The Conference Board of Canada

In partnership with Future Skills Centre

Curriculum and Reconciliation:

Introducing Indigenous Perspectives into K–12 Science

Impact Paper | October 13, 2020

Future Skills Centre

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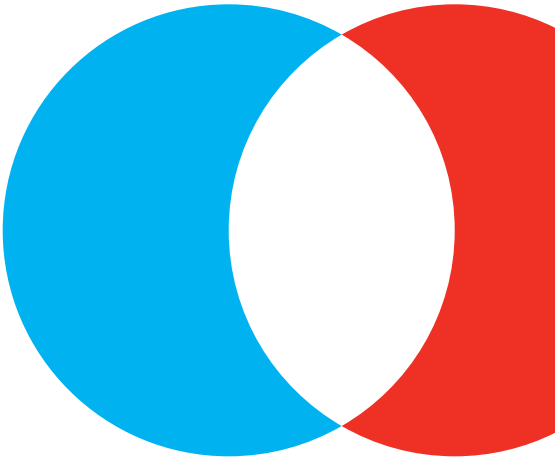
Contents



Key findings

- The majority of Indigenous students in Canada study science in school from a purely Western cultural perspective. For many, this experience can be alienating. As a result, Indigenous students often opt out of science classes in senior high school.

- Some provinces and territories have tried to make K–12 science curricula more inclusive over the past decade by introducing Indigenous perspectives.

- To maximize benefits to Indigenous learners, curriculum reformers need to work directly with teachers. Presently, only a few Canadian faculties of education teach teachers how to incorporate Indigenous perspectives on science. School districts must fill in the gaps.

- To successfully integrate Indigenous perspectives into K–12 science, initiatives must also look beyond reforming provincial/territorial curricula. They need to move toward co-designing teaching materials and providing intensive, culturally relevant teacher training.

- Bringing Indigenous perspectives on science, technology, engineering, and mathematics (STEM) into classrooms requires effective partnerships with local Indigenous communities. But it can be challenging to balance local content with broader curriculum change across provinces and territories.

- To realize the full impact of these changes, pedagogy, or how the sciences are taught in post-secondary education (PSE), will also have to change.

Why this research is important

Unlocking prosperity and self-determination

The Indigenous population in Canada is younger and growing more rapidly than any other socio-demographic segment in the country.[1] Expanding resource development opportunities and increasing recognition of Indigenous rights are creating unique economic opportunities for Indigenous peoples. Indigenous communities and businesses could benefit from a wave of major project investments over the coming decade. However, Indigenous youth are under-represented in the science, technology, engineering, and mathematics (STEM) occupations that are critical to maximizing economic opportunities and supporting self-determination. The National Indigenous Economic Development Board recently estimated that missed opportunities for Indigenous peoples could be costing Canada as much as $27.7 billion per year.[2]

Education is key to reconciliation

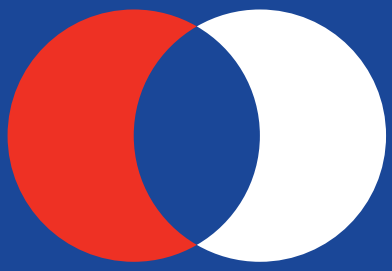
In 1996, the Royal Commission on Aboriginal Peoples called for "curriculum, in all subject areas, that includes the perspectives, traditions, beliefs and world view of Aboriginal peoples."[3] The past decade has seen a movement among some provincial and territorial ministries of education to start recognizing and incorporating Indigenous perspectives in updated school curricula. This approach to reconciliation was supported by the 2008 federal government apology to former students of the residential school system, and by the work of the 2015 Truth and Reconciliation Commission (TRC). (See "National and international calls for change.")

1 Statistics Canada, "Aboriginal Peoples in Canada."
2 National Indigenous Economic Development Board, The, *The Indigenous Economic Progress Report 2019*.
3 Royal Commission on Aboriginal Peoples, "Volume 5," 210.

National and international calls for change

- The Royal Commission on Aboriginal Peoples called for "curriculum, in all subject areas, that includes the perspectives, traditions, beliefs and world view of Aboriginal peoples."[4]
- The Truth and Reconciliation Commission's 10th Call to Action includes "improving education attainment levels and success rates" and "developing culturally appropriate curricula."[5]
- Article 15.1 of the 2007 United Nations Declaration on the Rights of Indigenous Peoples asserts that "Indigenous peoples have the right to the dignity and diversity of their cultures, traditions, histories and aspirations which shall be appropriately reflected in education...."[6]

Sources: Royal Commission on Aboriginal Peoples; Truth and Reconciliation Commission of Canada; United Nations.



4 Ibid., 210.
5 Truth and Reconciliation Commission of Canada, *Truth and Reconciliation Commission of Canada*.
6 United Nations, *United Nations Declaration on the Rights of Indigenous Peoples*.

Reforming school curriculum

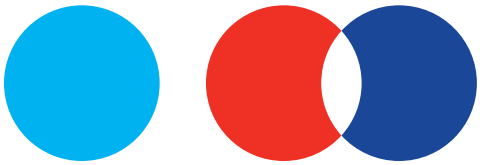
Canada has a poor track record of helping Indigenous students succeed in STEM, in school, and in the workforce. Many of the educational options that have emerged since the closing of the residential school system have not lived up to expectations, particularly within the context of provincial and territorial public schools. Indigenous students are still less likely than other students to complete high school. Indigenous students who do are unlikely to have the formal qualifications for entry into post-secondary studies in STEM, and so are unlikely to work in STEM fields.[7]

In the years following the Royal Commission on Aboriginal Peoples, all kinds of teaching materials and pedagogical advice have been produced to help teachers incorporate Indigenous perspectives in their classrooms. Websites like Promising Practices in Indigenous Education Website (PPW)[8] and the Deepening Knowledge: Aboriginal Peoples Curriculum Database[9] have compiled large libraries of resources to help teachers better serve Indigenous students. However, in the absence of endorsement by provincial curricula, these resources have had limited impact. If education is to support reconciliation and effectively integrate Indigenous learners, it will require reforms that go beyond the production of new teaching materials. Curriculum reform has to drive change.

7 Snively and Williams, "Chapter 2—Why Transforming the Science Curriculum Is Necessary for Aboriginal Students," 15.
8 Martin Family Initiative, Promising Practices in Indigenous Education Website (PPW).
9 Ontario Institute for Studies in Education, Deepening Knowledge.

Reaching the most learners

In June 2020, The Conference Board of Canada released a primer entitled *Incorporating Indigenous Cultures and Realities in STEM*.[10] The primer introduces a typology of strategies used by organizations in Canada to support Indigenous learners in STEM. (See "A typology of STEM strategies.) In this impact paper, we focus on the strategy that reaches the largest group of Indigenous learners—students in public schools. Curriculum reform in public school systems has the potential to reach the more than 80 per cent of Indigenous school students—about 375,000 students—who attend provincial or territorial public schools.[11] At the same time, all students could benefit from the more holistic understanding of ecosystems inherent in Indigenous knowledge. To date, K–12 science is the STEM subject where the most curriculum reform has taken place. Much less has been done to include Indigenous perspectives in mathematics and technology studies.



10 Cooper, *Incorporating Indigenous Cultures and Realities in STEM*.

11 Including about 340,000 who live off-reserve and about 35,000 who live on-reserve but attend off-reserve schools. Canadian School Boards Association—Indigenous Education Committee, *Indigenous Education Structure, Initiatives and Promising Practices*, 4.

A typology of STEM strategies

We found more than 100 different programs in Canada that specifically aim to help Indigenous learners succeed in STEM. These programs can be sorted into eight broad strategies for increasing Indigenous representation in STEM.

Each strategy falls into one of three periods in the learner's life course. Within each strategy, there are initiatives that attempt to address cultural differences.

Strategies targeting K–12 students

1. Curriculum reform in public schools
2. Curriculum reform in Indigenous-controlled schools
3. STEM outreach to Indigenous students

Strategies targeting learners in PSE

4. Comprehensive support services for Indigenous students in PSE
5. Indigenization of mainstream PSE
6. Indigenous PSE institutions promoting STEM fields

Strategies targeting STEM graduates

7. Associations of Indigenous STEM professionals
8. Employer recruitment and retention initiatives

Source: The Conference Board of Canada.

Why reform science curricula?

Many Indigenous students experience traditional Western science lessons as counterintuitive, if not alienating. They have to set aside their Indigenous ways of knowing nature and cross a cultural border at the classroom door.[12] The sciences traditionally taught in school in Canada during the 20th century were founded in a Eurocentric approach to understanding the natural environment. This method tends to compartmentalize phenomena and focus on measurement, analysis, and control.

In the 21st century, multicultural approaches that envisage a broader range of perspectives in the science classroom have gained currency.[13] Indigenous sciences use a more qualitative, integrated, and interrelated approach to develop a holistic understanding of how to live in harmony with nature. When educators make the effort to provide a culturally responsive curriculum that braids Indigenous ways of knowing nature with Western science, Indigenous students are more engaged and perform better.[14]

> Two-Eyed Seeing refers to learning to see from one eye with the strengths of Indigenous ways of knowing and from the other eye with the strengths of Western ways of knowing and to using both of these eyes together.[15]

Some provinces and territories are actively reforming their science curricula to encourage new approaches in K–12 science classrooms. Curricula can build bridges that allow both Western and Indigenous perspectives to flourish side-by-side in the classroom. Such curricula can help Indigenous students to thrive without compromising the values of their communities. And they provide a practical venue to develop the TRC's vision of mutual respect through mutual understanding. However, these efforts need to be aligned with changes at all levels of the education system if the science classroom is to become a better place for all students to succeed.

12 Aikenhead and Elliott, "An Emerging Decolonizing Science Education in Canada"; Hogue, "Let's Do It First and Talk About It Later."

13 Kim and Dionne, "Traditional Ecological Knowledge in Science Education."

14 Kanu, "Increasing School Success Among Aboriginal Students"; Hatcher and others, "Two-Eyed Seeing in the Classroom Environment"; Sutherland, "Resiliency and Collateral Learning in Science in Some Students of Cree Ancestry"; Snively and Williams, *Knowing Home*.

15 Hatcher and others, "Two-Eyed Seeing in the Classroom Environment," 146.

When educators make the effort to provide a culturally responsive curriculum that braids Indigenous ways of knowing nature with Western science, Indigenous students are more engaged and perform better.

The context of curriculum renewal

National guidelines but provincial implementation

While education in Canada is a provincial responsibility, the Council of Ministers of Education, Canada (CMEC) provides a mechanism for developing education guidelines at the national level. In 1997, CMEC produced its *Common Framework of Science Learning Outcomes K–12: Pan-Canadian Protocol for Collaboration on School Curriculum*.[16] This framework continues to underpin K–12 science curricula across the country. It also suggests incorporating Indigenous perspectives, but only as examples to illustrate broader concepts under the Social and Environmental Contexts of Science and Technology. Some provinces have gone much further in integrating Indigenous perspectives as they renew their science curriculum. (See "Provincial and territorial overview.")

To better understand the state of science curriculum reform across Canada, we scanned K–12 science curricula in each province and territory for references to Indigenous perspectives. We then talked with a range of experts directly involved with science education renewal to learn how curriculum reform initiatives have developed in different jurisdictions.

Enabling curriculum renewal

Indigenous co-design

Collaboration with Indigenous partners is essential; mere consultation is not enough. And collaboration usually means right down to the grassroots level if the curriculum is going to reflect local and regional Indigenous communities.

> **We started meeting with Elders … in the First Nations University for two days. We had each of those outcomes on a big flip chart laid out flat on tables and the Elders would walk around … and just write ideas down … of what First Nations knowledge would be appropriate to bring into our outcomes and indicators.**
>
> **—Provincial curriculum development specialist**

The right people at the right place and time

Individual champions and personalities make a difference. It takes the right people—ones committed to reform—who are in the right place at the right time; for example, people in influential positions in the Ministry of Education when curriculum is scheduled for revision.

16 Council of Ministers of Education, Canada, *Common Framework of Science Learning Outcomes K to 12*.

Political will

Politicians need to be on-side. Changes in political leadership can either start—or stop—an initiative to incorporate Indigenous perspectives in the curriculum.

Teamwork

Curriculum development is by nature a team activity. Curriculum reform initiatives bring together Ministry of Education representatives with academics, teachers, Indigenous knowledge keepers, and Elders. Students in the classroom also help evaluate new materials and approaches.

Build on success

Successful reform in one subject—like science—can inspire reform in another subject—for instance, mathematics.

See the bigger picture

The methods and content that work well for Indigenous students also work well for many non-Indigenous students.[17] Indigenizing curriculum leads to inclusive education practices for all students.

17 Aikenhead and others, *Enhancing School Science With Indigenous Knowledge.*

Provincial and territorial overview

Variations in how provincial and territorial school systems incorporate Indigenous perspectives in their curricula reflect differences in the composition of their populations. (See Exhibit 1.) Four jurisdictions stand out as cases to learn from—Saskatchewan, British Columbia, the Northwest Territories, and Ontario.

Indigenous perspectives fully integrated in core curriculum and standard textbooks

Saskatchewan schools have the second-largest proportion of Indigenous students among the provinces. More than a quarter of Saskatchewan youth aged 5 to 19 (26.4 per cent), or more than 55,000, identified as Indigenous in 2016.[18] Saskatchewan is the only province that has integrated Indigenous knowledge and perspectives into the core science curriculum (revised 2008–12) *and* ensured that they are included in recommended textbooks and lesson plans.[19] The *Pearson Science: Saskatchewan Edition* series, released between 2011 and 2014 and covering grades 1 through 9, represents the most comprehensive set of K–12 science materials in Canada that integrate Indigenous ways of knowing nature alongside Western approaches to science in the classroom.[20] Most Saskatchewan schools now use these texts. Curricula were also introduced for three new Grade 11 science courses—Environmental Science, Health Science, and Physical Science—that take a more practical, integrated approach to their subjects.

18 Statistics Canada, "Aboriginal Population Profile, 2016 Census."
19 Aikenhead and Elliott, "An Emerging Decolonizing Science Education in Canada."
20 Pearson Canada, *Pearson Science: Saskatchewan Edition*.

Reformed curriculum relies on local Indigenous perspectives and teaching tools

British Columbia schools have the greatest diversity of First Nations, with 34 unique First Nations languages across the province.[21] More than 67,000 students in British Columbia public schools, or 12 per cent, identified as Indigenous in 2017/18.[22] British Columbia's New Curriculum, redesigned for 2018, supports the integration of Indigenous knowledge and perspectives across the entire core science curriculum. However, the diversity of Indigenous peoples in British Columbia has made it impossible for the Ministry to produce specific teaching materials like in Saskatchewan. Instead, teachers are directed to tools and supports produced by the First Nations Education Steering Committee (FNESC) and others. In 2019, FNESC published an extensive teachers' resource guide to support teachers in all British Columbia schools to "incorporate unappropriated First People's perspectives into Science courses" at the local level, in alignment with the new curriculum.[23] Whether teachers have time for this innovation while delivering the whole revised curriculum is an open question.

Experiential science curriculum not widely recognized outside its jurisdiction

A majority of school-aged youth in the Northwest Territories (5,250, or 63 per cent of those aged 5 to 19) identified as Indigenous in 2016.[24] The Northwest Territories uses Alberta curriculum for most high school subjects, although the overall curriculum is enriched with Indigenous perspectives through the *Dene Kede and Inuugatigiit* curricula.[25]

In 2006, the territory's Department of Education, Culture and Employment produced an alternative suite of three high school Experiential Science courses. The courses on Terrestrial Systems and Freshwater Systems allow for the integration of knowledge and perspectives from all Indigenous groups in the territory. And the course on Marine Systems is particularly relevant for Inuit coastal communities. Detailed textbooks to accompany the curricula were published with sponsorship from industry and distributed to all schools. While the courses are recognized for the high school diploma in the territory, they are not widely recognized outside the territory, and so do not provide the science prerequisites needed for university studies in other provinces.

21 Murray, "60 Per Cent of All Canadian Indigenous Languages Are in B.C."

22 Bellringer, *Progress Audit*.

23 First Nations Education Steering Committee and First Nations Schools Association, *Secondary Science First Peoples Teacher Resource Guide*, 4.

24 NWT Bureau of Statistics, "2016 Census of Canada—Education and Labour Market Activity."

25 The *Dene Kede and Inuugatigiit* curricula were commissioned by the Department of Education, Culture and Employment to help teachers in the Northwest Territories bring attention to the Indigenous worldview in all their teaching. Department of Education, Culture and Employment, "Dene Kede and Inuuqatigiit."

Non-profit materials make up for minimal Indigenous content

Ontario schools have the largest number of Indigenous students of all jurisdictions in Canada. There were more than 93,000 Indigenous youth in Ontario aged 5 to 19 in 2016, but they made up just 4 per cent of youth that age.[26] In Ontario, the K–12 science curriculum acknowledges the educational value of Indigenous knowledge. However, Indigenous-related content is minimal and is primarily discussed in the context of relating science and technology to society.[27] The Ministry does not produce classroom texts. However, the non-governmental Natural Curiosity project at the University of Toronto's Ontario Institute for Studies in Education offers a teachers' resource that provides Indigenous perspectives within an "inquiry-based framework designed to enable classroom educators to meet Ministry expectations for infusing environmental education throughout the curriculum."[28]

Sources: Aikenhead and Elliott; Pearson Canada; Murray; Bellringer; First Nations Education Steering Committee and First Nations Schools Association; NWT Bureau of Statistics; Department of Education, Culture and Employment; Statistics Canada; Kim; University of Toronto.

26 Statistics Canada, "Aboriginal Population Profile, 2016 Census."
27 Kim, "Neo-Colonialism in Our Schools."
28 University of Toronto, "Natural Curiosity."

Exhibit 1
The landscape of public school science curricula in Canada

The 1997 Common Framework of Science Learning Outcomes K–12: Pan-Canadian Protocol for Collaboration on School Curriculum is the dominant conceptual framework that underpins school science curriculum across the country. The framework refers only to Indigenous perspectives under Social and Environmental Contexts of Science and Technology.

1 **Yukon**	YK uses BC curricula. The new BC curricula support YK's focus on experiential and place-based education in science, which aligns with Indigenous pedagogies.
2 **Northwest Territories**	The NT has its own K–6 science program that aligns with Dene and Inuit perspectives. The territory uses mostly AB high school curricula but has developed three alternative Experiential Science course curricula and textbooks for grades 10 to 12 that integrate Indigenous perspectives extensively.
3 **Nunavut**	NU mainly uses science curricula from NT for K–6 and from AB for 7–8–9, 10+. The Experiential Science from the NT, which incorporates Indigenous perspectives, is also used. One local NU curriculum for Applied Physics for grades 10 to 12 is designed to reflect modern Inuit life.
4 **British Columbia**	BC has implicit and explicit references to Indigenous knowledge and perspectives throughout the new K–12 curriculum, with at least one content suggestion per grade level. BC recommends resources published by the First Nations Education Steering Committee, such as the Science First Peoples Teacher Resource Guide, grades 5 to 9.
5 **Alberta**	AB incorporates Indigenous perspectives as an overarching goal in all subject curricula, including science, but the programs of study have few explicit references.
6 **Saskatchewan**	SK uses K–12 science curricula and provincially recommended Pearson Science: Saskatchewan Edition textbooks, which fully integrate Indigenous content, perspectives, and ways of knowing throughout.
7 **Manitoba**	MB science curricula make little mention of Indigenous perspectives. SK Pearson Science textbooks are approved for use in MB. MB adapted the Pearson Science 7 book, and fully integrated local Indigenous perspectives. The Manitoba First Nations Education Resource Centre provides teacher professional development and curriculum materials.
8 **Ontario**	ON science curricula have limited references to Indigenous perspectives. Indigenous identity is subsumed within "diversity." The University of Toronto's Natural Curiosity project developed curriculum materials on the importance of Indigenous perspectives in children's environmental inquiry.
9 **Quebec**	QC science curricula do not feature Indigenous perspectives.
10 **Newfoundland and Labrador**	NL elementary science curriculum—revised starting in 2015—incorporates Indigenous examples.
11 **Nova Scotia**	Under the 2017 Treaty Education Framework, Mi'kmaw perspectives such as Netukulimk, the Mi'kmaw way of living with nature, are integrated across the primary science curriculum.
12 **New Brunswick and Prince Edward Island**	NB and PEI still use the common Atlantic science curriculum developed in 1998, revised in 2003. This curriculum does not reflect Indigenous perspectives.

Sources: Council of Ministers of Education, Canada; First Nations Education Steering Committee and First Nations Schools Association; Pearson Canada; University of Toronto.

Exploring revised science curricula

It's about disruption and reinvention—disrupting the curriculum, and reinventing teaching.

—Provincial curriculum development specialist

To consider whether or not provincial and territorial reforms have been effective, we apply an analytical framework developed by van den Akker to explore the links between curriculum design and implementation.[29] This framework breaks reforms into 10 planning components, including their rationale, aims and objectives, content, learning activities, teacher roles, materials and resources, groupings, location, timing, and approaches to assessment.

Rationale

The Common Framework, developed by the Council of Ministers of Education, Canada, starts from a broad vision "that all Canadian students, regardless of gender or cultural background, will have an opportunity to develop scientific literacy. Scientific literacy is an evolving combination of the science-related attitudes, skills, and knowledge students need to develop inquiry, problem-solving, and decision-making abilities, to become lifelong learners, and to maintain a sense of wonder about the world around them."[30] All provinces and territories helped develop and adhere to this 20th-century rationale as they respond to the Calls to Action from the Truth and Reconciliation Commission.

... as educators, policy makers, curriculum developers it is incumbent upon us to create an ethical space of working between cultures that enables the academic success of Aboriginal learners.[31]

Aims and objectives

Short term

In the short term, the curriculum reformers we spoke with want to see Indigenous students more engaged in learning the sciences. They hope that students will pass their courses, get the science credit(s) required for graduation, and graduate from high school with the potential to continue with STEM studies in PSE. Reformers also anticipate that students will have more self-esteem when they see their Indigenous traditional knowledge, culture, and experiences reflected in the curriculum. In parallel, reformers expect that all students and teachers will better appreciate diverse ways of understanding nature.

Long term

Indigenous communities also have longer-term expectations for a reformed science curriculum. Communities want to see more of their members employed in STEM fields. When local Indigenous people fill positions in health care, engineering, environmental monitoring, finance, etc., that can increase self-determination for the community, politically and economically.

29 van den Akker, "Bridging Curriculum Design and Implementation."
30 Council of Ministers of Education, Canada, *Common Framework of Science Learning Outcomes K to 12, 4*.
31 Hogue, *Dropping the "T" From Can't*, 125.

Engagement, retention and success in the gatekeeper courses, the sciences and mathematics, is critically important if we are to have equitable representation and voice of Aboriginal peoples in science-related professions and in policy-making decisions that impact their lives.[32]

Political

Provincial politicians may see curriculum reform, and resultant student success, as a route to improving GDP. They also may be concerned about provincial standing in national and international rankings like the Organisation for Economic Co-operation and Development's Programme for International Student Assessment.

These various aims and objectives do not have to be mutually exclusive. But different groups involved in reform may prioritize some at the risk of overlooking others.

Content

In addition to updating content to reflect the new ideas in Western science, revised curricula provide room for content not previously emphasized. Some content may be removed to make room for more innovative material.

- **Local Indigenous content:** Referring to local knowledge, examples, events, and history, and exploring local environmental priorities from the perspective of local Indigenous populations, whether they are First Nations, Inuit, and/or Métis.

Learning activities

Reformed curricula expand potential student activities and ways of learning.

- **Inquiry:** Encouraging inquiry-based or experiential learning, with students engaging in hands-on activities, teamwork, and working collaboratively on real-world problems.
- **Holistic:** Endorsing holistic approaches that bridge divisions between scientific fields and subjects like biology, chemistry, and physics, between history and science, or between culture and science.
- **Alternative understanding:** Endorsing interpreting evidence through local culture, legends, mythology, etc. (e.g., including Indigenous legends about the constellations when introducing astronomy).[33]
- **Story-telling:** Using a story-telling approach that builds on narrative.

32 Ibid., 8–9.

33 Taylor, "Relearning the Star Stories of Indigenous Peoples."

Teachers can be inspired to engage in change when they are emotionally moved. Cultural immersion programs can be a catalyst for such engagement.

Teacher roles

Pedagogy matters. It has a major impact on student success, as measured by test scores and alternative methods of assessment. Overall, the revised curricula endorse a broader range of teaching methods and a more holistic approach that benefits all students. Some of the teaching methods supported by revised science curricula include:

- **Committed preparation:** Centring teaching in the cultural identity of the students and expanding teachers' knowledge through cultural immersion events.
- **Reaching out:** Forging relationships with Elders, Knowledge Keepers, and other specialists and welcoming them into the classroom.
- **Varying methods:** Using methods that balance holistic and analytic approaches, accommodate visual learners, and reinforce theoretical (abstract) terms with lots of practical (concrete) examples and learning activities.[34]
- **Enabling inquiry:** Providing opportunities for students and teachers to explore questions and make informed conclusions.
- **Heart with minds:** Innovation in teaching is more than intellectual. Teachers can be inspired to engage in change when they are emotionally moved from the heart. Cultural immersion programs can be a catalyst for such engagement.[35]

Materials and resources

The right kind of teaching materials can help a teacher who is less comfortable implementing the curriculum as it has been designed.

- **Customized textbooks:** Textbooks created to accompany the new curriculum provide teachers with practical ideas on how to actualize the curriculum outcomes and indicators that embody Indigenous perspectives. For example, the Ministry of Education in Saskatchewan worked with Pearson Canada to publish a full set of K–9 textbooks that offer Indigenous examples, technologies, and "Ask an Elder" sections.
- **Complementary materials:** Curriculum materials produced by Indigenous and non-profit organizations can either supplement or substitute for materials produced by ministries of education. The First Nations Education Steering Committee's *Secondary Science First Peoples Teacher Resource Guide* helps teachers in British Columbia with information about "how First Peoples knowledge and perspectives in science can be recognized and included in science inquiry."[36]

34 Aikenhead, "What's Happening in Saskatchewan?"

35 Meyer and others, *Culture-Based School Mathematics for Reconciliation and Professional Development*, 24.

36 First Nations Education Steering Committee and First Nations Schools Association, *Secondary Science First Peoples Teacher Resource Guide*, 4.

Learning partners

Revised curricula expand the idea of who is the teacher.

- **Elders:** Community members, parents, Elders, Knowledge Keepers, specialists, and role models are all welcome in the classroom.

It's incumbent on the teacher to go work with their local Elders and Knowledge Keepers to come in and tell the stories and talk.

—Provincial curriculum development specialist

- **Outreach programs:** Many schools work with non-profit STEM outreach organizations to facilitate more Indigenous content in the classroom.[37]

Location

Science lessons are moving out of the classroom into the environment.

- **On the land:** Learning on the land could be out in the bush or on the school grounds and could be an overnight camp or a quick outing from the school.

Timing

Reformed curricula allow for—or may even require—increased flexibility in the timing and delivery of course work. For example,

- **Course order doesn't matter:** Courses can be designed so they can be delivered in any order, particularly in senior high school. This is important in rural and remote schools struggling to meet the needs of a small student body. For example, the three Experimental Science courses in the Northwest Territories are designed so that schools can deliver them and students can take them in any order.
- **Class schedules can bend:** When science courses are delivered on the land, there is more room to adapt the schedule. The teacher can pace the course to fit changing students' interests and changes in the environment.
- **Seasonally adjusted:** Curriculum delivery may be aligned with the seasons, as defined by local Indigenous calendars.

37 For more information, see Erin Macpherson, *Learning Together: STEM Outreach Programs for Indigenous Learners* (Ottawa: The Conference Board of Canada, forthcoming).

Assessment

Revised curricula change both what is assessed and how it is assessed.

- **A variety of indicators:** The Saskatchewan curriculum allows science teachers to choose between a variety of indicators of curriculum outcomes. Some are specifically designed to encourage students to explore Indigenous perspectives (e.g., "Research First Nations and Métis perspectives regarding the use of living things for scientific research."[38])
- **Practical assessments:** High-stakes multiple-choice exams are the antithesis of inclusive and Indigenous pedagogies. So, reformed curricula, like Experiential Science in the Northwest Territories, encourage combining formal and informal assessment strategies in the field, laboratory, and classroom that include teacher observations of practical, hands-on, demonstrations of knowledge. (See "Experiential science curriculum in action.")

38 Ministry of Education, *Biology 30*, 36.

Experiential science curriculum in action

In 2006, the Department of Education, Culture and Employment in the Northwest Territories introduced Experiential Science 30—Freshwater Systems, a senior high school science course designed to link "field, laboratory and classroom experiences with real life situations and applications"[39] while integrating Indigenous traditions with Western science. Science teacher Nimisha Bastedo taught the course with students from Deh Gáh Secondary School, Fort Providence in 2017.

They did most of the course on the land.

> **... We had a few weeks in the classroom first, and we did some of the curriculum. Then we were out on the land for a month after that. We went through this textbook and found all of the field research things that we could do. So, we were covering the content through doing all of the hands-on things we could do in the field.**

They combined the science course with language and cultural activities.

> **... We had an Elder with us and other cultural educators. A typical day they had some lessons. We did some fieldwork. Then they were working on their own projects. And we would also go berry-picking and have some circle time and language activities.**

On the land, she was able to address some personal needs of students.

> **... Some of the students really struggle with attendance in town, because of things that are going on at home. But when they're out on the land, I can also work more with their rhythm. If they're not getting up out of bed right away, I can work with them into the evening on whatever project that they're doing.**

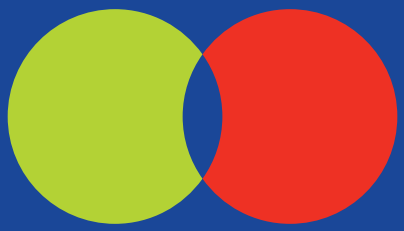
The course was taught in one block, starting in August to avoid the cold weather.

> **... Having schools start earlier in August, the chunk of time that we were in the classroom felt really long, doing the same course all day. I really had to think about how to switch it up. We were outside a lot as well during that time. And if it's not the student's favourite subject and they have to do that same subject all day, every day for two months, then it's a lot.**

And the contribution of Elders was significant.

> **... Being on the land is the best place to bring together traditional knowledge and subjects like science because it's all there, and you can just touch it. In those contexts we always have Traditional Knowledge Holders with us. We can bring them into the school as well, but the land is where they feel most comfortable. If we go fishing, we can be talking about the biology of the fish—as well as the traditional uses of the fish—all together. We try to integrate as much as we can, to encourage the students to appreciate the knowledge that their Elders have as a different form of science. It's just another understanding of our world.**

Source: The Conference Board of Canada.



39 Department of Education, Culture and Employment, *2006 Experiential Science 10-20-30 Terrestrial Marine Freshwater*, 2.

What are the challenges?

Aligning teacher support with the new curriculum

If Indigenous perspectives are to be incorporated into K–12 science, teachers need to be ready for a long personal learning process, and one that is tied to the local environment and culture. Evidence suggests that teachers who know they need to change their teaching often feel nervous about getting it right. A 2017 survey of British Columbia teachers found that more than half did not feel ready or prepared to integrate Indigenous perspectives across their new curriculum. Three-quarters felt they did not have access to necessary instructional materials, and 85 per cent were uncertain about using and interpreting Indigenous knowledge in their classrooms.[40]

- **Professional development:** Supporting teachers transforming to culturally responsive teaching engages both the heart and mind. It can require extensive onboarding, custom-designed textbooks, repeated professional development opportunities, a heavy dose of individual teacher initiative, and support from external organizations like Indspire.[41]
- **Turnover:** Introducing local knowledge in the classroom means teachers have to learn locally. But high teacher turnover is common in Northern and remote communities. This means school divisions need ongoing professional development to repeatedly help new hires, and replacements appreciate and effectively use local Indigenous knowledge in their classrooms.
- **Resistance:** On the ground, our interviewees observed that some teachers remain resistant and lack adequate cross-cultural awareness. Some of these teachers believe that a curriculum that incorporates Indigenous perspectives requires too big a change in teaching methods and/or too much new material to learn. Others were concerned that they had too little knowledge of local culture.
- **A role for PSE:** Of course, school divisions will have an easier job if Indigenous perspectives are incorporated into teacher education at the university level. And, in recent years some faculties of education have introduced courses specifically designed to help teachers bridge cultures in the science classroom. (See "Indigenizing teacher education.") However, prospective teachers spend a relatively short time at university, early in their careers. A course may start them on a path to exploring other world views, but supplemental learning outside the university will be necessary.
- **Appropriate classroom support:** Even school divisions with larger Indigenous populations may find it difficult to find enough Elders or Knowledge Keepers to work with teachers in all their schools. And not all school divisions are prepared to cover their costs.

Now the challenge is we have only four Knowledge Keepers on staff and we have 10 collegiates. So, trying to find time to have them support all 10 of those collegiates is sometimes a task that's daunting, but we do what we can.

—Indigenous education coordinator, urban school division

40 British Columbia Teachers Federation, *2017 BCTF Curriculum Change and Implementation Survey*, 15–16.

41 Indspire is an Indigenous national charity that invests in the education of First Nations, Inuit, and Métis people. Indspire provides teaching resources and professional development opportunities for educators.

Indigenizing teacher education

We scanned the websites of 63 faculties of education across Canada to see how universities are helping trainee teachers incorporate Indigenous perspectives in the classroom.

Courses on Indigenous science: We found only six that offer courses specifically designed to help trainee teachers incorporate Indigenous perspectives in science. For example:

- Is This a Course About Science, University of Saskatchewan
- Aboriginal Land Based Learning, Memorial University of Newfoundland
- Bridging Cultures: Diverse Ways of Knowing in Science, University of Alberta
- Indigenous, Environmental, and Sustainability Education, Trent University
- Curriculum and Instruction: Science, Vancouver Island University
- Science Methods, University College of the North

Courses on Indigenous pedagogies: However, a majority of faculties of education offer courses on Indigenous perspectives, and a few specifically teach about Indigenous pedagogy. For example:

- Integrating Indigenous Themes in the Curriculum, University of Prince Edward Island
- Indigenous Pedagogies, University of Victoria
- Aboriginal/Indigenous Learners: History, Culture, and Ways of Knowing, University of Northern British Columbia
- Programming for Aboriginal Students, University of Winnipeg

Bachelor programs: Some faculties of education offer full Bachelor programs for teachers who intend to work with Indigenous students, either in public schools or in First Nations schools. But these programs do not necessarily cover Indigenous perspectives in the sciences. Such programs include:

- Aboriginal Education Program, Brock University
- Aboriginal Teacher Education Program, Queen's University
- Community-based Aboriginal Teacher Education Program (CATEP), University of Winnipeg
- First Nations and Inuit Education Teacher Certification Programs, McGill University
- Indigenous Teacher Education Program, University of British Columbia
- Kenanow Education Program, University College of the North
- Native Studies–Secondary Education degree, University of Alberta
- Niitsitapi Teacher Education Program, University of Lethbridge
- Saskatchewan Urban Native Teacher Education Program (SUNTEP), universities of Regina and Saskatchewan
- Waaban Indigenous Teacher Education, York University
- Wabanaki Bachelor of Education, University of New Brunswick
- Yukon Native Teacher Education Program (YNTEP), University of Regina

These lists are not comprehensive. But they suggest that universities across the country are working to provide teacher training that meets the needs of Indigenous learners. However, few current graduates leave university with specialized training in bridging Western and Indigenous sciences in the classroom.

Source: The Conference Board of Canada.

An informal indicator of the success of Indigenized science in the classroom is more engaged students.

Aligning high-school curricula with PSE curricula

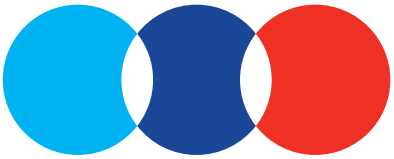
Beyond the broad goal of scientific literacy, many students take high school science with an eye to pursuing science studies in PSE. They expect that the curricula they covered in high school will meet the requirements for entry to PSE.

- **Recognizing credits:** High school credits that are not based on a provincial exam may be difficult for PSE institutions to evaluate. This can put students who have completed experiential science courses at a disadvantage. For example, students who pass the Northwest Territories' experiential science courses may still have to complete exam-based science courses from the Alberta curriculum to be accepted into PSE science programs.[42]
- **Alternatives within the curriculum can create a two-tier system:** Our interviewees noted that some of the new indicators designed to incorporate Indigenous perspectives in the Saskatchewan school curriculum do not prepare students well for the standard university curriculum. This can leave some Indigenous students who have passed high school science with good grades struggling with first-year university courses.[43]
- **Access programs.** The necessity for targeted supports to bridge from high school science into STEM studies in PSE, such as the Indigenous Student Achievement Pathways at the University of Saskatchewan, indicates in part, a disconnect between high school and PSE curricula.[44]

Measuring impact

No quantitative measures

We did not find evidence that any provinces have quantitative measurements of the long-term impact of revised K–12 science curriculum on Indigenous students. Indeed, experts point out that "hard evidence of impact is often rare to find."[45] Of course, impacts like larger numbers of Indigenous students studying and succeeding in PSE STEM fields, and going on to jobs in STEM fields, would take some years to materialize. In addition, accurate data collection is difficult because it depends on students self-identifying as Indigenous, and not all choose to do so. And, attributing long-term impacts to curriculum reform alone would be tenuous at best. Meanwhile, measuring the impact of reforms in science education often takes a back seat to concerns about basic literacy and numeracy.[46]



42 For more information, see Natalie Arruda and Jane Cooper, *Indigenous STEM Access Programs: Leading Post-Secondary Inclusion* (Ottawa: the Conference Board of Canada, forthcoming).
43 Personal communication, April 2020.
44 Personal communication, April 2020.
45 van den Akker, "Bridging Curriculum Design and Implementation," 7.
46 Personal communication, April 2020.

Many anecdotal reports

However, our interviewees reported informal indicators of successful outcomes in the short term from classes that are implementing an Indigenized science curriculum. These included:

- Indigenous students are more engaged in science and turn up for class regularly.
- Extra Indigenous students participate in extracurricular activities like science fairs.
- More Indigenous students choose to take the senior science courses that have integrated Indigenous perspectives.
- Including Indigenous perspectives in science class discussions is normal. All students expect to see other viewpoints included in their science studies.
- Teachers feel more comfortable using Indigenous ways of knowing during lessons and to meet curriculum outcomes. They now ask "How are we doing this?" rather than "Why are we doing this?"
- Elders are satisfied with how their knowledge has been incorporated into the curriculum.
- Teachers are accepting knowledge received from Elders for student assessments.
- Indigenous youth who spend a lot of time on the land can be recognized as experts, as lessons provide a forum for them to contribute their knowledge of nature. For example, young hunters often have expertise in animal behaviour, animal biology, and meteorology and weather prediction.
- Teachers are concerned that reverting to the old curriculum would reduce the number of Indigenous students getting the science credits they need to graduate, and so impact graduation rates.

It definitely helps when our students open up the textbook and see somebody that they know, or somebody that their mom or dad or their *kookum or mosoom* know, in the book. I think that's something really positive that's happening in our province.

—Saskatchewan First Nations educator

Recommendations for sustainable curriculum reform

Successful sustainable curriculum reform depends upon alignment and support from all levels of an education system.[47] Efforts to reform provincial science curricula to incorporate Indigenous perspectives alongside Western science may be aligned with the Common Framework at the national level. But to be successful, curriculum reform also needs to be supported by new approaches to teacher training in universities at the provincial level. At the same time, support for implementing new curriculum must come from regional school divisions and communities, such as professional development opportunities. And all these changes must be manifested in the local classroom. These are some areas where alignment could be improved in Canadian jurisdictions.

47 Tichnor-Wagner, *Draft Change Management*; van den Akker, "Bridging Curriculum Design and Implementation."

Faculties of education must train teachers to teach the curriculum

To have sustainable change in K–12 science, the Indigenized school curriculum will need to be supported or complemented more by relevant teacher training in faculties of education. Realistically, this means the change will not be fully integrated until a new generation of teachers enters the workforce.

School divisions must build on teacher training through professional development

Ongoing professional development is important to maintain an adequate pool of trained teachers. Local Indigenous content is found only at the local level. Keeping enough well-prepared teachers is hard when the curriculum demands specific local knowledge and/or teachers frequently move in and out of, or between, communities.

Ministries of education need to help align PSE curricula and K–12 curricula

Sustainable change in K–12 science curricula will depend on curriculum reform at all levels in education. If PSE institutions do not accept credits from the new high school curriculum, the curriculum is unlikely to take hold at high school either.

Publishers must keep teaching materials current

A lot of curriculum renewal is realized through curriculum materials. The design of those materials must keep pace with technological change. For example, an innovative science curriculum used in Mohawk schools in the 1990s was designed around paper worksheets.[48] While the content of the materials is still relevant, the format of the materials is long out of date.[49] Likewise, more recent curricula embedded in textbooks are at risk of rapidly becoming dated.

48 Restoule, “Walking on One Earth.”
49 Personal communication, April 2020.

Curriculum developers must choose language carefully

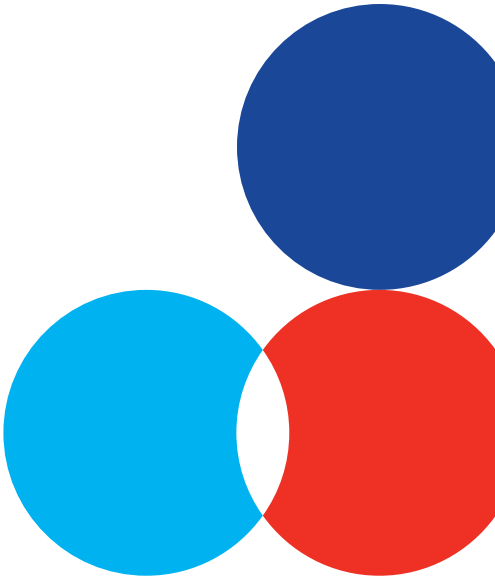
The English used in some of the new science textbooks is not accessible to students with lower literacy levels and English-as-a-second-language learners. It can be as difficult to translate Western science terms into plain English as it is to capture or express Indigenous ideas in English. But more importantly, Indigenous languages are a repository of Indigenous scientific knowledge and enable learning from Elders. Indigenous languages contain vital taxonomies for plants and animals that are specific to the people's relationship with the species. Literacy, in the widest sense of the word, is necessary for embracing Indigenous sciences, encompassing the ability to read the environment, including the forest, rivers, and oceans.[50]

Teachers have to balance broad goals with local content

Finally, van den Akker points out a persistent dilemma in curriculum reform: "How can aspirations for large-scale curriculum change and system accountability be combined with the need for local variations and ownership?"[51] This is particularly true when introducing Indigenous perspectives into curriculum. By definition, Indigenous knowledge is tied to the local environment and land. And so, a curriculum that values Indigenous perspectives must be one that embraces flexibility and variety in what is learned in the individual classroom, potentially at the expense of scalability and sustainability.

All parties need to look for new opportunities

The Saskatchewan experience benefited from an element of serendipity when more than a decade ago the Ministry of Education persuaded a national publisher to invest in a set of customized school textbooks for a small-market province. Pearson Canada gave the ministry editorial control and let it choose the authors and vet all the work. A repeat of this experience seems unlikely now, as publishers focus on PSE where profits are more secure. New curriculum reform projects will have to find different ways to create and distribute the innovative materials that can drive change.



50 Snively and Williams, "'Coming to Know'," 113.

51 van den Akker, "Bridging Curriculum Design and Implementation," 9.

Appendix A
Methodology

The findings presented in this impact paper flow from:

- an environmental scan of provincial and territorial K–12 science curricula across Canada;
- a scan of websites of 63 faculties of education across Canada;
- an interjurisdictional review of 250 academic and grey literature sources on theory and practice in cross-cultural STEM education;
- interviews with 13 Canadian professionals involved with K–12 science curriculum renewal (totalling 8.75 hours), including academics, Ministry of Education staff, curriculum developers, and Indigenous and non-Indigenous educators—working in British Columbia, Alberta, Saskatchewan, the Northwest Territories, and Ontario. All interviews were recorded, transcribed, and coded using qualitative data analysis software.

Appendix B
Bibliography

Aikenhead, Glen S. "What's Happening in Saskatchewan? We're Learning to Infuse Indigenous Perspectives Into Our Science Courses." A paper prepared for LOCUM, Edmonton: Alberta Education, 2015. Accessed June 28, 2020. https://www.ntnu.edu/documents/1263718082/1265865039/What+is+happening+in+Sask+-+Enhancing+Sch+Sci+with+IK.pdf/aae54506-dbc2-4e29-aa32-840a4f72b31f.

Aikenhead, Glen S., and Dean Elliott. "An Emerging Decolonizing Science Education in Canada." *Canadian Journal of Science, Mathematics and Technology Education* 10, no. 4 (November 30, 2010): 321–38. Accessed June 27, 2020. https://doi.org/10.1080/14926156.2010.524967.

Aikenhead, Glen, Jennifer Brokofsky, Theresa Bodnar, Chris Clark, Christie Foley, Jennifer Hingley, Darryl Isbister, Terry Johnson, Cyndi Lauze, Sarah Myers, and others. *Enhancing School Science With Indigenous Knowledge: What We Know From Teachers and Research*. Saskatoon: Saskatoon Public School Division, 2014. Accessed June 29, 2020. https://education.usask.ca/documents/profiles/aikenhead/enhancing-school-science.pdf.

Bellringer, Carol. *Progress Audit: The Education of Aboriginal Students in the B.C. Public School System, An Independent Audit Report*. Victoria: Office of the Auditor General of British Columbia, 2019. Accessed June 29, 2020. https://www.bcauditor.com/sites/default/files/publications/reports/OAGBC_Ab-Ed-Progress_RPT.pdf.

British Columbia Teachers Federation. *2017 BCTF Curriculum Change and Implementation Survey*. Victoria: British Columbia Teachers Federation, 2017. Accessed June 27, 2020. https://bctf.ca/uploadedFiles/Public/Issues/Curriculum/Survey/2017Survey.pdf.

Canadian School Boards Association—Indigenous Education Committee. *Indigenous Education Structure, Initiatives and Promising Practices.* Wolfville, NS: CSBA, 2018. http://cdnsba.org/wp-content/uploads/2013/10/Indigenous-Education-Structure-Initiatives-and-Promising-Practices.pdf.

Conference Board of Canada, The. "How Can More Indigenous People Access STEM Careers? n.d.. Accessed July 7, 2020. https://www.conferenceboard.ca/research/how-can-more-indigenous-people-access-stem-careers.

Cooper, Jane. *Incorporating Indigenous Cultures and Realities in STEM*. Ottawa: The Conference Board of Canada, 2020. Accessed June 30, 2010. https://www.conferenceboard.ca/e-library/abstract.aspx?did=10697.

Council of Ministers of Education, Canada. *Common Framework of Science Learning Outcomes K to 12: Pan-Canadian Protocol for Collaboration on School Curriculum*. Toronto: CMEC, 1997.

Department of Education, Culture and Employment. "Dene Kede and Inuuqatigiit." Yellowknife: Government of Northwest Territories, n.d. Accessed June 30, 2020. https://www.ece.gov.nt.ca/en/services/curriculum/dene-kede-and-inuuqatigiit.

—. *2006 Experiential Science 10-20-30 Terrestrial Marine Freshwater.* Yellowknife: Department of Education, Culture and Employment, 2006. Accessed June 29, 2020. https://www.ece.gov.nt.ca/sites/ece/files/resources/experimental_science_10_-_30.pdf.

First Nations Education Steering Committee and First Nations Schools Association. *Secondary Science First Peoples Teacher Resource Guide*. Vancouver: First Nations Education Steering Committee, 2019. Accessed June 30, 2020. http://www.fnesc.ca/wp/wp-content/uploads/2019/08/PUBLICATION-SCIENCE-FIRST-PEOPLES-Secondary-TRG-2019.pdf.

Hatcher, Annamarie, Cheryl Bartlett, Albert Marshall, and Murdena Marshall. "Two-Eyed Seeing in the Classroom Environment: Concepts, Approaches, and Challenges." *Canadian Journal of Science, Mathematics and Technology Education* 9, no. 3 (2009): 141–53.

Hogue, Michelle M. "Let's Do It First and Talk About It Later: Rethinking Post-Secondary Science Teaching for Aboriginal Learners." *In Education* 19, no. 3 (April 21, 2014): 137–51.

—. *Dropping the "T" From Can't: Enabling Aboriginal Post-Secondary Academic Success in Science and Mathematics*. Vernon, BC: J. Charlton Publishing, 2018.

Kanu, Yatta. "Increasing School Success Among Aboriginal Students: Culturally Responsive Curriculum or Macrostructural Variables Affecting Schooling?" *Diaspora, Indigenous, and Minority Education* 1, no. 1 (January 1, 2007): 21–41.

Kim, Eun-Ji. "Neo-Colonialism in Our Schools: Representations of Indigenous Perspectives in Ontario Science Curricula." *McGill Journal of Education* 50, no. 1 (2015): 119–43.

Kim, Eun-Ji Amy, and Liliane Dionne. "Traditional Ecological Knowledge in Science Education and Its Integration in Grades 7 and 8 Canadian Science Curriculum Documents." *Canadian Journal of Science, Mathematics and Technology Education* 14, no. 4 (October 2, 2014): 311–29. Accessed June 27, 2020. https://doi.org/10.1080/14926156.2014.970906.

Martin Family Initiative. Promising Practices in Indigenous Education Website (PPW). Martin Family Initiative, 2019. Accessed June 28, 2020. https://www.themfi.ca/ppw-educational-resources.

Meyer, Sharon, Glen Aikenhead, Kelley Cardinal, Danny Sylvestre, and Ted View. *Culture-Based School Mathematics for Reconciliation and Professional Development*. Saskatoon: McDowell Foundation, 2019.

Ministry of Education. *Biology 30*. Regina: Ministry of Education, 2016. Accessed June 29, 2020. https://curriculum.nesd.ca/Secondary/Documents/Biology%2030%202016.pdf.

Murray, Nick. "60 Per Cent of All Canadian Indigenous Languages Are in B.C." *Nelson Star*. April 1, 2019. Accessed June 29, 2020. https://www.nelsonstar.com/news/60-per-cent-of-all-canadian-indigenous-languages-are-in-b-c/.

National Indigenous Economic Development Board, The. *The Indigenous Economic Progress Report 2019*. Ottawa: NIEDB, 2019. Accessed June 20, 2020. http://www.naedb-cndea.com/wp-content/uploads/2019/06/NIEDB-2019-Indigenous-Economic-Progress-Report.pdf.

NWT Bureau of Statistics. "2016 Census of Canada—Education and Labour Market Activity." Accessed June 30, 2020. https://www.statsnwt.ca/census/2016/.

Ontario Institute for Studies in Education. Deepening Knowledge: Aboriginal Peoples Curriculum Database. Toronto: Ontario Institute for Studies in Education, 2019. Accessed June 28, 2020. https://www.oise.utoronto.ca/deepeningknowledge/.

Pearson Canada. *Pearson Science: Saskatchewan Edition*. Regina: Pearson Canada, 2011–14, available for purchase.

Restoule, Jean-Paul. "Walking on One Earth: The Akwesasne Science and Math Pilot Project." *Environments* 28, no. 2 (2000): 37.

Royal Commission on Aboriginal Peoples. "Volume 5: Renewal: A Twenty-Year Commitment." In *Report of the Royal Commission on Aboriginal Peoples*. Winnipeg: RCAP, 1996. Accessed September 12, 2019. http://data2.archives.ca/e/e448/e011188230-05.pdf.

Snively, Gloria J., and Lorna B. Williams. "'Coming to Know': Weaving Aboriginal and Western Science Knowledge, Language, and Literacy Into the Science Classroom." *L1 Educational Studies in Language and Literature* 8, no. 1 (2008): 109–33.

Snively, Gloria, and Lorna Williams, editors. "Chapter 2—Why Transforming the Science Curriculum Is Necessary for Aboriginal Students." In *Knowing Home—Braiding Indigenous Science With Western Science, Book 1*, 13–34. Victoria: University of Victoria, 2016. Accessed June 27, 2020. https://dspace.library.uvic.ca/bitstream/handle/1828/7821/Ch%202_Knowing%20Home.pdf?sequence=5&isAllowed=y.

—. *Knowing Home: Braiding Indigenous Science With Western Science, Book 1*. Victoria: University of Victoria, 2016. Accessed June 30, 2020. https://pressbooks.bccampus.ca/knowinghome/.

Statistics Canada. "Aboriginal Peoples in Canada: Key Results From the 2016 Census." *The Daily*, October 25, 2017. Accessed June 27, 2020. https://www150.statcan.gc.ca/n1/en/daily-quotidien/171025/dq171025a-eng.pdf?st=CEi3vhYf.

—. "Aboriginal Population Profile, 2016 Census." June 21, 2018. Accessed June 29, 2020. https://www12.statcan.gc.ca/census-recensement/2016/dp-pd/abpopprof/index.cfm?Lang=E.

Sutherland, Dawn. "Resiliency and Collateral Learning in Science in Some Students of Cree Ancestry." *Science Education* 89, no. 4 (July 2005): 595–613. Accessed June 29, 2020. https://doi.org/10.1002/sce.20066.

Taylor, Christie. "Relearning the Star Stories of Indigenous Peoples." Ratio broadcast, *Science Friday.* September 6, 2019. Accessed June 20, 2020. https://www.sciencefriday.com/articles/indigenous-peoples-astronomy/.

Tichnor-Wagner, Ariel. *Draft Change Management: Facilitating and Hindering Factors of Curriculum Implementation*. Vancouver: Organisation for Economic Co-operation and Development, 2019. Accessed June 29, 2020. https://www.oecd.org/education/2030-project/contact/Change_management_for_curriculum_implementation_Facilitating_and_hindering_factors_of_curriculum_implementation.pdf.

Tippet, Christine D., and Todd M. Milford. *Science Education in Canada*. n.p.: Springer International Publishing, 2019.

Truth and Reconciliation Commission of Canada. *Truth and Reconciliation Commission of Canada: Calls to Action*. Winnipeg: Truth and Reconciliation Commission of Canada, 2015. Accessed June 29, 2020. http://nctr.ca/assets/reports/Calls_to_Action_English2.pdf.

United Nations. *United Nations Declaration on the Rights of Indigenous Peoples*. New York: United Nations, 2007. Accessed October 29, 2019. https://www.un.org/development/desa/indigenouspeoples/wp-content/uploads/sites/19/2018/11/UNDRIP_E_web.pdf.

University of Toronto. "Natural Curiosity." n.d. Accessed July 7, 2020. https://wordpress.oise.utoronto.ca/naturalcuriosity/our-pedagogy/.

van den Akker, Jan. "Bridging Curriculum Design and Implementation." In *Future of Education and Skills 2030: Curriculum Analysis*. Paris: Organisation for Economic Co-operation and Development, 2018. Accessed June 29, 2020. https://www.oecd.org/education/2030-project/contact/Bridging_curriculum_redesign_and_implementation.pdf.

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