; Communication of Learning	Building a Relational Learning Community; Access to Place-Based Learning; Multiple Ways of Knowing and Demonstrating Learning; Developing Scientific Identities
 Figure 62	Written reflection	Reflective Practice during Scientist-story circles; Communication of Learning	Building a Relational Learning Community; Access to Place-Based Learning; Multiple Ways of Knowing and Demonstrating Learning; Developing Scientific Identities

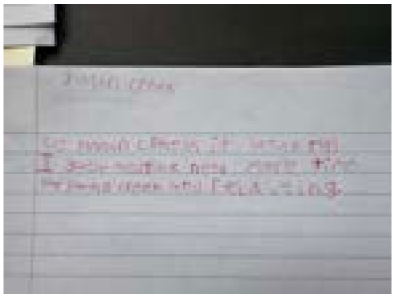
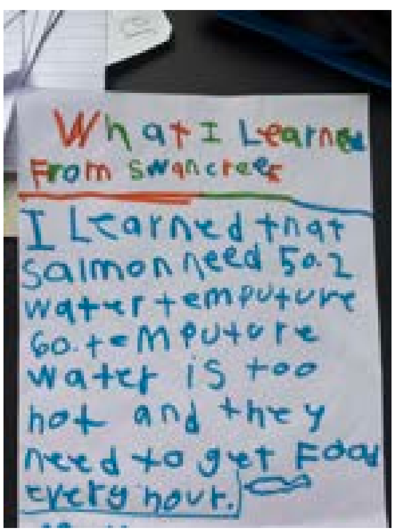
Figure Name	Context/Location First Cycle Codes	and Pattern Codes	Appropriate Finding Theme
 Figure 63	Written reflection	Reflective Practice during Scientist-story circles; Communication of Learning	Building a Relational Learning Community; Access to Place-Based Learning; Multiple Ways of Knowing and Demonstrating Learning; Developing Scientific Identities
 Figure 64	Written reflection	Reflective Practice during Scientist-story circles; Communication of Learning	Building a Relational Learning Community; Access to Place-Based Learning; Multiple Ways of Knowing and Demonstrating Learning; Developing Scientific Identities

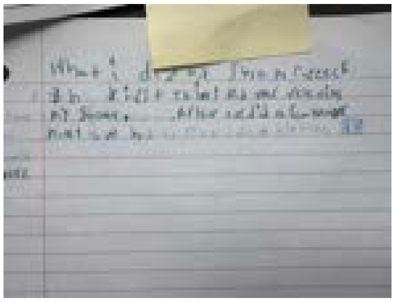
Figure Name	Context/Location First Cycle Codes	and Pattern Codes	Appropriate Finding Theme
 Figure 65	Written reflection	Reflective Practice during Scientist-story circles; Communication of Learning	Building a Relational Learning Community; Access to Place-Based Learning; Multiple Ways of Knowing and Demonstrating Learning; Developing Scientific Identities
 Figure 66	Written reflection	Reflective Practice during Scientist-story circles; Communication of Learning	Building a Relational Learning Community; Access to Place-Based Learning; Multiple Ways of Knowing and Demonstrating Learning; Developing Scientific Identities

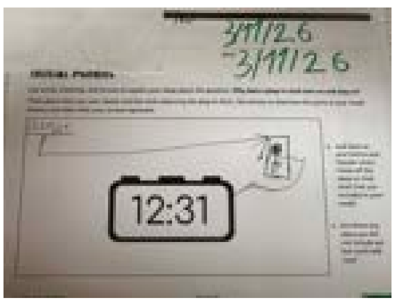
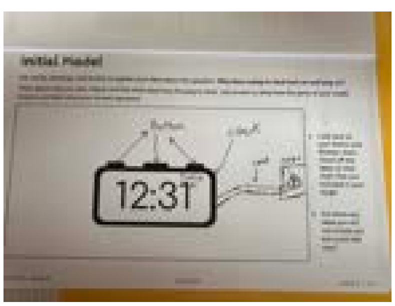
Figure Name	Context/Location First Cycle Codes	and Pattern Codes	Appropriate Finding Theme
 Figure 67	OpenSciEd worksheet packet	Reflective Practice during Scientist-story circles; Communication of Learning.	Multiple Ways of Knowing and Demonstrating Learning; Developing Scientific Identities
 Figure 68	OpenSciEd worksheet packet	Reflective Practice during Scientist-story circles; Communication of Learning.	Multiple Ways of Knowing and Demonstrating Learning; Developing Scientific Identities
 Figure 69	OpenSciEd worksheet packet	Reflective Practice during Scientist-story circles; Communication of Learning.	Multiple Ways of Knowing and Demonstrating Learning; Developing Scientific Identities

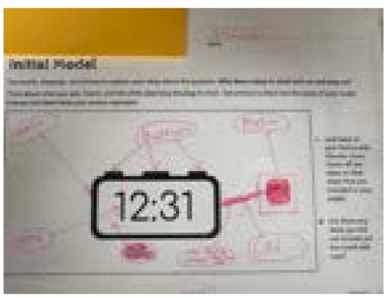
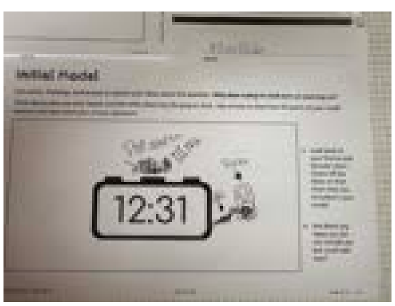
Figure Name	Context/Location First Cycle Codes	and Pattern Codes	Appropriate Finding Theme
 Figure 70	OpenSciEd worksheet packet	Reflective Practice during Scientist-story circles; Communication of Learning.	Multiple Ways of Knowing and Demonstrating Learning; Developing Scientific Identities
 Figure 71	OpenSciEd worksheet packet	Communication of Learning.	Multiple Ways of Knowing and Demonstrating Learning; Developing Scientific Identities
 Figure 72	OpenSciEd worksheet packet	Communication of Learning.	Multiple Ways of Knowing and Demonstrating Learning; Developing Scientific Identities

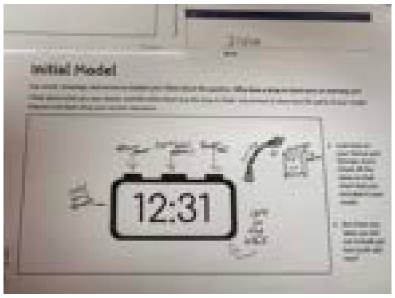
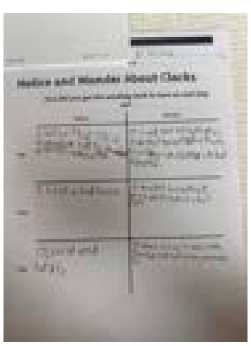
Figure Name	Context/Location First Cycle Codes	and Pattern Codes	Appropriate Finding Theme
 Figure 73	OpenSciEd worksheet packet	Reflective Practice during Scientist-story circles; Communication of Learning.	Multiple Ways of Knowing and Demonstrating Learning; Developing Scientific Identities
 Figure 74	OpenSciEd worksheet packet	Reflective Practice during Scientist-story circles; Communication of Learning.	Multiple Ways of Knowing and Demonstrating Learning; Developing Scientific Identities
	OpenSciEd worksheet packet	Reflective Practice during Scientist-story circles; Communication of Learning.	Multiple Ways of Knowing and Demonstrating Learning; Developing Scientific Identities

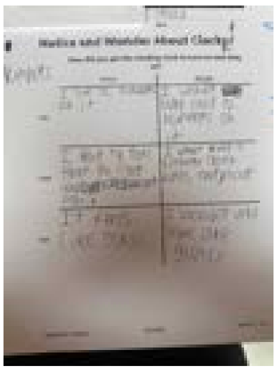
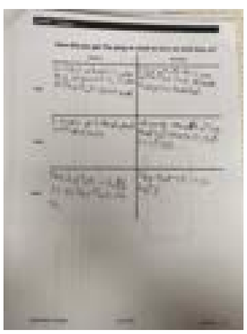
Figure Name	Context/Location First Cycle Codes	and Pattern Codes	Appropriate Finding Theme
Figure 75			
 Figure 76	OpenSciEd worksheet packet	Reflective Practice during Scientist-story circles; Communication of Learning.	Multiple Ways of Knowing and Demonstrating Learning; Developing Scientific Identities
 Figure 77	OpenSciEd worksheet packet	Reflective Practice during Scientist-story circles; Communication of Learning.	Multiple Ways of Knowing and Demonstrating Learning; Developing Scientific Identities

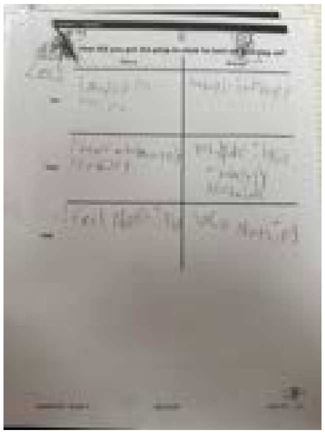
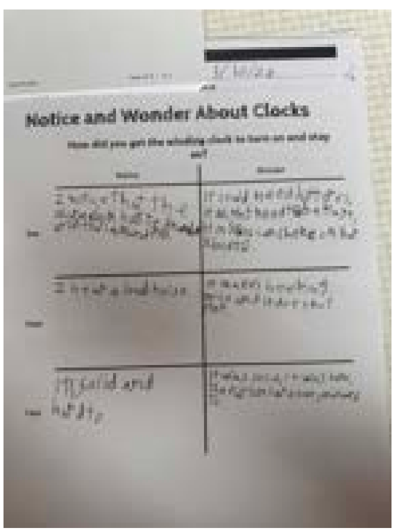
Figure Name	Context/Location First Cycle Codes	and Pattern Codes	Appropriate Finding Theme
 Figure 78	OpenSciEd worksheet packet	Reflective Practice during Scientist-story circles; Communication of Learning.	Multiple Ways of Knowing and Demonstrating Learning; Developing Scientific Identities
 Figure 79	OpenSciEd worksheet packet	Reflective Practice during Scientist-story circles; Communication of Learning.	Multiple Ways of Knowing and Demonstrating Learning; Developing Scientific Identities

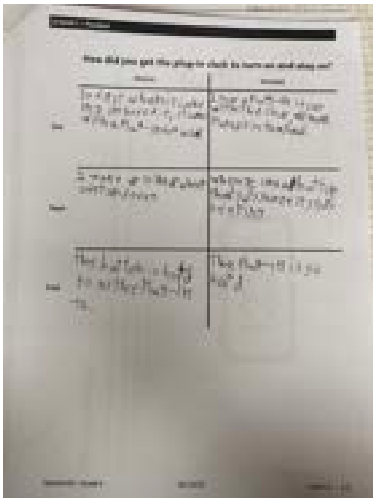
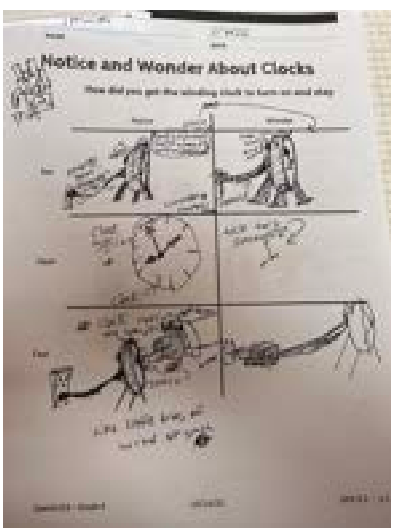
Figure Name	Context/Locati on First Cycle Codes	and Pattern Codes	Appropriate Finding Theme
 Figure 80	OpenSciEd worksheet packet	Reflective Practice during Scientist-story circles; Communication of Learning.	Multiple Ways of Knowing and Demonstrating Learning; Developing Scientific Identities
 Figure 81	OpenSciEd worksheet packet	Reflective Practice during Scientist-story circles; Communication of Learning.	Multiple Ways of Knowing and Demonstrating Learning; Developing Scientific Identities

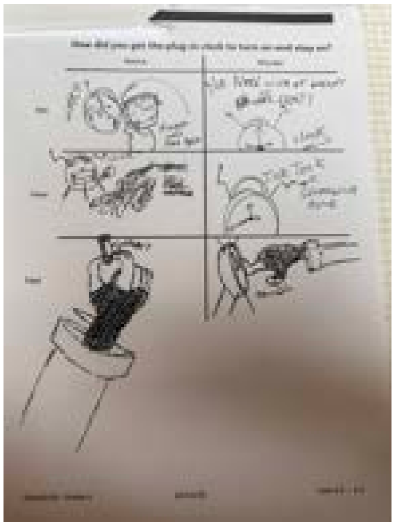
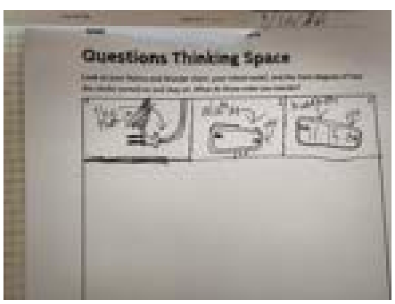
Figure Name	Context/Location First Cycle Codes	and Pattern Codes	Appropriate Finding Theme
 Figure 82	OpenSciEd worksheet packet	Reflective Practice during Scientist-story circles; Communication of Learning.	Multiple Ways of Knowing and Demonstrating Learning; Developing Scientific Identities
 Figure 83	OpenSciEd worksheet packet	Reflective Practice during Scientist-story circles; Communication of Learning.	Multiple Ways of Knowing and Demonstrating Learning; Developing Scientific Identities

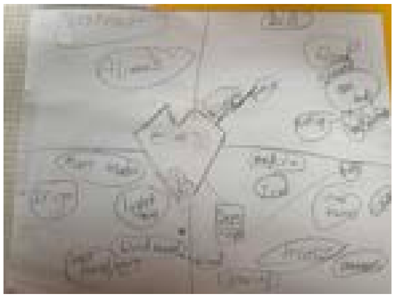
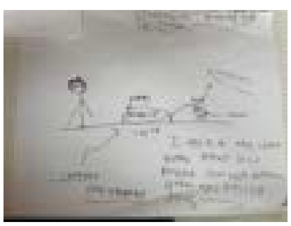
Figure Name	Context/Location First Cycle Codes	and Pattern Codes	Appropriate Finding Theme
 Figure 84	Written reflections	Reflective Practice during Scientist-story circles; Synthesis.	Multiple Ways of Knowing and Demonstrating Learning
 Figure 85	illustrations	Reflective Practice during Scientist-story circles.; Student engagement	Multiple Ways of Knowing and Demonstrating Learning
 Figure 86	Written Notes OpenSciEd supporting claims with evidence	Evidence-Based Reasoning	Multiple Ways of Knowing and Demonstrating Learning

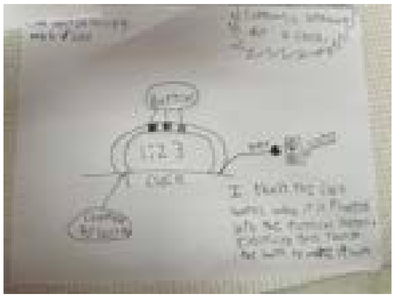
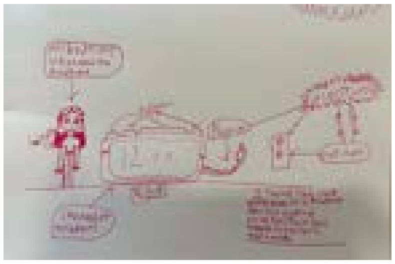
Figure Name	Context/Location First Cycle Codes	and Pattern Codes	Appropriate Finding Theme
 Figure 87	OpenSciEd supporting claims with evidence	Reflective Practice during Scientist-story circles.	Multiple Ways of Knowing and Demonstrating Learning
 Figure 88	Written reflection	Reflective Practice during Scientist-story circles; Communication of Learning	Building a Relational Learning Community; Access to Place-Based Learning; Multiple Ways of Knowing and Demonstrating Learning; Developing Scientific Identities

Figure Name	Context/Location First Cycle Codes	and Pattern Codes	Appropriate Finding Theme
 Figure 89	Written Notes OpenSciEd	Reflective Practice during Scientist-story circles; Communication of learning; evidence based reasoning	Multiple Ways of Knowing and Demonstrating Learning
 Figure 90	Walking to the Lake Leshi Food Forest.	Reflective Practice during Scientist-story circles; Place-Based Learning stewardship, outdoor exploration	Building a Relational Learning Community; Access to Place-Based Learning; Developing Scientific Identities

Appendix D: List of Acronyms

CLS	Chief Leschi Schools
DiP	Dissertation in Practice
IK	Indigenous Knowledge
IKS	Indigenous Knowledge Systems
STEM	Science, Engineering, Technology, Math
SOAR	Success Outcome Arts and Rigor
PBL	Place-Based Learning
PoP	Problem of Practice
UWT/MTC	University of Washington Muckleshoot Tribal College

Appendix C: List of Definitions

Word or phrase	Definition	Sources from the literature	Employed Definition for this DiP
Ethnography	is a qualitative research methodology in which researchers systematically examine their own lived experiences to gain insight into broader cultural, social, and institutional contexts	Merriam and Tisdell (2016) Creswell and Poth (2018)	is a qualitative research methodology in which researchers systematically examine their own lived experiences to gain insight into broader cultural, social, and institutional contexts
Axiology	Ethical obligations	Wilson (2008)	
Decolonization	Numerous storied examples of restoring agency, self-determination, and land sovereignty		

	to Indigenous communities by centering values from Indigenous Knowledge. Reclaiming land is a critical step toward empowerment because the land is not just a resource but a living entity		
Epistemology	A way of knowing, being and doing.	Wilson (2008)	A way of knowing, being and doing.
Feeding Log	A feeding log is a naturally fallen, decaying tree trunk on a forest floor that provides a vital micro-ecosystem for feeding, foraging, and	Wisniewski, A. (2017). Nurse Logs: Healers of the Forest. American Forests. July, 12	A feeding log is a naturally fallen, decaying tree trunk on a forest floor that provides a vital micro-ecosystem for feeding, foraging, and

	nourishing new forest life.		nourishing new forest life.
Indigenous Knowledge	wholistic, place-based understandings developed through long-standing relationships among people, land, water, and all living beings. It is relational, experiential, and sustained through storytelling, ceremony, observation, and practice across generations. In this research, Indigenous Knowledge is understood as a living	Cajete (2015), Kimmerer (2013), Smith (2021), Wilson (2008).	Indigenous Knowledge is understood as a living system of knowing, being, and doing that guides respectful relationships, responsibility, and reciprocity within science education.

	system of knowing, being, and doing that guides respectful relationships, responsibility, and reciprocity within science education.		
Indigenous Knowledge System (IKS)	IKS is relational and inseparable from the communities, lands, responsibilities, and relationships that produce them.	(Smith, 1999, Kovach, 2009, Wilson, 2008)	IKS is relational and inseparable from the communities, lands, responsibilities, and relationships that produce them.
Ontology	The nature of being, existence, and reality	Wilson (2008)	The nature of being, existence, and reality
Qualitative inquiry	recognizes that educational experiences are shaped by context and that understanding	(Creswell & Poth, 2018; Denzin & Lincoln, 2018; Merriam & Tisdell, 2016)	recognizes that educational experiences are shaped by context and that understanding

	emerges through careful observation, reflection, and interpretation.		emerges through careful observation, reflection, and interpretation.
Wholism	An Indigenous concept emphasizing the inseparable relationships among intellectual, emotional, physical, spiritual, and communal dimensions of life.	Absolon , 2022	Wholism frames student learning as interconnected across relationships with self, community, land, and scientific understanding academic achievement.

Appendix D:Timeline of Experiences

This chart looks at each of the components of this DiP and provides a timeline of experiences

Dates	Elementary Salmon Program	Lake Leschi	OpenSciEd	NGSS	Notes
Daily	Discuss salmon restoration project	Daily weather observations/ access; Discuss what we saw and what we want to see next	Establishing Norms for STEM Practices; Scientist-story circles; Think pair share	4-LS1-1. Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior,	As a class we took pride in how we supported each other in our classroom routines.

Dates	Elementary Salmon Program	Lake Leschi	OpenSciEd	NGSS	Notes
				and reproductio n	
Daily after October until March Date when the salmon fry are taken to Swan Creek for release	Students who work in pairs visit the salmon tank in the elementary library. Students check the temperature of the water in the tank. Students observe that each system	When visiting Lake Leschi during this time students were able to see the on-site hatchery from the outside. We did not have access into the	OpenSciEd Unit on Forces and Motion OpenSciEd Unit on Forces and Motion	Energy (4-PS3) Structure, Function, and Information Processing (4-LS1) Systems and System Models (4-LS1-2)	Forces and motion touched on themes of potential and kinetic energy that related to the OpenSciEd unit on energy utilized in this DiP This was a support for the

Dates	Elementary Salmon Program	Lake Leschi	OpenSciEd	NGSS	Notes
	of the tank is running properly. Collect water samples daily and checking for ammonia in the water Students feed the salmon twice daily Students clean the tank, when necessary, with adult supervising	hatchery at Lake Leschi			DiP by giving an introduction to the format OpenSciEd worksheet packets. When given the choice students preferred a blank sheet of paper to a worksheet. Same information but with more space for

Dates	Elementary Salmon Program	Lake Leschi	OpenSciEd	NGSS	Notes
					illustrations and labeling
November 18th, 2025 Filed Trip to Lake Leschi	Visit on site hatchery that vertically aligns though secondary, high school and CTE program from the outside. No access. Visited Lake Leschi food forest and observed that the weather was changing and winter was	Looking for natural systems of energy transfer Sun, plants, animals Looking for man-made systems of energy transfer	OpenSciEd unit on Forces and Motion continued; What is a concept map?	Fourth grade performance expectations include PS3, PS4, LS1, ESS1, ESS2, ESS3, and ETS1 crosscutting concepts of patterns, cause and effect,	Student Choice: Student Cameras Notice and Wonder Identifying biodiversity and ecosystems Quick illustrations

Dates	Elementary Salmon Program	Lake Leschi	OpenSciEd	NGSS	Notes
	coming			energy and matter, systems and system models Science and Engineering Practices	Learning expectations for field study
November 19th, 2025	What is actually inside the Hatchery Container, showed picture from 2024 secondary STEM club, What is	Concept map of natural energy system transfer Concept map of natural energy system	Review of Science and engineering practices	4-ESS1-1 Constructing Explanations and Designing Solutions 4-ESS1-1 SS1.C: The	Classroom reflection of work and feedback Lucky the Dog was adopted

Dates	Elementary Salmon Program	Lake Leschi	OpenSciEd	NGSS	Notes
	Community grounded praxis in relation to the CLS elementary salmon program. Their role in sustainability. Capturing student voice	transfer		History of Planet Earth Patterns can be used as evidence to support an explanation. (4-ESS1-1)	
November 20th, 2025	Classroom reflection of work and connections. Think pair share and scientist-story	Classroom reflection of work and connections. Think pair share and scientist-story	Review Science and Engineering practices	4-ESS1-1 Constructing Explanations and Designing Solutions	Who are citizen scientists? Who are scholars?

Dates	Elementary Salmon Program	Lake Leschi	OpenSciEd	NGSS	Notes
	circles	circles			Who are researchers?
November 20th, 2025	Slideshow of field trip to Lake Leschi	Slideshow of field trip to Lake Leschi	Think pair share and scientist-story circles	Patterns 4-ESS1-1	Discussion of DiP, research partners in this DiP, social justice and our work making a difference (age-appropriate)
December 2nd, 2025	Focus: Energy and fuels	Scientist pairs	Focus: Energy and	Focus: Energy and	Review Norms

Dates	Elementary Salmon Program	Lake Leschi	OpenSciEd	NGSS	Notes
	that humans use are derived from natural sources, and their use affects the environment in multiple ways. Some resources are renewable over time, and others are not. (4-ESS3-1)	compare concept maps and identify differences and agreements	fuels that humans use are derived from natural sources, and their use affects the environment in multiple ways. Some resources are renewable over time, and others are not. (4-ESS3-1)	fuels that humans use are derived from natural sources, and their use affects the environmen t in multiple ways. Some resources are renewable over time, and others	Findings support that the sun is the primary source of all energy on earth. Parker Solar Space Probe models

Dates	Elementary Salmon Program	Lake Leschi	OpenSciEd	NGSS	Notes
				are not. (4-ESS3-1)	
December 3rd, 2025	Focus: Energy and fuels that humans use are derived from natural sources, and their use affects the environment in multiple ways. Some resources are renewable over time, and others are not. (4-ESS3-1)	Scientist pairs compare concept maps and identify differences and agreements	Focus: Energy and fuels that humans use are derived from natural sources, and their use affects the environment in multiple ways. Some resources are renewable over time, and others are not.	Focus: Energy and fuels that humans use are derived from natural sources, and their use affects the environment in multiple ways. Some	Review Norms Findings support that the sun is the primary source of all energy on earth. Parker Solar Space Probe models

Dates	Elementary Salmon Program	Lake Leschi	OpenSciEd	NGSS	Notes
			(4-ESS3-1)	resources are renewable over time, and others are not. (4-ESS3-1)	
Thursday December 4th, 2025	Focus: Energy and fuels that humans use are derived from natural sources, and their use affects the environment in multiple ways. Some resources are renewable	Scientist Circles compare concept maps and identify differences and agreements	Focus: (4-ESS3-1) Energy and fuels that humans use are derived from natural sources, and their use affects the environment	Focus: Energy and fuels that humans use are derived from natural sources, and their use affects the	Parker Solar Space Probe models

Dates	Elementary Salmon Program	Lake Leschi	OpenSciEd	NGSS	Notes
	over time, and others are not. (4-ESS3-1)		in multiple ways. Some resources are renewable over time, and others are not.	environment in multiple ways. Some resources are renewable over time, and others are not. (4-ESS3-1)	
December 9th, 2025	Elementary Salmon tank, water treatment cycling though the tank and systems in	Planning what we will investigate at our next Lake Leschi visit	4-ESS3-2. Generate and compare multiple solutions to reduce the	Obtain and combine information to describe that energy and fuels	Students used drones from the Indigenous Education Institute and suggested

Dates	Elementary Salmon Program	Lake Leschi	OpenSciEd	NGSS	Notes
	preparations for upcoming Salmon Eggs		impacts of natural Earth processes on humans.	are derived from natural resources and their uses affect the environmen t (4-ESS3-1)	using the drones to feed the salmon at Lake Leschi, or the Puyallup tribe's hatchery
Thursday December 11th, 2025	Water testing of the salmon tank Review as a class the tank's systems and what will be checked with selected partner	Discussing with students how the next trip to Lake Leschi will be shorter Students complained it	4-ESS3-2. Generate and compare multiple solutions to reduce the impacts of natural Earth processes on	4-ESS3-2. Generate and compare multiple solutions to reduce the impacts of natural	Student generated checklists Student data collection

Dates	Elementary Salmon Program	Lake Leschi	OpenSciEd	NGSS	Notes
		was not going to be enough time. I agreed to put in my findings.	humans.	Earth processes on humans.	
December 16th, 2025	Practice expectations for the salmon tank in the library.	Practice lining up quickly during transitions to prepare for our 30 minute trip to Lake No Access	Challenge: No access to the OpenSciEd fourth grade box for the unit on Energy.	(4-ESS3-1) Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the	Preparation for when the opportunity for access is allowed

Dates	Elementary Salmon Program	Lake Leschi	OpenSciEd	NGSS	Notes
				environment	
December 17th, 2025	Practice expectations for the salmon tank in the library.	Practice lining up quickly during transitions to prepare for our 30 minute trip to Lake Leschi No Access	Prepared student worksheets for the energy unit and the students were not happy with me because of too many worksheets. I explained that we will have to complete	(4-ESS3-1) Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environmen	Findings: The fourth grade class I taught at CLS does not like worksheets.

Dates	Elementary Salmon Program	Lake Leschi	OpenSciEd	NGSS	Notes
			some of the worksheets	t	
Thursday December 18th, 2025	Afternoon assembly	Afternoon assembly No Access	Afternoon assembly	Afternoon assembly	Afternoon assembly
January 6th, 2026	Review age appropriate DiP progress with students Review Pictures taken already	Planning what we will investigate at our next Lake Leschi visit No Access	Challenge: No access to the OpenSciEd fourth grade box for the unit on Energy.	(4-ESS3-1) Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect	During their tech time Students watched videos on natural resources of energy and how it can be harnessed from two perspectives (positive/negat

Dates	Elementary Salmon Program	Lake Leschi	OpenSciEd	NGSS	Notes
				the environment	ive) Link National Geographic. (2017, September 22).
January 7th, 2026	We received our Salmon Eggs from the Puyallup hatchery via the Foss Waterway Seaport Salmon Live stream set up in the elementary library.	Planning what we will investigate at our next Lake Leschi visit No Access	Challenge: No access to the OpenSciEd fourth grade box for the unit on Energy.	S1.A: Structure and Function Plan and implement an investigation using 3D modeling	Learning how to use three dimensional modeling with tinkercad Salmon Live stream set up in the elementary library.

Dates	Elementary Salmon Program	Lake Leschi	OpenSciEd	NGSS	Notes
January 8th, 2026	Salmon data pairs begin rotations	Planning what we will investigate at our next Lake Leschi visit Weather is not permitting safe and healthy access	Challenge: No access to the OpenSciEd fourth grade box for the unit on Energy.	(4LS1-1); (4-LS1-2) Systems and System Models A system can be described in terms of its components and their interactions. 4-LS1-1. Construct an argument that plants	Salmon Cam not working

Dates	Elementary Salmon Program	Lake Leschi	OpenSciEd	NGSS	Notes
				and animals have internal and external structures that function to support survival, growth, behavior, and reproductio n	
January 13th, 2026	Salmon data pairs, rotation Assigned two students access	Planning what we will investigate at our next Lake Leschi visit	Challenge: No access to the OpenSciEd fourth grade	(4-LS1-2), Developing and Using Models (4-LS1-1)	Checked on the salmon webcam throughout the day with

Dates	Elementary Salmon Program	Lake Leschi	OpenSciEd	NGSS	Notes
	to the Salmon webcam Computer, trained them on how to make it work.	No Access Weather is not permitting safe and healthy access	box for the unit on Energy.	Engaging in Argument from Evidence	students.
January 14th, 2026	Foss Waterway Seaport Museum Visit Salmon data pairs, rotation	Planning what we will investigate at our next Lake Leschi visit Weather is not permitting safe and healthy access	Challenge: No access to the OpenSciEd fourth grade box for the unit on Energy.	(4LS1-1); (4-LS1-2)	

Dates	Elementary Salmon Program	Lake Leschi	OpenSciEd	NGSS	Notes
Thursday January 15th, 2026	Salmon data pairs, rotation	What is Biodiversity and what did we see at our last visit to Lake Leschi Weather is not permitting safe and healthy access	Challenge: No access to the OpenSciEd fourth grade box for the unit on Energy.	4-LS1-1.	What is Biodiversity and what did we see at our last visit to Lake Leschi (photos and Scientist-story circle)
Thursday, January 20th, 2026	Salmon data pairs, rotation	What is Biodiversity and what did we see at our last visit to Lake Leschi	Challenge: No access to the OpenSciEd fourth grade box for the	4-LS1-1.	What is Biodiversity and what did we see at our last visit to Lake Leschi

Dates	Elementary Salmon Program	Lake Leschi	OpenSciEd	NGSS	Notes
		(photos and Scientist-story circle) Weather is not permitting safe and healthy access	unit on Energy.		(photos and Scientist-story circle)
January 21st, 2026	Salmon data pairs, rotation	What are invasive species and what plants are native? Weather is not permitting	Challenge: No access to the OpenSciEd fourth grade box for the unit on Energy.	(4LS1-1); (4-LS1-2)	What are invasive species and what plants are native? Where do things grow? Oranges,

Dates	Elementary Salmon Program	Lake Leschi	OpenSciEd	NGSS	Notes
		safe and healthy access			avocados, bananas
Thursday January 22nd, 2026	Salmon data pairs, rotation	What are invasive species and what plants are native? Weather is not permitting safe and healthy access	Challenge: No access to the OpenSciEd fourth grade box for the unit on Energy.	(4LS1-1); (4-LS1-2)	
January 27th, 2026	Salmon data pairs, rotation	How long will it take for the food forest to	Challenge: No access to the OpenSciEd	4-PS4-3 Generate and compare	How long will it take for the food forest to grow?

Dates	Elementary Salmon Program	Lake Leschi	OpenSciEd	NGSS	Notes
		grow? Scientist-story circle Weather is not permitting safe and healthy access	fourth grade box for the unit on Energy.	solutions that use patterns to Transfer information	Scientist-story circle
January 28th, 2026	Salmon data pairs, rotation	Weather is not permitting safe and healthy accessWhere do the salmon released at Lake Leschi go?	Challenge: No access to the OpenSciEd fourth grade box for the unit on Energy.	4-PS4-3 Generate and compare solutions that use patterns to Transfer information	Looked at maps on the computer

Dates	Elementary Salmon Program	Lake Leschi	OpenSciEd	NGSS	Notes
		Is there an outlet to a bigger body of water with a stream that would allow for them to reach saltwater at the right time and return once they are ready to spawn?			
Thursday January 29th, 2026	Salmon data pairs, rotation	Weather is not permitting safe and healthy	Challenge: No access to the OpenSciEd fourth grade	4-PS4-3 Generate and compare solutions	UWT meeting with DiP Committee

Dates	Elementary Salmon Program	Lake Leschi	OpenSciEd	NGSS	Notes
		access Life cycle of the Salmon and instinct of seasonal patterns	box for the unit on Energy.	that use patterns to Transfer information	
February 3rd, 2026	Salmon data pairs, rotation Salmon Life cycle continued: Naming the five of the most common species of salmon Chum, Sockeye, King, Coho, and Pink	No Access	Challenge: No access to the OpenSciEd fourth grade box for the unit on Energy.	4-LS1-1; 4-LS1-2	

Dates	Elementary Salmon Program	Lake Leschi	OpenSciEd	NGSS	Notes
February 4th, 2026	Salmon data pairs, rotation Name and illustrate each system working together for the salmon tank	No Access	Challenge: No access to the OpenSciEd fourth grade box for the unit on Energy.	SEP 4 — Analyzing and Interpreting Data	
Thursday February 5th, 2026	Salmon data pairs, rotation Test tank water	Visit 2 Access!!! Collected photos, illustrations and made power point	Challenge: No access to the OpenSciEd fourth grade box for the unit on Energy.	SEP 4 — Analyzing and Interpreting Data	
February 10th, 2026	Salmon data pairs, rotation	Scientist-story circles	Challenge: No access to the	MP.2 Reason abstractly	

Dates	Elementary Salmon Program	Lake Leschi	OpenSciEd	NGSS	Notes
	Test tank water		OpenSciEd fourth grade box for the unit on Energy.	and quantitatively. **MP.3** Construct viable arguments and critique reasoning.	
February 11th, 2026	Salmon data pairs, rotation	No Access	Challenge: No access to the OpenSciEd fourth grade box for the unit on Energy.	MP.5 Use appropriate tools strategically. MP.6 Attend to precision.	
February 12th,	Salmon data pairs, rotation	Visit 3 Access!!!	Challenge: No access to	4-ESS1-1; 4-ESS2-1	

Dates	Elementary Salmon Program	Lake Leschi	OpenSciEd	NGSS	Notes
2026			the OpenSciEd fourth grade box for the unit on Energy.		
February 17th, 2026	Procedures OpenSciEd; Universal practices Salmon data pairs, rotation Salmon data pairs, rotation	Procedures OpenSciEd; Universal practices	Procedures OpenSciEd; Universal practices	Procedures OpenSciEd; Universal practices	
February 18th, 2026	Procedures Universal practices	Procedures Universal practices	Procedures Universal practices	Procedures Universal practices	

Dates	Elementary Salmon Program	Lake Leschi	OpenSciEd	NGSS	Notes
	Salmon data pairs, rotation				
February 25th, 2026	Procedures Universal practices Salmon data pairs, rotation	Procedures Universal practices	Procedures Universal practices	Procedures Universal practices	
Thursday February 26th, 2026	Salmon data pairs, rotation	Visit 4 Access!!!	Challenge: No access to the OpenSciEd fourth grade box for the unit on Energy.	4-ESS2-1	

Dates	Elementary Salmon Program	Lake Leschi	OpenSciEd	NGSS	Notes
March 3rd, 2026	Salmon data pairs, rotation	Scientist-story circle for previous day's visit to the Lake Leachi Food Forest	Challenge: No access to the OpenSciEd fourth grade box for the unit on Energy.	SEP 4 — Analyzing and Interpreting Data	
March 4th, 2026	Salmon data pairs, rotation	No Access	Challenge: No access to the OpenSciEd fourth grade box for the unit on Energy.	SEP 4 — Analyzing and Interpreting Data	
Thursday March 5th, 2026	Salmon data pairs, rotation	Visit 5 Access!!!	OpenSciEd materials for unit 6 arrive	4-PS3-4	

Dates	Elementary Salmon Program	Lake Leschi	OpenSciEd	NGSS	Notes
March 10th, 2026	Salmon data pairs, rotation	No Access	OpenSciEd Anchoring Phenomena Unit 6 Notice and Wonder	4-PS3-2 Observe and provide evidence that energy transfers through sound, light, heat, and electric currents.	
March 11th, 2026	Salmon data pairs, rotation	No Access	Initial model Unit 6	4-PS3-2 Observe and provide evidence that energy transfers through	

Dates	Elementary Salmon Program	Lake Leschi	OpenSciEd	NGSS	Notes
				sound, light, heat, and electric currents.	
Thursday March 12th, 2026	Salmon data pairs, rotation	No Access	Initial model Unit 6	4-PS3-2 Observe and provide evidence that energy transfers through sound, light, heat, and electric currents.	
March 17th, 2026	Salmon data pairs, rotation	Frontloading expectations for Swan Creek salmon	Concept model	Frontloading expectations for Swan	Frontloading expectations for Swan Creek salmon

Dates	Elementary Salmon Program	Lake Leschi	OpenSciEd	NGSS	Notes
		release		Creek salmon release	release
March 18th, 2026	Salmon data pairs, rotation	Frontloading expectations for Swan Creek salmon release	Consensus model (pairs)	Frontloading expectations for Swan Creek salmon release	Frontloading expectations for Swan Creek salmon release
Thursday March 19th, 2026	Salmon data pairs, rotation	Visit 6 Access!!!	Consensus model (small groups)	4-PS3-2 Observe and provide evidence that energy transfers through sound, light, heat,	Frontloading expectations for Swan Creek salmon release

Dates	Elementary Salmon Program	Lake Leschi	OpenSciEd	NGSS	Notes
				and electric currents.	
March 20th 2026	Salmon data pairs, rotation	No Access	Consensus model whole group/ Scientist-Story circle	Consensus model whole group/ Scientist-Story circle	Frontloading expectations for Swan Creek salmon release
March 25th, 2026	Salmon Release at Swan Creek	No Access	4-LS-1 Explain how plant and animal structures support survival, growth, behavior and reproduction	4-PS3-2 Observe and provide evidence that energy transfers through sound, light, heat, and electric currents.	Macroinvertibres Biodiversity scavenger hunt

Dates	Elementary Salmon Program	Lake Leschi	OpenSciEd	NGSS	Notes
Thursday March 26th, 2026	Clean the Salmon tanks and systems	Visit 7 Access!!!	4-LS-1 Explain how plant and animal structures support survival, growth, behavior and reproduction	4-PS3-2 Observe and provide evidence that energy transfers through sound, light, heat, and electric currents.	
March 31th, 2026	Clean the Salmon tanks and systems	Visit to the electrical room on campus at CLS	4-ESS3-1 Explain how energy and fuels come from natural resources and how their use affects the	4-ESS3-1 Explain how energy and fuels come from natural resources and how	

Dates	Elementary Salmon Program	Lake Leschi	OpenSciEd	NGSS	Notes
			environment	their use affects the environmen t	
April 14th, 2026	Clean the Salmon tanks and systems	No Access	Taking turns with the material in the OpenSciEd box, starting with assembling the model clock	Synthesis, filling out the gaps	Using same norms as previously set
April 15th, 2026	Reset salmon tank in elementary library and help with secondary's tank set-up	No Access	assembling the model clock from the OpenSciEd box	Synthesis, filling out the gaps	Scientist-Story circles and presentation of work

Dates	Elementary Salmon Program	Lake Leschi	OpenSciEd	NGSS	Notes
April 16th, 2026	Reset salmon tank in elementary library and help with secondary's tank set-up	Visit #8 Access!!!	Observing and comparing natural systems of energy transfer and man made ones	Synthesis, filling out the gaps	Scientist-Story circles and presentation of work
April 21st, 2026	Reset salmon tank in elementary library and help with secondary's tank set-up	No Access	Observing and comparing natural systems of energy transfer and man made ones	Synthesis, filling out the gaps	Scientist-Story circles and presentation of work
April 22nd,	Ready for next season	No Access	Lesson Combination	Synthesis, filling out	Scientist-Story circles and

Dates	Elementary Salmon Program	Lake Leschi	OpenSciEd	NGSS	Notes
2026			Synthesis, filling out the gaps	the gaps	presentation of work
April 23rd, 2026	Ready for next season	No Access	Lesson combination Synthesis, filling out the gaps	Synthesis, filling out the gaps	Scientist-Story circles and presentation of work
April 28th, 2026	Ready for next season	No Access	Synthesis, filling out the gaps	Synthesis, filling out the gaps	Scientist-Story circles and presentation of work
April 29th, 2026	Ready for next season	No Access	Synthesis, filling out the gaps	Synthesis, filling out the gaps	Scientist-Story circles and presentation of work
April 30th,	Tank ready for next season	No Access	Synthesis, filling out the	Synthesis, filling out	

Dates	Elementary Salmon Program	Lake Leschi	OpenSciEd	NGSS	Notes
2026			gaps	the gaps	

Appendix E: Alignment of Personal Values, Program Values, and Teaching Praxis

Personal Values	UWT/MTC Educational Leadership Values	Teaching Praxis at Chief Leschi Schools
Authenticity: staying genuine and transparent in relationships with students and colleagues	Community-Grounded Approaches: leadership in place, relationships, and service	Co-designing seasonal field trips and experiential learning connecting science learning to Lake Leschi, salmon, and the food forest.
Truthfulness: speaking and acting with integrity	Disrupting and Dismantling Systems of Oppression: critically examining colonial narratives in education	Reframing STEM lessons through Indigenous epistemologies, centering student voice and land-based knowledge.
Consistency and Reciprocity: following through on commitments and modeling reliability	Relational Learning: cultivating learning through respect, trust, and shared experience	Building classroom culture around reciprocal storytelling, scientist-story circles, peer mentorship, and following through on commitments.

Loyalty: sustaining long-term relationships and commitments to community wellbeing	Ancestral Knowledge: honoring intergenerational wisdom and cultural continuity	STEM learning and social-emotional regulation that honors Indigenous identities.
Generosity: sharing time, knowledge, and resources	Healing and Collective Wellbeing: education as restoration and balance	Reciprocity in the form of rewards Raffles, class celebrations, student choice