



QUILLS

Queen's University Indigenous Land-Based Learning STEM
Queen's University Biological Station

Teacher's Guide

Supporting Document for the Queen's University Land-Based Learning STEM (QUILLS) Program

Context

In pursuit of ReconciliACTION Dr. Stephen C. Lougheed, Director of the Queen's University Biological Station (QUBS), received funding from The Natural Sciences and Engineering Research Council of Canada (NSERC), to create science learning materials designed to bring together Indigenous ways of knowing and being and environmental science and technology. The funding came through NSERC's PromoScience program which supports hands-on learning experiences for young students intended to promote an understanding of science and engineering. With the funding QUBS created the Queen's University Indigenous Land-Based Learning STEM (QUILLS) program. QUILLS is a collaborative project, drawing on the expertise of local Indigenous Knowledge Keepers, educators, and faculty members from the departments of Biology, Environmental Science, Geography, and Education at Queen's University. Working in relationship stakeholders created five culturally responsive Learning Bundles focused on grade 7 to 10 Science outcomes, incorporating the themes of the biodiversity crisis, global climate change, traditional Indigenous knowledge systems and the environment, invasive species, and contaminants in the environment. Materials braid together local Indigenous land-based knowledges, Western STEM studies conducted locally, and grade 7-10 curriculum outcomes.



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Authors Note

This guide was written by Alice Johnston with editing support from Emily Verhoek and Jessi DiRocco. Alice Johnston identifies as a non-Indigenous settler Canadian who strives towards allyship in the work she does as a teacher and researcher. Alice is the former Indigenous Knowledge STEM Program Coordinator for the Queen's University Biological Station, a PhD Candidate in the Faculty of Education at Queen's University and works with the Indigenous Education Team in the Limestone District School Board. Alice draws upon her five years of teaching experience in Northern and Western Canada and her academic research to inform insights shared in this guide. Emily Verhoek is the Outreach and Teaching Coordinator for the Elbow Lake Environmental Education Centre and the facilitator of the QUILLS Project. Emily has her B.Sc in Biological Science from the University of Guelph and B.Ed. from Queen's University with teachable subjects in Intermediate/Senior Biology, Geography, and Math. Jessi DiRocco identifies as a mixed-heritage person, reconnecting with her Kanyen'kehá:ka roots with Kenhtè:ke and is the Elementary Student Support and Engagement Teacher at the Limestone District School Board. Additional thanks to Taylor Tye, Paul Grogan, Elizabeth Brule, John Smol, and Stephen C. Loughheed for providing further feedback and editing support.



The Beginning of a Learning Journey

Many teachers indicate that they understand that it is their professional responsibility as outlined by the Truth and Reconciliation Calls to Action, as well as the objectives and goals of their school boards, to integrate Indigenous ways of knowing and being into their teaching practice. Furthermore, many educators care about reconciliation and decolonization on a personal level and are, therefore, intrinsically motivated to do this decolonizing work. Unfortunately, however, most teacher education programs have not adequately prepared teachers to do this work in a good way- meaning in a way that honours tradition and spirit. This tension, in part, is what motivated the creation of the QUILLS program.

In this Teacher's Guide, each Learning Activity, and the QUILLS videos we have tried our best to clearly articulate where the knowledge we are sharing comes from and how it can be delivered effectively. That being said, it is not enough for teachers to simply pick up these resources and deliver them to their students. Additional background work must be done to understand the history of colonization across Turtle Island and the way colonization and neocolonialism both estranges Indigenous and non-Indigenous peoples from the land and marginalizes Indigenous ways of knowing and being from within our dominant institutions. This can be gained by taking Additional Qualifications (AQs) and attending PD sessions. It can also be gained by doing additional reading. To help you in this regard we have made some text suggestion at the end of this guide. There is also no substitute for building rich and meaningful connections with community members who through relationship can share teachings with you and your students.

Our understandings of how to do decolonizing work in a good way are also constantly changing. This resource was released in 2023 and it is likely that in 5 – 10 years our understandings and assumptions will have shifted. For this reason, it is important to stay up to date on best practice and modify and adapt these resources and your teaching practice as is necessary.

There is no one Indigenous perspective that is shared across Turtle Island or even here in Katarokwi, however, as a general rule, once you have built relationships with community members listen to what they have to say. Take suggestions and guidance with an open heart. Also, know that even if you do put the work in it is likely that you will still make mistakes. While mistakes can of course be problematic, Indigenous community members shared with QUILLS that what is most important is what you do next. You must have the humility to acknowledge your mistakes and have the reflexivity and motivation to change your teaching practice moving forward.

Thank you for your interest in the QUILLS program. We wish you luck on this important learning and teaching journey!



1.0 Local Indigenous Groups

As Europeans began to arrive in Southern Ontario, the area known as Katarokwi (Kingston) was home to several unique Indigenous groups including the Huron-Wendat, the Anishinaabe, and the Haudenosaunee peoples. In the late 16th century, due to rising tensions with settlers and other local Indigenous groups, the Huron-Wendat (Huron-wawn-DAt) left the region for the Indigenous Territory of Oklahoma and for Northern Simcoe County in Ontario. Today, the Huron-Wendat First Nation is located in Wendake, Quebec. The Anishinaabek (A-nish-in-'a-beg) are comprised of the Ojibwe (Chippewa), Mississauga (Michi Saagiig Nishnaabeg), Sauteaux (Nahkawiniwak), Nipissing (Nbisiing), and Algonquin (Omamiwininiwag) people. The Katarokwi region is known to be generationally inhabited by the Mississauga and Algonquin peoples. These peoples speak Anishinaabemowin, which belongs to the Algonquin language family. The Haudenosaunee (Hoe-den-oh-'show-nee) were traditionally people of the Five Nations/Haudenosaunee confederacy comprising the Onondowahgah (Seneca), Guyohkohnyoh (Cayuga), Onayotekaono (Oneida), Onundagaono (Onondaga), and Kanyen'kehá:ka (Mohawk) peoples. Today the confederacy is referred to as the Six Nations Confederacy after the Skaruhreh (Tuscarora) joined in 1722. The Nations of the Confederacy speak related Iroquoian languages. The Tyendinaga Mohawks of the Bay of Quinte is geographically Kingston's closest First Peoples reserve community. Many of the people in this community speak the Kenhtè:ke dialect of Kanyen'kéha; this is the dialect from which the name Katarokwi derives – originally Ken'tarókwi which translates to: a place where there is clay. Other local communities with which Kingston shares ties are Alderville First Nation (Mississauga) and Ardoch Algonquin First Nation. Today, in addition to Anishinaabe and Haudenosaunee Peoples, the Katarokwi region is host to Métis, Cree, and many other Indigenous groups from across Turtle Island.

The land on which the Elbow Lake Environmental Education Centre is situated is considered unceded territory, part of the Algonquin Land Claim by the Algonquins of Ontario currently under negotiation with the federal government of Canada. Traditionally, the Anishinaabe and Haudenosaunee Nations used these lands during spring and summer for trading.

A trade agreement was memorialized in oral tradition as well as symbolized by a beaded wampum belt. Wampum belts are recorded documents constructed from purple and white shell beads forming symbolic designs reflective of significant events and/or codes of ethics. One of the wampum belts that represents this area is referred to as the 'Dish with One Spoon'. In the Dish with One Spoon agreement, the dish symbolizes shared territory, while the soft-edged spoon indicates that people are eating out of the single dish, without intention of harming one another, hunting in the shared territory and expected to share the game and fish, not only with each other, but also in a manner that leaves enough for the future.



2.0 Perspectives of Science

2.1 Indigenous Ways of Knowing Nature

Indigenous languages are verb based, whereas the English language is noun based. Accordingly, the English word “knowledge” does not have an equivalent in Indigenous languages. Instead, the Indigenous expression for knowledge would translate roughly into something like “ways of living” or “ways of being” (Aikenhead & Michell, 2011). Accordingly, as opposed to adopting the phrase Indigenous knowledge, throughout this guide the phrase Indigenous ways of knowing and being is used. Additionally, in reference to Indigenous science the phrase Indigenous ways of knowing nature (IWKN) is utilized. It is difficult to succinctly define such a sophisticated, and complex way of relating to the land. That said a definition of Indigenous ways of knowing nature (IWKN) might look something like the following:

IWKN includes a vast, diverse, and sophisticated body of knowledge of a group of peoples that has been generated over thousands of years (Deloria & Wildcat, 2001). It is passed down from one generation to another through family, Elders, community members, and Knowledge Keepers and continues to evolve over time (Hampton, 1995). IWKN are an integral part of Indigenous identities and a collection of knowledge founded upon Indigenous peoples’ relationship with land, water, plants, and animals since time immemorial (Antoine, Mason, Mason, Palahicky, Rodriguez de France, 2018). It includes ways of knowing that pertain not only to cultures and beliefs, but also to physical space, environments, and place (Cajete, 1994). Indigenous ways of knowing nature are collected through a closely connected reciprocal relationship with land, characterized by observing, interacting, and experiencing the natural world, in which we are all a part (Knudston & Suzuki, 2006). IWKN are holistic and have a distinct spiritual dimension (Cajete, 1994; Henderson, 2000; Deloria & Wildcat, 2001). Within IWKN it is understood that every being is alive and has a spirit, and that we are all interconnected and interdependent (Cajete, 1994; Henderson, 2000; Deloria & Wildcat, 2001). Additionally, it is understood that messages regarding how to conduct oneself in a good way are transmitted from the spirit world through the land (Cajete, 1994; Deloria & Wildcat, 2001). IWKN capture the nuances of specific place, and the interconnectedness of all living and non-living things in that place. IWKN will vary from community to community, as it is dependent on each different geographical area, meaning that there is a diverse collection of Indigenous land-based knowledges, and not just one single truth (Cajete, 1994). Indigenous ways of knowing nature also encompass the environmental knowledge of successive generations about a specific place (Cajete, 1994). This intergenerational knowledge tells an important and indispensable story about how land has changed over time (Deloria & Wildcat, 2001). Accordingly, IWKN have come to inform various scientific fields including those related to climate change, sustainability, and resource management (Dudgeon & Birkes, 2003; Johannes, 1989).



The Indigenous ways of knowing nature you will encounter in the QUILLS program is local knowledge pertaining to the Katarokwi (Kingston) region which has been and continues to be passed down from generation to generation. It is knowledge about how to live and thrive in this place. As it has for millennia, this knowledge continues to support the flourishing of Anishinaabe and Haudenosaunee peoples in the area.

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2.2 Definition of Western Science

Western science is a formalized framework for understanding the natural and physical world – seeking to explain patterns and phenomena using detailed observations, experiments, and quantitative approaches. It includes central tenets of scepticism, transparent methodologies, and replicability. Challenges to existing ideas, based on new observations and experiments, are used to continually increase our understanding of the world around us. Western science is typically presented as being ‘reductionist’ by isolating and experimenting on components of complex systems, although some disciplines assume a more holistic approach (e.g., ecologists wishing to understand biological communities and ecosystems). Finally, Western science is intended to be independent of the observer and thus aspires to objectivity. Of course, Western science is a human endeavour – meaning that, irrespective of these aforementioned ideals, scientists can bring biases and assumptions reflecting their culture and upbringing, similar to all other approaches (S. Lougheed & J. Smol, personal communication, August 30, 2023).

It is important to emphasize that within Western science distinct scientific paradigms, or framework’s for thought and action, operate. Paradigms determine what a community of like-minded scientists think and how they conduct research. In this regard groups of scientists working within a paradigm belong to a subculture of Western science. For instance, community ecologists study the interactions and relationships that exist within a particular community, as well as the interplay of factors that affect biodiversity, community structure, the abundance of



species, and the overall dynamics of particular species. The core values underpinning this field involve the awareness of relationship between species and environment, and the overall web of interconnectedness that lies within a community. These understandings, in turn, inform conservation practices, resource and ecosystem management, community health, and human development. In this manner, the way in which community ecologists see the interconnectedness of all elements in an ecosystem mirror, in some ways, Indigenous ways of knowing nature. That being said, the core values held by a community ecologist may differ from principles held by a Western scientist who, for instance, studies interactions between different cells in a human body. A medicine radiologist who uses radioactive material to diagnose and treat diseases, for example, has to understand human responses and behaviours to various medicines, as well as the overall dynamics of various cells. Their focus is on interactions within the human body but not necessarily how the human body fits within the larger ecosystem or universe. There is a varying spectrum of values, principles, and applications in Western Science, as each branch requires a different approach to thinking and understanding.

2.3 Dominance of Western Science

Modern Western science is commonly privileged or viewed as superior to other culturally informed ways of understanding the natural world within Canada's dominant institutions. Belief in the superiority of Western science is problematic due to some of the limitations of Western Science. Western science is excellent at enabling us to understand the structure and function of ecological systems. It also enables us to diagnose and analyze environmental degradation in powerful ways (Kimmerer, 2013). It is not, however, as good at enabling us to generate sustainable solutions to environmental problems. This is because Western science purports to be value free. In this regard it is not well equipped to answer ethical questions regarding the way ecosystems should or should not be managed in the face of complex global challenges such as biodiversity loss, invasive species, contaminants in the environment, and global climate change.

The universalism of Western science is additionally problematic as the impact of Western science extends beyond its scope as a set of processes to exercise curiosity, inquiry, and meaning making into natural and human made worlds. For instance, despite its potential for value neutral and positive application, Western science and technology are sometimes taken up within contemporary society to serve the purposes of capitalist expansion and industrial growth. The way Western science is taken up to serve the interests of capitalist expansion and industrial growth is linked to the social paradigm that coalesced at the advent of the colonial period. A dominant social paradigm is comprised of the language usages, beliefs, concepts, and values that shape the practices and institutions within a society (Bednar, 2003). During the sixteenth and seventeenth-century North America's social paradigm became pervaded by the Eurocentric capitalist worldview (Landstreicher, 2001). At this time Europeans considered land valueless until "developed", and thus associated progress with human modification of the land. The social paradigm also held that humans were separate from and superior to nature



(Johnston, 2022). Accordingly, the capitalist worldview emerged as one that saw land and its gifts as having the primary purpose of feeding the human desire for consumption.

The way the tools of Western science are used in service of capitalism and industrialism vary greatly depending on the particular paradigm of Western science a researcher is couched within. A deep ecologist or community ecologist, for instance, would be far less likely to conduct research in service of capitalist expansion than would a biochemical medical researcher working on a research and development project (Aikenhead & Michell, 2011). Despite diversity across paradigms, however, the link between industrial expansion and Western science remains one factor responsible for the high-attrition rates of Indigenous learners from STEM subjects and fields. There are Indigenous learners who are mistrustful of Western science as they attribute the degradation of their traditional land-base to its impacts (Kimmerer, 2013). Fortunately, the belief that Western science is the only means through which to construct knowledge about the natural world, has been challenged (Kimmerer, 2013). For example, in the face of climate change, academics, scientists, policy makers, and teachers are looking to Indigenous ways of knowing nature for sustainable solutions (Faircloth & Tippeconnic, 2004; Riggs, 2005; Snively & Corsiglia 2001). Despite this positive movement, however, within many dominant Canadian institutions, including the public education system Western science remains privileged over Indigenous ways of knowing nature (Kimmerer, 2013).

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2.4 Science in Ontario Schools

In addition to understanding Indigenous land-based knowledge and Western science it is integral to recognize how science is both understood and implemented in schools. The way



research scientists from academic institutions engage in scientific experimentation, for instance, is commonly distinct from the way science is conceptualized and taught across the school system.

2.5 Definition of Science in Ontario Schools

There is no one standardized definition of science that informs science education across Ontario schools. There are, however, several foundational documents offering definitions of science that shape and reflect how science is understood by teachers, administrators, and curriculum writers across Ontario. The following definition draws on descriptions of science introduced in the Council of Ministers of Education Canada (CMEC) 1997 *Common Framework of Science Learning Outcomes: Pan-Canadian Protocol for Collaboration on School Curriculum; The Science Co-ordinators' and Consultants' Association of Ontario (SCCAO) and Science Teachers' Association of Ontario (STAO/APSO), "Position Paper: The Nature of Science"* (2006); *The Ontario Curriculum grades 1-8: Science and Technology* curriculum document (Ontario Ministry of Education, 2007); as well as *The Ontario Curriculum Grades 9 and 10 Science* curriculum document (Ontario Ministry of Education, 2008).

According to these documents science refers to both the processes used to come to understand natural and human-made environments and to an organized body of knowledge about nature gathered by these processes (CMEC, 1997, p. 9; SCCAO & STAO, 2006; OME, 2007; OME, 2008). Science is dynamic, with a long history, and in this manner many cultures have contributed to the development of scientific understanding. There are also many qualities that inform scientific exploration including "curiosity, creativity, imagination, and intuition," as well as many practices informing scientific experimentation including "observation, replication of experiments, interpretation of evidence, and debate over evidence and its interpretations" (CMEC, 1997, p. 9). There is no one set procedure for conducting a scientific experiment, rather science is informed by several distinct theories, knowledges, experimentations, and processes (CMEC, 1997, p. 9). Furthermore, it is the job of scientists to continuously assess and judge the soundness of scientific knowledge by testing theories and laws and modifying them when new evidence emerges (SCCAO & STAO, 2006). In this regard theories of science are constantly being tested and revised as new knowledges and theories come to replace existing ones (CMEC, 1997, p.9). Challenging existing theories is complex and involves many individuals with diverse backgrounds. This process has occurred throughout history and is influenced by many scientific factors including experimentation, as well as social factors, including social, cultural, economic, and political influences, in addition to personal bias and the need for peer acceptance (CMEC, 1997, p.9). While, occasionally, theories and concepts undergo change, for the most part, the basic ideas of science have proven to be stable (OME, 2007, p.4; OME, 2008, p.4). It is also important to note that technology is interdependent with science. Technology refers to the development and use of materials to both solve human problems and satisfy human needs and desires (SCCAO & STAO, 2006, p. 1-2). Science often uses and requires the tools developed by technology while technology employs principals, theories, laws, and processes developed by science (SCCAO & STAO, 2006, p. 1-2). Although technology provides many benefits it also has



associated risks whose implications are important to both consider and fully understand (SCCAO & STAO, 2006, p. 1-2).

2.6 Priorities of Science Education in Ontario Schools

Science education in Ontario is focused on producing scientifically literate citizens who can understand and apply the tools of science, technology, and engineering in a manner that benefits Canadian society and the environment (SCCAO & STAO, 2006). To this end science education is focused on helping students to see and be able to navigate the connection between science, technology, society, and the environment (CMEC, 1997; OME, 2022a; OME, 2022b). Sustainability is of growing concern in the Ontario science curriculum and so, through a greater emphasis on environmental education, students are increasingly being encouraged to think critically and in interdisciplinary ways about environmental issues when relating science to society, or when developing solutions to scientific or engineering design processes (OME, 2022a; OME, 2022b). Greater emphasis is also being placed on ensuring that curriculum reflects the demographics, geographical diversity, traditional knowledge base, and position of Canada internationally (Murray, 2015). To this end, and to foster greater sustainability, there is a developing focus on integrating Indigenous ways of knowing and being in meaningful ways into the science curriculum (Murray, 2015; OME, 2022a; OME, 2022b). Greater focus is also being placed on implementing interdisciplinary science, technology, engineering, and math (STEM) learning. This, with mounting emphasis on engineering skills, is intended to help students be able to develop solutions to technical and complex twenty-first century problems (OME, 2022a; OME, 2022b). Additionally, while fostering overall feelings of optimism and positive regard for science, students are also encouraged to understand and address the unintended consequence of scientific progress as it relates to such things as climate change and emerging technologies (OME, 2022a; OME, 2022b).

CMEC (Council of Ministers of Education, Canada). (1997). Common framework of science learning outcomes: Pan-Canadian protocol for collaboration on school curriculum. Ottawa, Canada: Author.

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Ontario Education. (2022a). *Science and Technology Grades 1-8*. [Program of Studies]. <https://assets-us-01.kc-usercontent.com/fbd574c4-da36-0066-a0c5-849ffb2de96e/a6136d61-3120-43f0-94a3-5859e0319382/The%20Ontario%20Curriculum%20Grades%201%E2%80%9380%938%20E2%80%9393%20Scienc%20and%20Technology%202022.pdf>

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Ontario Ministry of Education (2007). *Shaping Our Schools, Shaping our Future: Report of the Working Group on Environmental Education*.

The Science Co-ordinators' and Consultants' Association of Ontario (SCCAO) and Science Teachers' Association of Ontario, (2006). *Position paper: The nature of science*. Retrieved from: https://cdn-5cb4e3b3f911cf0dc86f377b.close.com/wp-content/uploads/2019/12/Nature_of_Science.pdf

3.0 Decoloniality

Colonization created borders both physical and mental. For instance, on Turtle Island, long after the arrival of the earliest Europeans, peoples' minds remain colonized by ideologies and assumptions inherited from colonialism. The colonial matrix of power, or what is commonly referred to as coloniality, for instance, organizes and structures power relations according to norms established by settler colonialism, patriarchy, capitalism, imperialism, and neoliberalism (Shultz & Pillay, 2018). Within the colonial matrix of power Western, male perspectives are centered and universalized while perspectives that deviate from this norm are understood to be lesser than and peripheral (Shultz & Pillay, 2018). In response to the colonial matrix of power decoloniality does not attempt to discredit Western knowledge systems but does recognize that Western perspectives represent only one way of making sense of and operating in the world. Decoloniality positions Western thought as one possible way making sense of the world but not the only way. (Mignolo, 1995; Quijano, 2001; Grosfoguel, 2007; Maldonado-Torres, 2007; Mbembe, 2015; Mignolo and Walsh, 2018; & Ndlovu-Gatsheni, 2017).

The colonial matrix of power is also informed by Cartesian dualism. Cartesian dualism is a fundamental idea about the universe that was established in Renaissance Europe by René Descartes in 1641 (Aikenhead & Michell, 2011). Cartesian dualism essentially divides existence into matter and mind. The natural world, examined by most scientists in their work, includes inert matter and energy and is believed to be devoid of any human intuition or spiritual force. The mind on the other hand is linked to the metaphysical plane. According to Cartesian dualism the worlds of mind and matter, are distinct and non-interacting (Aikenhead & Michell, 2011). In contrast to Cartesian dualism is monism in which the physical and metaphysical planes are believed to co-mingle (Aikenhead & Michell, 2011). Within a monist reality, held by most Indigenous peoples around the globe, the material and non-material worlds interact. Accordingly, nature is both material and sacred. Additionally, monists believe that valid forms of knowing emerge from interactions on the physical plane which is imbued with spirit. Cartesian dualism, on the other hand, positions knowledge gathered on the physical plane as superior to knowledge emerging from the body and spirit. In response, decolonial theory challenges us to reconsider what types of knowledge we recognize as valuable. Decoloniality, for instance, encourages us to value and articulate metaphysical knowledge emerging from and ingrained in the body and in local histories, as opposed to exclusively knowledge emerging from the mind. This implicitly challenges the Western construction of knowledge informed by the five senses as superior, and in so doing contests the dominance of European way of knowing and being (Mignolo, 2011). Ways of knowing and being emerging from marginalized groups are



positioned as viable options that exist alongside modernity as neither superior nor inferior but simply different.

Increasingly, Indigenous communities across Turtle Island are organizing to revitalize Indigenous ways of knowing and being, ingrained in the body and in community. This decolonial praxis is facilitated through what is often referred to as Indigenous resurgence. (Coulthard, 2014; Simpson, A., 2014; Simpson, L., 2017; Taiaiake Alfred, 2005). Indigenous resurgence is enacted through what Dene academic Glen Coulthard refers to as grounded normativity (Coulthard, 2014). Grounded normativity are the instructions community members gather regarding how to live in harmony with the human and non-human community when interacting in traditional cultural practices on the land. In this sense land operates as an ontological framework for understanding ethical relationships (Deloria, 1973). Through grounded normativity community members strengthen relationships between themselves and with the land generative of empowerment (Simpson, L., 2017).

The notion that European universalism can be eroded and valid forms of knowing can be fostered by engaging in practices on the land is important as it reveals the integral role that land-based learning, reconnecting students to reciprocal lifeways, can play in the process of decolonial work.

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- Simpson, A. (2014). *Mohawk Interruptus: Political Life Across the Borders of Settler States*. Duke University Press.
- Simpson, L. B. (2017). *As we have always done: Indigenous freedom through radical resistance*. Minneapolis, MN: University of Minnesota Press.
- Taiaiake, A. (2005). *Wasá'se: Indigenous pathways of action and freedom*. Peterborough, ON: Broadview Press.



Taiiiake Alfred, G. & Corntassel, J. (2005). Being Indigenous: Resurgences against contemporary colonialism. *Government and Opposition*, 40(4), 597-614. <https://doi.org/10.1111/j.1477-7053.2005.00166.x>

4.0 Decolonial STEM Education

Decolonial STEM teaching and learning can help to counteract European Universalism and the dominance of Western science over non-Western ways of understanding, being on, and connecting to land. In turn decolonial STEM learning can help to reengage Indigenous learners in STEM subjects and fields while connecting all learners, Indigenous and non-Indigenous alike, to the land and reciprocal lifeways. (Wildcat et al., 2014; Radu, House & Pashagumskum, 2014; Alfred, 2005; Tuck et al., 2014).

Alfred, T. (2005). *Wasáse: Indigenous Pathways of Action and Freedom*. University of Toronto Press.

Radu, I., House, L. M., & Pashagumskum, E. (2014). Land, life and knowledge in Chisasibi: Intergenerational healing in the bush. *Decolonization: Indigeneity, Education & Society*, 3(3), 86-105.

Tuck, E., McKenzie, M., McCoy, K. (2014). Land education: Indigenous, post-colonial, and decolonizing perspectives on place and environmental education. *Environmental Education Research*, 20(1), 1-23.

Wildcat, M., McDonald, M. Irlbacher-Fox, S., Coulthard, G. (2014). Learning from the land: Indigenous land based pedagogy and decolonization. *Indigeneity, Education and Society*, 3(3), I-XV.

5.0 Two-Eyed Seeing

To precipitate decoloniality, it is important to infuse Indigenous ways of knowing and being into the Eurocentric curriculum through honour and celebration. This is particularly relevant in STEM programming as many initiatives intended to foster Indigenous student interest in STEM learning are highly assimilative (Kimmerer, 2013). Two-eyed seeing is a model for how Indigenous and mainstream knowledges can be utilized to positively impact dominant society (Tafuya, 1981). For instance, two-eyed seeing honours the common ground between the two knowledge systems. Notably, Two-eyed seeing also strives to keep knowledge systems distinct so that a clash of cultures is avoided (Canadian Council on Learning [CCL], 2007). This ensures that individuals do not need to relinquish their own knowledge base in order to appreciate aspects of the other (Brandt, 2007). Since its introduction, researchers and practitioners who acknowledge the value in both Indigenous and non-Indigenous ways of knowing and being have taken up the phrase widely. Two-eyed seeing acknowledges that together Indigenous and Eurocentric knowledge systems can compensate for each other's deficiencies (Bartlett, Marshall & Marshall, 2012).

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

Brandt, C. B. (2007). Epistemology and temporal/spatial orders in science education: A response to Aikenhead and Ogawa's: Indigenous knowledge and science revisited: *Cultural Studies of Science Education*, 2(3), 539-620.

Canadian Council on Learning: Report on Learning in Canada. (2007). *Redefining how success is measured in first nations, inuit and métis learning*. Ottawa, Ontario. Retrieved June 29, 2008 from,



<http://www.cclcca.ca/CCL/Reports/RedefiningSuccessInAboriginalLearning?Language=EN>

- Kimmerer, R. W. (2013). The fortress, the river and the garden: A new metaphor for cultivating mutualistic relationship between scientific and traditional ecological knowledge. In A. Kulnieks, D. R. Longboat & K. Young (Eds.), *Contemporary studies in environmental and indigenous pedagogies* (pp. 49-76). Rotterdam, SH: Sense Publishers.
- Tafoya, T. (1981). Coyote's Eyes: Native Cognition Styles. *Journal of American Indian Education*, 21(2), 21–33.

5.1 The Garden Metaphor:

While two-eyed seeing offers a potential guide for how a relationship between Indigenous and non-Indigenous knowledge systems can be fostered, there are those who are skeptical of this approach. Potawatomi scholar Robin Kimmerer (2013), for instance, cautions that the differences in scale and power of the two knowledge systems leave Indigenous ways of knowing and being vulnerable to domination by non-Indigenous knowledges. Additionally, the emphasis the model places on autonomy as opposed to mutual care may serve to limit creative synergy between the two ways of knowing (Hatcher et. al 2009).

In response to this concern, Kimmerer presents the three sisters garden as an alternate metaphor to guide the way we think about the relationship between Indigenous and non-Indigenous ways of knowing. The three sisters garden, comprised of corn, beans, and squash, is a traditional form of Indigenous polyculture gardening, reflective of the Indigenous values of relationship, kinship, and reciprocity.

In a three sisters garden, corn is planted first. Once the corn is well-established it provides direction and support for other plant species. Drawing on the three sisters as a metaphor for knowledge mutualism, corn is emblematic of Indigenous ways of knowing. Indigenous ways of knowing and being must come first!

Beans are another central element of a three sisters garden, as they release nitrogen into the soil, helping other plant species to thrive. Beans also profit from their position in a three sisters garden, as they use the scaffolding provided by the corn to grow, expand, and flourish. In the three sisters garden metaphor, beans are representative of Western science. Driven by curiosity, Western science uses Indigenous ways of knowing and being as a moral anchor to root its exploration of the physical mechanisms that underlie the patterns and processes of the natural world.

Squash, spreading prickly leaves out close to the soil, helps to foster a productive growing climate for the other species in a three sisters garden. Its broad leaves suppress the growth of weeds, keep the soil moist, and house a host of tiny predators that feed on damaging pests. In the knowledge symbiosis metaphor, squash is representative of an educational climate of mutual respect and intellectual pluralism by creating space for both Indigenous and non-Indigenous knowledge systems to be fully expressed. The proximity of squash to the land also



reminds us of the value of teachings and practices that emerge from the land itself. Education must be connected to reciprocal lifeways connected to the natural world.

Last in the knowledge symbiosis metaphor, Kimmerer includes those who tend the garden. The planter who plants the seeds, turns the soil, and picks the weeds, is central to the thriving of a three sisters garden. Similarly, teachers, are responsible for cultivating an intellectual landscape in which Indigenous and non-Indigenous knowledge systems come together in a reciprocal manner. This includes providing resources and an environment to strengthen both Indigenous and non-Indigenous knowledge systems and ensuring that non-Indigenous ways of knowing do not dominate or overshadow Indigenous life ways in a Eurocentric school system.

Hatcher, A., Bartlett, C., Marshall, A., & Marshall, M. (2009). Two-Eyed Seeing in the Classroom Environment: Concepts, Approaches, and Challenges. *Canadian Journal of Science, Mathematics and Technology Education*, 9(3), 141–153.

Kimmerer, R. W. (2013). The fortress, the river and the garden: A new metaphor for cultivating mutualistic relationship between scientific and traditional ecological knowledge. In A. Kulnieks, D. R. Longboat & K. Young (Eds.), *Contemporary studies in environmental and indigenous pedagogies* (pp. 49-76). Rotterdam, SH: Sense Publishers.

6.0 Indigenous Pedagogy

Fostering two-eyed seeing and working towards an intellectual polyculture relies upon ensuring that Indigenous ways of knowing and being are meaningfully incorporated into K-12 learning in all subject areas (Hampton, 1995). To better understand how we can bring Indigenous knowledge into STEM teaching and learning it is beneficial to examine forms of Indigenous pedagogy. Indigenous pedagogical approaches can provide a blueprint for how the education system can connect learners to Indigenous ways of knowing and being and to the land.

Hampton, E. (1995). Towards a redefinition of Indian education. *First Nations Education in Canada: The Circle Unfolds*, 5–46.

6.1 Holistic Education

The current Eurocentric curriculum primarily focuses on developing the mental and physical capacities of learners (Kanu, 2011). While there are exceptions in which emotional and spiritual growth are considered, these examples are not consistent (Morcom, 2017). This approach to education is starkly different from that employed by Indigenous communities wherein the focus is on developing the child holistically. For instance, emotional and spiritual domains are nurtured in addition to physical and cognitive capacities. To teach holistically teachers must consider the mental, emotional, physical, and spiritual aspects of their students (Battiste, 2013, p. 183).

In STEM education there is often a focus on developing student's mental capacities to the exclusion of emotional, spiritual, and physical growth and well-being. Additionally, at the



secondary level teachers are motivated to cover vast amounts of curriculum content, thereby, precipitating the assumption that teachers do not have the time or capacity to create interdisciplinary holistic connections. Despite these beliefs holistic education is just as crucial in STEM learning as it is in all other subjects. An important aspect of holistic teaching is a focus on spiritual growth. Indigenous education views learning as personal, subjective, spiritual, and transformative. Spirituality is different than religion, however, and in a classroom, can be demonstrated in many different ways. For instance, honouring local teachings and the land the students are living on, admiring creation, and personally connecting to the material students are being taught are all ways of integrating spirit into teaching.

In addition to bringing into balance the four aspects of the child (emotional, physical, mental, and spiritual), Indigenous pedagogical approaches recognize that a learner is positioned in a rich web of human and non-human relationships (Morcom, 2017). As a result, emphasis in education is placed on the “connection between the individual to the family, community, nation, and Mother Earth (the world), which includes the environment (land, water, air, and spirit)” (Ray and Cormier, 2012, p. 169). A holistic approach to learning acknowledges that individuals exist in a web of relationships with community members and with elements in the natural world. Holistic learning enables students to engage in these critical relationships while exploring and listening to their inner metaphysical space.

Battiste, M. (2013). *Decolonizing education: Nourishing the learning spirit*. Saskatoon, SK: Purich.

Kanu, Y. (2011). *Integrating Aboriginal Perspectives into the School Curriculum*. Buffalo, NY: University of Toronto Press.

Morcom, L. (2017). Indigenous holistic education in philosophy and practice, with wampum as a case study. *Foro de Educación*. 15(23), 121-138.

Ray, L., & Cormier, P. N. (2012). Killing the Weendigo with maple syrup: Anishnaabe pedagogy and post-secondary research. *Canadian Journal of Native Education*, 35(1), 163-176.

7.0 Outdoor Learning

Indigenous pedagogy is intimately connected to the land. Within Indigenous pedagogical models it is through engaging directly with the land and Indigenous life ways that individuals are able to access Indigenous ways of knowing and being.

7.1 Land-Based Education

Indigenous peoples view the land as a portal into the cosmological realm with valuable lessons to teach about how to conduct oneself in a good way in the world (Anuik, Battiste, & George, 2010; Styres, Haig-Brown, & Blimkie, 2013). In this manner the land is often referred to as “first teacher”. Land-based learning occurs in community contexts under the guidance of community members and knowledge keepers (Davis et al., 2015; Living Sky School Division, 2015).

Community relationships are seen as integral in helping individuals discern messages relayed to them through the land. For instance, in Indigenous pedagogical models, it is understood that it is the job of the family, community, and Elders to guide individuals in their learning (Battiste,



2013). Community members act as conduits helping youth to discern land-based teachings (Ermine, 1995; Simpson, 2014). Land-based teaching has the ability to disrupt the colonial ideological premise that Eurocentric thought is superior to holistic Indigenous epistemologies emerging from the metaphysical realm. Alternatively, by connecting students to the land and its teachings, land-based learning allows students to understand and appreciate the value inherent in Indigenous ways of knowing and being (Anuik et al., 2010).

- Anuik, J., Battiste, M. & George, P. (2010). Learning from promising programs and applications in nourishing the learning spirit. *Canadian Journal of Native Education*. 33(1), 63-82, 154-155.
- Battiste, M. (2013). *Decolonizing education: Nourishing the learning spirit*. Saskatoon, SK: Purich.
- Davis, J., Firman, B., Cook R. & Dykun, L. (2015). Land based education success pathway Thompson community circle. *Voice Pathways to Success*. Retrieved from: <https://www.mysterynet.mb.ca/common/pages/DisplayFile.aspx?itemId=60412>
- Ermine, W. (1995). Aboriginal Epistemology. In M. Battiste & J. Barman (Eds.), *First nations education in Canada: The circle unfolds*. (pp.101-112). Vancouver: UBC Press.
- Living Sky School Division No. 202. (2015). *Growth Without Limits; Learning For All Land- Based Learning Program*. Retrieved from <https://saskschoolboards.ca/wp-content/uploads/pa15lssd.pdf>
- Simpson, L. B. (2014). Land as pedagogy: Nishnaabeg intelligence and rebellious transformation. *Decolonization: Indigeneity, Education & Society*. 3(3), 1-25.
- Styres, S. (2011). Land as first teacher: a philosophical journeying. *Reflective Practice: International and Multidisciplinary Perspectives*, 12(6), 717-731.

7.2 Land Education

Land education, which began to be theorized more substantively after 2010 (Tuck, McKenzie & McCoy, 2014), is an approach to land-based learning that intentionally names and problematizes the construction of Indigenous inferiority in addition to the settler-occupation of Indigenous land (Paperson, 2014). Land education does this by putting Indigenous epistemological and ontological accounts of land at the center. This centering includes Indigenous understandings of land, Indigenous languages and practices in relation to land, and Indigenous critiques of settler colonialism (Tuck et al., 2014; Yerxa, 2014).

Like land-based education, land education works to erode Eurocentrism. Land education, however, takes a distinct approach from land-based education by explicitly teaching students about how the construction of Indigenous inferiority and European superiority was used to justify the colonial project. Land educators also strive to examine with students the impact of coloniality on local landscapes and Indigenous populations. Land education theorists claim that this historical unpacking is integral since without it, Indigenous epistemologies will continue to be viewed as peripheral when integrated alongside European knowledges (Calderon, 2014; Tuck et al., 2014). For instance, Calderon (2014) writes “before (Indigenous) viewpoints are included, work must be done to disrupt settler identity. Without the implementation of a rigorous land education, the inclusion of Indigenous viewpoints will continue to be marginalized because current trends of multiculturalism simply integrate material into existing curriculum frameworks” (Calderon, 2014).



While all manifestations of land education precipitate a process through which participants learn in relationship to the land, land education can take place in a classroom setting in addition to outside on the land (Engel-Di Mauro & Carroll, 2014). For instance, while the impacts of the colonial matrix of power might be explored outside by encouraging students to observe how colonial land-use policies impact the natural world, similar learning can also occur inside a classroom (Tuck et al., 2014). Calderon (2014), for example, writes about how through examining how land is portrayed in textbooks land education can teach students to think critically about the impacts of colonization (Calderon, 2014). This is why you will see QUILLS learning materials intended to be taught both outside on the land and inside the classroom!

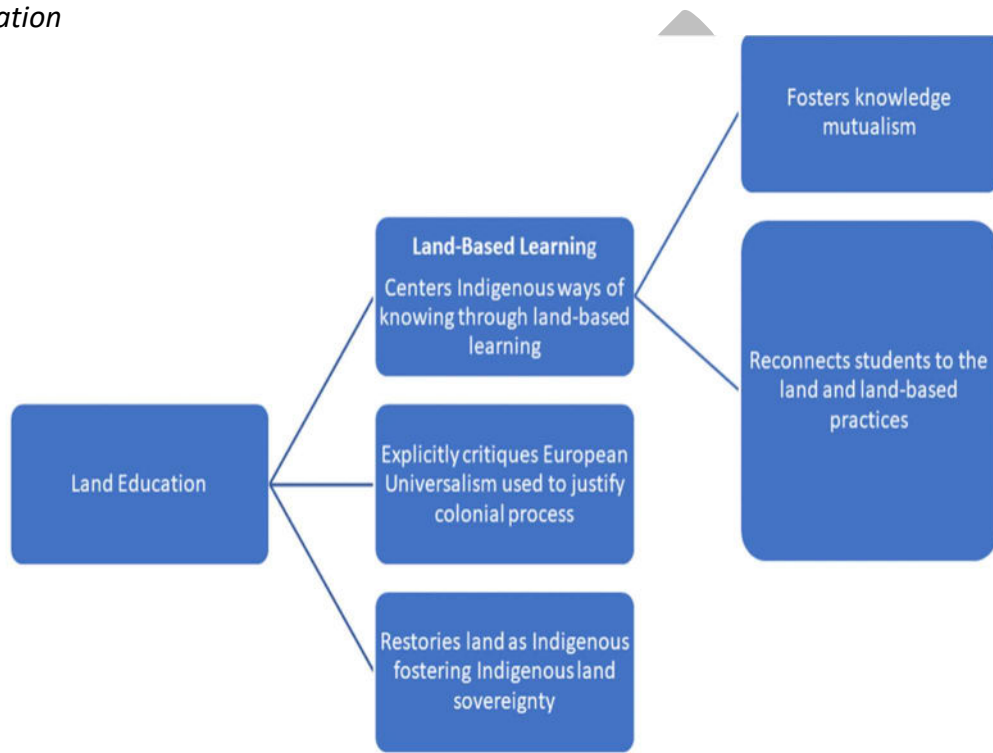
- Calderon, D. (2014). Speaking back to manifest destinies: a land education-based approach to critical curriculum inquiry. *Environmental Education Research*, 20(1), 24-36.
- Engel-Di Mauro, S. & Keita Carroll, K. (2014). An African-centred approach to land education. In K. McCoy, E. Tuck & M. McKenzie (Eds.), *Land education: Rethinking pedagogies of place from Indigenous, postcolonial, and decolonizing perspectives*. (p. 70-81). New York, NY: Routledge.
- Paperson, L. (2014). A ghetto land pedagogy: An antidote for settler environmentalism. *Environmental Education Research*, 20(1), 115-130.
- Tuck, E., McKenzie, M., McCoy, K. (2014). Land education: Indigenous, post-colonial, and decolonizing perspectives on place and environmental education. *Environmental Education Research*, 20(1), 1-23.
- Yerxa, J. (2014). Gii-kaapizigemin manoomin neyaashing: A resurgence of Anishinaabeg nationhood. *Decolonization: Indigeneity, Education & Society*. 3(3), 159-166.

8.0 Choice of Terms

Land-based education represents an optimal model of outdoor learning in Indigenous contexts due to its centering of Indigenous knowledges and epistemologies. That said, as was shown above, it can maximize its outcomes by adopting land education mechanisms. The style of outdoor learning we attempted to integrate into our learning bundles ascribes to that illustrated in the graphic below.



Land Education



9.0 Teaching Holistically as a Non-Indigenous Person

As a non-Indigenous educator, you may feel that it is not your place to introduce Indigenous ways of knowing nature into the learning environment. This belief may be informed by an underlying fear that you may do something wrong and accidentally misrepresent or appropriate aspects of the Indigenous cultures whose groups inhabit this traditional territory. While this fear is understandable, all teachers have a professional responsibility, as laid out in the [2015 Truth and Reconciliation Calls to Action](#), to centre Indigenous ways of knowing and being in their teaching practice. For this reason, it is not enough to say, “I don’t know how to incorporate Indigenous ways of knowing, therefore, it is not my job.” It is the job and responsibility of all teachers!

Leaving this work exclusively up to Indigenous people also burdens Indigenous educators with a tremendous amount of emotional labour (Hochschild, 1979). Indigenous educators encounter



many situations which engender emotional labour in educational spaces. Some of these include being forced to relive direct, traumatic experiences of colonialism and systemic racism when asked about specific events/processes, continuously being asked to share pieces of identity and having it turned into a generalization or inaccurate re-tellings, sharing information that is already easily accessible online, and being tokenized in predominantly white spaces. It is understandable that people who lack certain lived experiences, look to people who do have this knowledge from their own lives, however, regardless of intentions, this approach often has a negative impact on Indigenous community members. In the context of education, it is the duty of non-Indigenous peoples to take up *some* of the burdens of decolonizing our educational spaces in an effort to reduce emotional labour and stress.

Hochschild, A. R. (1979). Emotion work, feeling rules, and social structure. *The American Journal of Sociology*, 85(3), 551-575.

Truth and Reconciliation Canada. (2015). *Honouring the truth, reconciling for the future: Summary of the final report of the Truth and Reconciliation Commission of Canada*. Winnipeg: Truth and Reconciliation Commission of Canada.

9.1 Indigenizing vs. Decolonizing

You may have heard the terms decolonization and Indigenization before. You may also be unclear on exactly what these terms mean or how they relate to your professional responsibilities as a teacher. These are complicated terms with different interpretations. The QUILLS program understands the terms as follows.

Decolonization can be thought of as the “taking away of the colonial” (CTL, 2022). In Canada, a settler colonial state, this requires dismantling Eurocentrism, or the belief that European ways of knowing, being, doing, and believing are superior to those from other cultures (CTL, 2022). Teachers can work towards decolonization by explicitly teaching about the impact of colonization, or the fabrication of Indigenous ways of knowing and being as inferior, on Indigenous peoples, Canadian institutions, and the land. Some are critical of this approach, however, as they believe that it recenters the colonizer.

Indigenization can be thought of as the reaffirming and centering of Indigenous ways of knowing, thinking, feeling, and being. This requires reconnecting to Indigenous land-based lifeways rooted in reciprocity with the natural world. As a teacher, Indigenization can include elevating the voices, traditions, and culture of Indigenous peoples. It can also include adopting traditional Indigenous pedagogical approaches (Oll, 2022). It should be understood that there is no one generic Indigenous learning style. Instead, there is significant variation among groups, thereby making an uncritical application a potential example of epistemic racism (Hampton, 1995). Teachers, when possible, should adopt Indigenous approaches to learning endemic to the land base they are on. This may include such things as experiential learning, storytelling, observation, supervised and unsupervised participation, inter-generational teaching, apprenticeship, dreaming and imagination, appropriate rituals, and ceremony (with community



members present) etc. Indigenization should also move beyond tokenistic gestures and instead towards a system in which Indigenous ways of knowing and being are considered equitably when in practice alongside non-Indigenous knowledge systems.

When teaching, there can be a fine line between Indigenization and cultural appropriation. Accordingly, it is important to always prioritize relationship building with Indigenous community members and when possible, to bring community members into your classroom. The QUILLS program has carefully vetted its learning resources with Anishinaabe and Haudeonsaunee community members, from this shared territory, to ensure that while having the potential to Indigenize, materials are not culturally appropriative. That said, the way in which programming is delivered can also affect its impact. Teachers are urged to follow the suggestions embedded in the activities, as well as those outlined in the QUILLS Teacher's Guide and QUILLS professional development sessions to avoid perpetuating harm of any kind.

Hampton, E. (1995). Towards a redefinition of Indian education. First Nations Education in Canada: The Circle Unfolds, 5–46.

Queen's Centre for Teaching and Learning, (2022). What is Decolonization? What is Indigenization?
Retrieved from: <https://www.queensu.ca/ctl/resources/decolonizing-and-indigenizing/what-decolonization-what-indigenization>

Queen's Office of Indigenous Initiatives, (2022). Decolonizing and Indigenizing. Retrieved from:
<https://www.queensu.ca/indigenous/decolonizing-and-indigenizing/defintions>

9.2 Stating your Positionality

When integrating Indigenous ways of knowing nature into teaching and learning, it is important that teachers make their positionality clear. In other words, when teaching about IWKN, teachers should begin by clearly articulating:

- *Who they are, where they are from, and what their relationship is to the land-base.*

Self-locating creates a space where all participants in the learning environment have a chance to understand each other's stories and lived experiences and how these may inform individual perspectives and potential biases. Our experiences, upbringing, and knowledges shape how we think, feel, and act as we walk through the world. Reflecting on this provides a space where we can understand our own and each other's intersectionality (Crenshaw, 1989). Intersectionality refers to the way different aspects of our identity come together to shape how we experience and are experienced by the world. It is the study of overlapping and intersecting social identities and related systems of domination, oppression, and discrimination (Crenshaw, 1989). Sharing positionality can also help educators model humility, vulnerability, and honesty. An environment where educators are willing to admit the extent of their knowledge, the privileges they experience, and the intentions they have in the classroom, can foster more trusting and respectful relationships with students. Furthermore, values of respect, relationship, reciprocity, and mindfulness, generated by this teaching approach are critical for engaging with holistic



education. Carrying these values will help educators protect and sustain the interconnectedness that lies within the natural learning process.

Crenshaw, K., 1989. Demarginalizing the intersection of race and sex: a Black feminist critique of anti-discrimination doctrine, feminist theory and anti-racist politics. *University of Chicago Legal Forum*, 1989 (1), pp.139-167.

9.3 Locating the Knowledge

In addition to stating their positionality another important practice teachers should engage in is sharing who they gained the knowledge from and where that individual is from. This is a practice of honouring relations by locating the knowledge both in the web of community relations as well as on the traditional territory. Teachers should also make clear who students can talk to and where they can go should they wish to learn more about a topic.

9.4 Following Protocol

Sharing experiences and cultural knowledge requires forming genuine human connections. It is important that teachers make a genuine effort to form relationships with Indigenous peoples in their community and school board. Meaningful relationships ensure that knowledge and experience sharing are reciprocal. Furthermore, it is important to keep in mind that not all knowledge *shared with you can be shared by you*. In order to understand the difference, it is integral to maintain an open dialogue with community members and to follow protocols surrounding knowledge sharing. To this end, when teachers ask questions, it is important that they accept the answers they receive even if they are not what they want to hear. As a general rule, teachers should approach relationships with mindfulness, respect, humility, and good intentions.

To learn more about your role in the decolonization of education and in broader contexts, please visit [The National Centre for Truth and Reconciliation Calls to Action](#), and the [United Nations Declaration on the Rights of Indigenous Peoples](#), to start.

Truth and Reconciliation Canada. (2015). *Honouring the truth, reconciling for the future: Summary of the final report of the Truth and Reconciliation Commission of Canada*. Winnipeg: Truth and Reconciliation Commission of Canada.

United Nations (General Assembly). (2007). Declaration on the Rights of Indigenous People.

10.0 How to Use the Units

10.1 Cultural Connections and Involving Community Members

While all teachers have a professional responsibility to integrate Indigenous ways of knowing and being into their teaching practice, it is also imperative to prioritize the voices of individuals from First Nation, Métis, and Inuit (FNMI) communities when sharing Indigenous stories. Both the Anishinaabe and Haudenosaunee have oral cultures in which a vast amount of historic and scientific information is passed down through stories. Many knowledges are not written down



or made available outside of the Indigenous community. Accordingly, information that is available online may have come from outside of the community and, therefore, may not reflect community knowledge sharing protocols. For example, many Haudenosaunee people avoid saying the Peace Maker's Haudenosaunee name because it is considered an invocation of prayer. While this is common knowledge throughout Haudenosaunee communities, some outside sources disregard this teaching. Teachers can avoid culturally offensive blunders as well as cultural appropriation and essentialization by having a community member in the classroom. It is especially important to reach out to such communities when covering spiritually significant topics such as those related to ceremony, or which contain sacred teachings. This practice ensures that proper permissions, traditions, and protocols are followed and respected.

Teachers can connect with Elders and Knowledge Keepers by contacting the Indigenous liaison at their school division office. Keep in mind that relationships built with Indigenous community members should always be based on reciprocity. Elders and Knowledge Keepers have spent decades becoming experts in certain areas and should be respected and remunerated as such. Many Elders and Knowledge Keepers also appreciate gifts of *asemma* (tobacco) as a thank you for sharing their time and knowledge.

10.2 Gifting Tobacco

Asemma (tobacco) is considered a sacred medicine by many Indigenous nations and has both ceremonial and medicinal purposes. It is honoured as the first medicine that was received from Creator and is used to set good intentions and honour promises. A gift of tobacco is a sign of respect and may be offered when asking for help, guidance, or protection. Tobacco is commonly gifted:

- To Elders, Knowledge Keepers or community members in exchange for knowledge or help.
- To plants or animals when harvesting/hunting to show respect and gratitude.

Tobacco is considered a sacred medicine by many Indigenous nations and is offered as a sign of respect, gratitude, and a way to set good intentions. It can be gifted to Elders, Knowledge Keepers, community members in exchange for knowledge or help to show respect and gratitude. Check what the gifting protocols are for the specific culture of your guest, however, as traditions vary culture to culture. In this region, Tobacco ties are often thoughtfully crafted and gifted when you are asking a community member for help. This honours and shows respect for the individual's traditions, time, and knowledge. Tobacco ties should be created and given by the left hand. This is because the left hand is the closest to the heart. For individual teachings, a tobacco tie is given; for multiple teachings or special events or projects, a tobacco bundle is offered. A good resource on making and giving tobacco ties can be found in [Carleton University's Tobacco Offering Protocol](#).



It is also important to note that tobacco teachings vary depending on the traditional territory you find yourself on. For instance, the Inuit did not traditionally gift tobacco. For this reason, it is important to check with community members and/or the Indigenous leads in your school board to ensure that you are following proper protocols.

Indigenous peoples also offer tobacco to Mother Earth before gathering medicines, roots, plants, or when animals are being hunted. It is also commonly offered to the water as an acknowledgment of its critical role in life and to ask for safe passage. Offering tobacco is a way that Indigenous people show their respect for the earth and the gifts they receive from it. Again, tobacco is typically placed on the land with the left hand prior to gathering. Putting down tobacco and harvesting plants with your students should only be done with the guidance of an Indigenous community member. We also recommend that you check with your school division's Indigenous lead to receive further teachers regarding the gifting of tobacco.

An interesting perspective that was shared with QUILLS by a number of local Indigenous community members is that the etiquette of Indigenous ceremonies or land-based practices is not what is important for students to learn about. Instead, it is often the meaning or lesson that the practice represents which is valuable for students to be exposed to. For instance, the practice of putting tobacco down on the land reflects the reciprocal relationship that local Indigenous groups have with the land. This teaching related to reciprocity can be communicated to all students regardless of their cultural background. Furthermore, students do not have to put tobacco down on the ground in order to learn about living in reciprocity with the natural world. Students can be encouraged to enact or reflect relationality with the earth in other ways that are cohesive with their cultural background.

10.3 Suggestions for Adapting Resources to Your Local Context

It is important to keep in mind that Indigenous knowledges are local and non-generalizable. In other words, different nations across Turtle Island have distinct knowledge systems informed by the contours of the land on which they are situated. Accordingly, knowledges connected to the Katarokwi region are not necessarily held in common by other First Peoples across Turtle Island. As such, if you are a teacher residing on a different traditional territory, please consult with local Indigenous community members regarding the way QUILLS resources can be adapted to your local context.

11.0 Pedagogical Approaches in the STEM Curriculum

11.1 Language Learning

Indigenous languages are important vessels containing and transmitting Indigenous ways of knowing and being. This is because Indigenous Knowledges are structured through language. This can be understood by examining some of the fundamental differences between English and Indigenous languages.



First, Indigenous languages are polysynthetic. Polysynthetic Indigenous languages, by being comprised of longer more complex words, with each word containing many morphemes, reflect the Indigenous understanding that all things are interconnected. Conversely, English is an isolating language. It has fewer morphemes per word and sentences are comprised of many separate words. In the English language, you need to put together many separate words to convey an idea. In polysynthetic languages, a single verb can contain as much information as one sentence in English. This shows how root words are built upon to demonstrate more descriptive meaning. Indigenous languages are also verb-based, while English is noun-based. This means that Indigenous languages are intrinsically more descriptive. The belief that all life is interconnected is entrenched within the language(s).

Second, the way pronouns are used in Indigenous language also reflects how elements within the natural world are valued differently. Many Indigenous languages do not contain pronouns to refer to elements in the natural world. In this manner, elements of the natural world are called by name and not by pronouns such as “it” and “they”. This invites a deeper more intimate relationship with the natural world. To learn more, you may wish to read the following article: [Nature Needs a New Pronoun: To Stop the Age of Extinction Let's Start by Ditching "It"](#) by Robin Kimmerer.

Despite the importance of Indigenous languages, through the processes of colonization, many First Nations languages have undergone attack and are disappearing. The loss of Indigenous languages is the loss of Indigenous knowledge! Fortunately, some languages on the verge of extinction are experiencing renewal thanks to the hard work of several handfuls of community members working tirelessly to revitalize languages (which in turn will serve to keep Indigenous ways of knowing and being alive).

Incorporating traditional Indigenous languages into experiential science activities wherever possible is an important part of bringing IWKN into STEM learning. There may be local community language resources in the school or community to support this. Two groups local to the Katarokwi region that do a lot of work in the area of language revitalization are the [Kingston Native Centre and Language Nest \(KNCLN\)](#) and [Tsi Tyónnheht Onkwawén:na \(TTOO\)](#). You can find both organizations online to learn more. You will also see Anishinaabemowin and Kanyen'kéha words and phrases integrated into the Bundle. We encourage you to take the time to learn and to teach these words to your students. Oral recordings of each word shared can be found on the QUILLS website.

Kimmerer, R. (2015). Nature Needs a New Pronoun: To Stop the Age of Extinction Let's Start by Ditching "It". *Yes! Magazine*. Retrieved from: <https://www.yesmagazine.org/about>

11.2 Place Names



Indigenous ways of knowing nature are often embedded in place names as place names provide information about First Peoples and their relationship with the land. Paying attention to the name of places on your traditional territory can lead to a wealth of information about local ecosystems, and land use or plant and animal behaviour both before and after colonization. The Kanyen'ké:ha name for Kingston, for instance, is Katarokwi (Murray, 2017). Many people think it means gathering place, but it actually means "a place where there is clay" referencing what the local landscape looked like prior to colonization. Learning Indigenous place names can reveal a lot about the geography of local places both today and before the arrival of the earliest Europeans. Many First Nations communities have documented traditional place names of their ancestral territories that through relationship building can be made available as a classroom resource. Keep in mind, however, that some place names may be considered private and should only be used by community members.

Murray, L. (2017). Ka'tarohkwi: The original swamp ward? *Swamp Ward and Inner Harbour History Project*. Retrieved from: <https://swampwardhistory.com/katarokwi-the-original-swamp-ward/>

11.3 Storytelling

Story is an important aspect of Indigenous pedagogy. Stories enable holistic learning as they meld values, concepts, protocol, practices and facts into a narrative. They also can help students develop the important skills of listening and thinking (Battiste, 2013; Morcom, 2017). Accordingly, story can be an important addition to STEM learning. Oral storytelling can be incorporated by inviting First Nations storytellers into the class. Alternatively, teachers can read written versions of traditional stories where appropriate and permitted. Reading published stories that are relevant to science learning can integrate STEM teaching with many subject areas including English and/or First Nations language learning. You will see many stories embedded in the QUILLS Learning Materials. We encourage you to not skip over these but to take the time to read these stories with your students.

Battiste, M. (2013). *Decolonizing education: Nourishing the learning spirit*. Saskatoon, SK: Purich.

Morcom, L. (2017). Indigenous holistic education in philosophy and practice, with wampum as a case study. *Foro de Educación*. 15(23), 121-138.

11.4 Talking Circles

In the Learning Bundles, we often suggest the use of Talking Circles. Talking circles are traditional methods of discussion, perspective sharing, and decision-making utilized in many Indigenous communities. Barkaskas and Gladwin state that "communities use talking circles as part of ceremonial, healing, educational, and legal systems, depending upon intentions and contexts, and also use them as a way of bringing people together to pass on cultural knowledges, practices, and values" (2021). Talking circles also provide students with opportunities for understanding and connecting. This relational practice stems from the circular and interconnected ways of life germane to many Indigenous cultures. As members of a circle,



we can share and learn from community voices equitably. Engaging in talking circles requires sharing ideas with others, having an open mind, and listening with respect.

Before engaging in a talking circle with your students, Barkaskas and Gladwin (2019) recommend that members of the circle follow three approaches which include "situated relatedness", "respectful listening", and "reflective witnessing". These approaches ask members to:

- Situate and position themselves within time and space and the relationships they have with each other inside and outside the circle
- Listen actively and respectfully by understanding that each person is speaking from their own lived experience and listen to build relationship
- Value and honour each other's differing perspectives.

During the talking circle, students may pass around an object that reminds them of their relationship with the land on which the circle has formed. As the object is passed around the circle, only the person holding the object should speak. Students who do not wish to speak may skip their turn by passing the object on to the next person. It is important that students who are not speaking practice active listening when their peers are sharing. The Anishinaabe move to the left or "heart-wise" around the circle. Conversely, the Haudenosaunee move to the right or "moon wise" around the circle. Because we are on shared territory in the Katarokwi region you can choose to move either left or right around the circle with your students. A ceremonial talking circle includes four rounds. During each round participants respond to different questions or prompts.

Talking circles are a way to decolonize educational systems and environments. Practicing talking in various learning environments "serves to decolonize institutions by normalizing Indigenous pedagogies and methodologies even in the context of teaching non-Indigenous content" (Barkaskas & Gladwin, 2019).

Barkaskas, P, & Gladwin, D. (2019). Pedagogical talking circles: Decolonizing education through relational Indigenous frameworks. *Journal of Teaching and Learning*, 15(1), 20-38.

11.5 Outdoor Learning Journals

We also suggest the use of Outdoor Learning Journals throughout the Learning Bundles. Outdoor Learning Journals can serve as a tool for students to reflect on their learning and to see their learning as a process. Learning journals allow students to take ownership of their learning, while also providing students with opportunities to express their thinking and feelings in a creative format.

Outdoor Learning Journals can be used by students to:



- express what they sense in nature, using their five senses (sight, touch, smell, hearing, and taste)
- reflect on their own personal responsibilities to live in reciprocity with the land and to contribute to sustainability
- express gratitude to the natural world
- track connections between the land and language as students learn more about Anishinaabemowin and Kanyen'kéha.

A study by Tsevreini (2020) on "nature journaling," demonstrates that students who participate in reflective journaling while in nature have increased 'feelings of relationship with and gratitude towards the environment they are a part of'. Students in the study also experienced heightened senses as they recognized things they often overlooked, experienced greater self-awareness, and enjoyed an overall feeling of peace (Tsevreini, 2020). To incorporate this practice, simply ask students to use their journals in different sit spots while learning outdoors.

Tsevreini, I. (2020). Nature journaling as a holistic pedagogical experience with the more-than-human world. *The Journal of Environmental Education*, 52(1), 14-24.

11.6 Sit Spots

A sit spot is a place outside, chosen by the student, where they can quietly reflect on and observe nature. Asking students to find a place in nature by themselves, encourages student to connect with the land, while providing them with the opportunity to have a rest from their potentially busy lives. It is important that students choose a spot that is special to them and be given the opportunity to return to that spot multiple times over the year. This enables students to develop a relationship with a place in addition to all of the beings that inhabit this area of land. Central to Indigenous ways of knowing and being are relationships of reciprocity with the natural world. For many Indigenous groups the land is not a resource explicitly to be extracted from but a relative that through relationship is nurtured and sustained through reciprocal gifts and mutual care. Sit spots, encouraging sustained contact with a place, enable students to enter into relationship with the land. Overtime feelings of care precipitating reciprocal actions often develop.

Sit spots also provide students with time to learn from the land. For instance, in their sit spot students may watch how different species behave, how water flows down a stream, or what plants of differing heights do to get sunlight. It lets the knowledge from the land come to students through sustained observation. Furthermore, observations may precipitate more questions from students about the beings around them which can provide impetus for inquiry and project-based learning.



Sit spots and outdoor learning journals work well together. Journaling about everything students feel or learn about in their spot enables students to remember things that they might otherwise forget when they re-enter the fast-paced learning environment of school.

12.0 Culturally Responsive Assessment

Many Indigenous learners are culturally and linguistically distinct from non-Indigenous students and accordingly may struggle to perform on assessment measures germane to non-Indigenous learners. Standardized tests, for instance, arguably assess Indigenous student familiarity with the Eurocentric middle-class experience as opposed to knowledge of the curriculum (Bell, 2004). Accordingly, schools require assessment strategies informed by First Nations, Métis and Inuit community members and stakeholders. The Canadian Council on Learning introduced seven learning objectives combatting the Eurocentric bias in assessment in their 2007 report *Redefining How Success is Measured in First Nations, Inuit, and Métis Learning*. The report stated that assessment should be:

- Holistic
- Lifelong
- Experiential
- Rooted in Aboriginal Languages and Culture
- Spiritually Oriented
- Communal involving family and a community of Elders
- Representative of both Aboriginal and Western knowledges

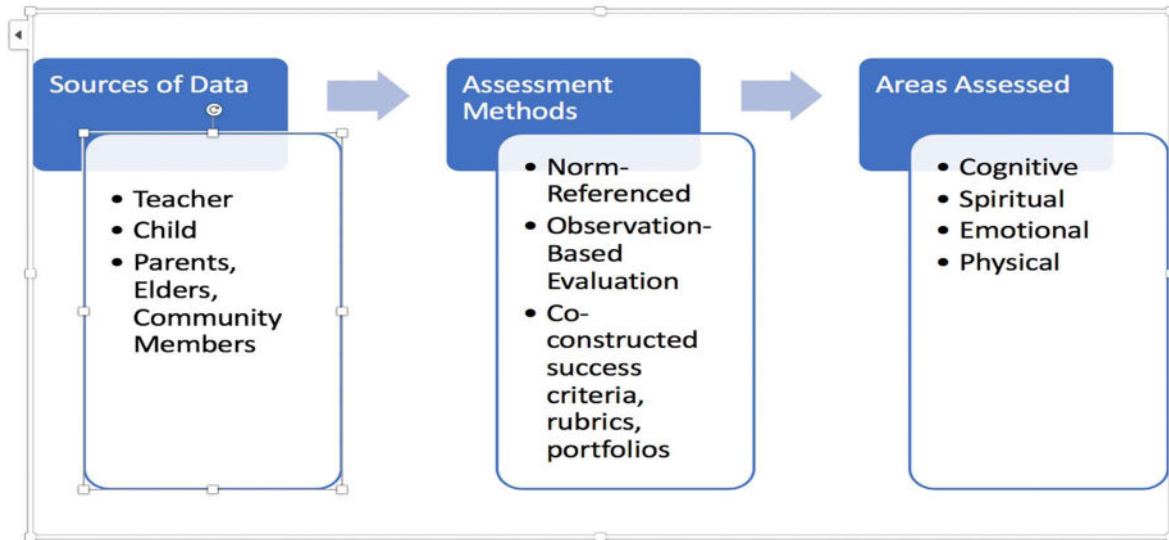
To integrate an assessment practice reflective of these goals we suggest adopting a multi-method approach to assessment drawing on four pillars (Claypool & Johnston, 2008). These pillars are:

- 1) Norm-referenced (or standardized) measures
- 2) Interviews
- 3) Behavioral Observations and
- 4) Formative Assessment Procedures

Multi-method assessment is good for all learners not just Indigenous learners and reminds us of the art and science of good assessment. An overreliance on one pillar can produce an unbalanced picture of the student in question.



11.1 Assessment Model



11.2 Source of Data

In this model of assessment, the teacher is only one source of assessment. Students are also actively engaged in the assessment process engaging in self-assessment as well as peer-generated assessment. An effective pedagogical tool that can help with self and peer assessment, and help build a sense of community, are talking circles. In addition to self and peer assessment parents, Knowledge Keepers, and community members should also be invited in to perform their traditional role as teachers and mentors. In this sense the school becomes an extension of the community.

12.2 Assessment Methods

In regards to assessment methods norm-referenced (or standardized tests) should be only one method relied upon. Additionally, when standardized tests are utilised, professionals should consider whether the individual is able to understand and complete the test in such a fashion that the results will represent a true picture of the abilities or constructs being assessed. If not, reporting should contextualize the circumstances that impacted the results. Teachers should also rely upon observation based assessment. Teachers can observe students engaged in experiential learning in a variety of social contexts. Observation based assessment can also be performed by parents and community members. Land education provides many rich opportunities for observation-based assessment fostering student engagement. Teachers should also utilize rubrics and portfolios in assessment. Rubrics and portfolios can allow teachers to share the results of learning holistically.

Other holistic assessment tools include:

- Learning Bundles/ Learning Logs
- Storytelling



- Community Projects
- Journals
- Photo Essays
- Real-World Connections

Success criteria should also be co-constructed with students and community members. This process allows teachers to link authentic assessment tools with authentic assessment tasks. Teachers can talk to community members for guidance on this process to ensure that assessment reflects understandings and abilities that matter to students and that are culturally responsive.

12.3 Areas Assessed

The areas teachers assess should reflect the holistic nature of Indigenous ways of knowing and being. Teachers should assess a student's emotional, physical, and spiritual growth and well-being in addition to cognitive understanding. When assessing cognitive growth students should be assessed based on their understanding of both Western and Indigenous ways of knowing and being. This will ensure that teachers are effectively cultivating two-eyed seeing through their STEM teaching.

A student's emotional growth and well-being is contingent on having a strong network of family and friends. Teachers should prioritize inviting a diverse range of community members into learning spaces and fostering a sense of belonging for their students. Land education provides plenty of opportunities to foster relationality with the community and with the land itself.

Teachers should also embed opportunities for kinesthetic learning that is collaborative and nurtures physical wellness (Rose Toulouse, 2011). Traditionally, children in community learned by observing their environment and then interacting kinesthetically with community and land (Rose Toulouse, 2011). This visual and kinesthetic approach to learning can be easily replicated by providing opportunities for students to engage in Indigenous land-based practices that nurture physical literacy.

Teachers should be assessing student's spiritual growth and well-being. The spiritual domain refers to all thoughts, activities, interactions, and rituals that intimately connect a person to the world. It includes one's ability to develop meaningful relationships with the earth, the earth's relatives, and other people. The key tenet is the belief in a purpose greater than the self. This can be fostered by teachers respecting and valuing other ways of knowing (Battiste & Henderson, 2000). Teachers should also help students foster relationships in the classroom and broader community in order to help them discover their unique passions and interests as well as how they can contribute to the wider society (Battiste, 2013). Teachers should also provide students with the opportunity to feel in control of their lives and to be able to make a



difference in the world. This can be done by providing opportunities for students to nurture their learning spirits through inquiry and project-based learning.

Assessments should be rigorous without limiting accessibility, encouraging students to do their very best. (Stembridge, 2019). Teachers should have high expectations for all learners. "Every experience is a potential harvest of expanded understanding" (Stembridge, 2019, p. 109), and thus, assessments rooted in Indigenous education can provide experiences for students of all backgrounds to further understand and strengthen their own gifts, identity, and responsibility to themselves and those around them.

For more information related to assessment, please consider reading [Achieving Aboriginal Student Success: A Guide to K to 8 Classrooms](#) by Pamela Rose Toulouse and [Our Words, Our Ways: Teaching First Nations, Métis, and Inuit Learners](#) by the Alberta Education Aboriginal Services Branch and Learning and Teaching Resources Branch.

- Alberta Learning and Teaching Resources Branch. (2005). *Our words, our ways: Teaching First Nations, Métis and Inuit learners*. Alberta Education. <https://open.alberta.ca/dataset/1db7d737-1486-441b-a49a-d62506a4bf39/resource/78a7d033-9c08-4e84-b617-ea10f78343c4/download/our-words-our-ways.pdf>
- Battiste, M., 2013. *Decolonizing education nourishing the learning spirit*. 1st ed. Saskatoon: Purich Publishing.
- Battiste, M., & Henderson, J. Y. (sa'ke'j). (2000). *Protecting Indigenous Knowledge and Heritage: A Global Challenge*. UBC Press.
- Canadian Council on Learning: Report on Learning in Canada. (2007). *Redefining how success is measured in first nations, inuit and métis learning*. Ottawa, Ontario. Retrieved June 29, 2008 from, <http://www.cclcca.ca/CCL/Reports/RedefiningSuccessInAboriginalLearning?Language=EN>
- Johnston, A. & Claypool, T. (2010). Incorporating a Multi-Method Assessment Model in Schools That Serve First Nations, Inuit, and Métis Learners. *Native Studies Review* 19, No. 2.
- Rose Toulouse, P. (2011). *Achieving Aboriginal student success: A guide for K-8 classrooms*. Winnipeg, MB: Portage & Main Press.
- Stembridge, A. (2019). *Culturally responsive education in the classroom: An equity framework for pedagogy*. Routledge, Taylor & Francis Group.

13.0 Additional Reading and Resources

13.1 Books and Articles

Professional Development/Education Related

- **Ensouling our Schools**
Katz, J. (2018) *Ensouling Our Schools*. Winnipeg, MB: Portage & Main Press.
- **Decolonizing Education: Nourishing the Learning Spirit**
Battiste, M., 2013. *Decolonizing education nourishing the learning spirit*. 1st ed. Saskatoon: Purich Publishing.
- **Unsettling Settler Colonial Education**
Lee, T.S., 2022. *Unsettling Settler-Colonial Education: The Transformational Indigenous Praxis Model*. New York, NY: Teachers College Press.



- **Colonized Classrooms: Racism, Trauma and Resistance in Post-Secondary Education**
Cote-Meek, S. (2014). *Colonized classrooms: Racism, trauma and resistance in post-secondary education*. Winnipeg, MB: Fernwood Publishing.

To Better Understand Indigenous Peoples Perspectives

- **Unreconciled: Family, Truth, and Indigenous Resistance**
Wente, J. (2008). *Unreconciled: Family, truth, and Indigenous resistance*. Toronto, ON: Penguin Books.
- **From the Ashes: My Story of Being Métis, Homeless, and Finding my Way**
Thistle, J. (2019). *My story of being Métis, homeless, and finding my way*. Toronto, ON: Simon & Schuster Canada.
- **A Mind Spread Out on the Ground**
Elliott, A. (2019). *A mind spread out on the ground*. Toronto, ON: Doubleday Canada.
- **21 Things You May Not Know About the Indian Act**
Joseph, B. (2018). *21 things you may not know about the Indian act*. Port Coquitlam, BC: Indigenous Relations Press.
- **The Inconvenient Indian: A Curious Account of Native People in North America**
King, T. (2013). *The inconvenient Indian: a curious account of native people in North America*. [Toronto]: Anchor Canada.
- **Five Little Indians**
Good, M. (2020). *Five Little Indians*. [Toronto, ON] Harper Collins Canada.
- **Daughters of the Deer**
Daniel, D. (2022). *Daughters of the Deer*. [Toronto] Random House Canada

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- **Braiding Sweetgrass: Indigenous Wisdom, Scientific Knowledge, and the Teachings of Plants**
Kimmerer, R. Wall. (2015). *Braiding Sweetgrass: Indigenous Wisdom, Scientific Knowledge, and the Teachings of Plants*. Minneapolis, MN: Milkweed Editions.
- **Bridging Cultures: Indigenous and Scientific Ways of Knowing Nature**
Aikenhead, G. & Michel, H. (2010). *Bridging cultures: Indigenous and scientific ways of knowing nature*. Toronto, ON: Pearson Canada Inc.
- **Look to the Mountain**
Cajete, G. (1994) *Look to the mountain: An ecology of Indigenous education*. Asheville, NC: Kivaki Press.
- **Native Science: Natural Laws of Interdependence**
Cajete, G. (2000) *Native science: Natural laws of interdependence*. Santa Fe, N.M: Clear Light Publishers.

13.2 Web



Decolonizing Indigenous Education

Toronto Zoo, Turtle Island Conservation	Resources to promote Stewardship and Conservation using Traditional Knowledge. Includes educational resources and sheets in Ojibway and Mohawk languages.	https://www.torontozoo.com/tz/ticwho
Aikenhead, G. (2000). Rekindling Traditions	Decolonized STEM unit plans developed in Northern Saskatchewan	https://education.usask.ca/ccstu/
Land Education Dreambook	Guided activities for groups interested in developing land education programs for youth.	https://www.landeducationdreambook.com
Indigenous Education: The National Centre for Collaboration	Great selection of land-based lesson plans!	https://www.nccie.ca
TRACKS Program	Trent Aboriginal Cultural Knowledge and Science program based on Michi Saagiig Anishnaabeg territory.	https://www.tracksprogram.ca/
ETFO Indigenous Land-Based Learning	An online book that shares the importance of land-based learning from an Indigenous perspective.	https://etfofmi.ca/wp-content/uploads/2020/11/Book_Land-Acknowledgement.pdf
GoodMinds	A First Nations family-owned business passionate about Indigenous education. A store for all First Nations, Métis, Inuit and Native American educational resources and products.	https://goodminds.com