First Nations Earth Science 11: Place-based Secondary Science Education Incorporating Indigenous Knowledge

by

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Abstract

Keywords: Indigenous education, Science education, Earth Science, TEKW in Science Curriculum, Indigenous perspectives, Indigenous worldview, Traditional knowledge

This Project reports on a locally-developed First Nations Earth Science 11 course where students participated in experiments and projects that promoted their understanding through an Indigenous, place-based and land-based environment. Learning science with Indigenous Elders on the land is a breath of fresh air. By blending Western science learning with Traditional Ecological Knowledge students were able to see, feel, smell and sense the knowledge that is being passed down to them. Using traditional Indigenous methods of teaching science in the field may help promote not only an understanding of science, but an understanding of traditional Indigenous methods of learning and the practice of traditional skills that pertain to science learning. The data collected through this project reveals that both Indigenous and non-Indigenous students can benefit from this type of learning, suggesting that it is valuable to integrate Indigenous knowledge in science education.

Introduction

This Project reports on research examining the experiences of Indigenous students in a locally-developed, place-based First Nations senior secondary course in Earth Science entitled *First Nations Earth Science 11*. First taught in 2007, this course was developed, taught and then examined by the author. In this Project the author will outline the reasons for the development of this course, why incorporating an Indigenous perspective into school science education is important, how the course developed and the methods used to research the effectiveness of *First Nations Earth Science 11*.

Rationale for the *First Nations Earth Science 11* Course

The *First Nations Earth Science 11* was developed in a secondary school in British Columbia, Canada. The *First Nations Earth Science 11* course was first proposed in a staff meeting at the host school when the school Principal and faculty (teachers) with an Indigenous ancestry noted that Indigenous students at the school were not completing the necessary requirements for graduating from secondary school. Table 1 below shows graduation rates for Indigenous students in British Columbia during the first years of this course (2007-08). Since 2007-2008 there has been a slight increase in graduation rates within many jurisdictions in British Columbia: See Table 2. Both Tables show, however, that graduation rates remain considerably lower for Indigenous students than for their non-Indigenous peers. In British Columbia, many Indigenous students are not completing high school; in fact, as Krocker (2004) notes, “the enrolment rates drop consistently after Grade 8 and continue to decline until Grade 12” (Krocker, 2004, p. 17).

Among the credits needed for graduation in British Columbia, students must complete high school credits in Grade 10 science as well as successfully pass a provincial exam and credits in a Grade 11-level science in a course of their choice (Earth Science, Physics, Chemistry or

Biology). Many students struggle to get through the Science 10 curriculum and if they succeed, then find that they have a bigger struggle to get through the Grade 11 science credit course. This is where the school featured in this study found that students needed help and the essential reason the author proposed creating the *First Nations Earth Science 11* course.

Table 1

Aboriginal Student Data for Selected School Districts in British Columbia 2007–08

School district	Aboriginal students (%)	Six-year completion all students (%)	Six-year completion Aboriginal students (%)	Scholarships number of students	Scholarships Grade 12 students (%)
38 Richmond	1.2	91	65	213	8
45 West Vancouver	0.6	93	60	44	6
49 Central Coast	66.7	70	40	1	6
45 West Vancouver	0.6	93	60	44	6
50 Haida Gwaii	67.1	50	44	1	2
52 Prince Rupert	60.2	63	39	4	1
74 Gold Trail	57.1	63	46	1	0
84 Vancouver Island West	51.0	62	49	0	0
87 Stikine	79.0	36	26	0	0
92 Nisga'a	99.2	41	41	0	0

Note. Table data excerpted from BC Ministry of Education: Summary of Key Information for 2008/2009

Table 2

Dogwood District/Authority Award for Aboriginal and Non-Aboriginal Students 2007–2012

School Year	Aboriginal students	Non-Aboriginal students

	Total	Awarded n (%)	Total	Awarded n (%)
2007/08	5,353	107 (2)	55,019	2,671 (5)
2008/09	5,577	121 (2)	54,928	2,673 (5)
2009/10	6,001	149 (2)	57,070	2,658 (5)
2010/11	6,533	126 (2)	59,274	2,682 (5)
2011/12	6,379	139 (2)	58,239	2,666 (5)

Note. Data excerpted from HAWD (BC Ministry of Education, April 2013a, p. 32), Scholarships and Awards, 2011/12

The *First Nations Earth Science 11* was created with the intent to adapt the Earth Science curriculum to reflect the learning styles of Indigenous peoples. Why are Indigenous students not completing high school science at rates similar to their non-Indigenous peers? Many scholars have turned their attention to understanding this question. Some show that science course materials lack relevancy to the lives and experiences of Indigenous students. Aikenhead and Huntley (1999) noted:

> In some cases, the disparity between home and school environments is so great that some Native American students experience a kind of culture shock which significantly affects their attitudes toward school (Cajete, cited in Aikenhead and Huntley, 1999, p. 161). In response to this and other factors (e.g. irrelevance to everyday life and to cultural survival; (AAAS, 1977), Aboriginal students have generally not pursued science courses in the upper grades of high school. (p. 3)

Krocker (2004), in her study of students from two Yukon First Nations, also found that, "comments by students revealed they would like to see a cultural approach taken through science education that bears a stronger connection to their lives outside of the school setting" (Krocker, 2004, p. 2).

After observing Indigenous students in this school for a few semesters and seeing their lack of interest in science, the author decided to design a course that would hopefully enable these students to successfully complete the required science credits for graduation. The purpose of this course was to: 1) Increase the graduation rates of Indigenous students; 2) Provide a cultural connection to the land and local environment through science; and 3) Encourage continued interest in science beyond this class.

Definition of Terms Used in This Project

Many terms related to the Original Peoples of a land have changed and evolved over time. Over the ten years since the start of this high school course and this research project, terms have changed and have been more clearly defined in literature and in political spheres. The following is an explanation of the terms used in this project:

Indigenous: Refers to the global term used for the Original Peoples of territories worldwide, as stated in the United Nations Declaration on the Rights of Indigenous Peoples (2008). In this project Indigenous is used to describe people, traditions, and traditional ways of knowing and understanding; in this way, "Indigenous" is used both as a noun and as an adjective. Current research uses this term most commonly today. This term is also used in this project to refer to all Original Peoples.

Aboriginal: This term was created in the amendments to the Constitution Act of Canada in 1982. It includes First Nations (Status and Non-status), Inuit, and Metis. Most scholarly work during the period from the 1980s to the early 2000s uses this term when referencing Indigenous peoples in relationship with Canada.

First Nations: First Nations references both individual people and nations in relationship with the Canadian government under the Indian Act of 1871. This project takes place in a school district of British Columbia on the territories of seven First Nations. First Nations is commonly used in the BC

Ministry of Education's curriculum. Therefore the course was created to indigenize content and named *First Nations Earth Science 11*, which was in line with the history course created by the Department of Education titled, *First Nations Studies 12*.

Elder: This term refers to mature people who have gained an understanding and perspective of life based on their experience, age and worldview. In this project, Elder refers to all knowledge keepers of both advancing years and experience who are of the Original People of the land and who live their traditional teachings and have permission to teach others.

Knowledge Keeper: This term refers to anyone of an Indigenous background who has learned the traditional ways and practices of their Elders and practice them and teach these today. Knowledge Keepers are not necessarily people of advanced age. Knowledge keepers have been taught very specific traditions, often shared by Elders, in very defined areas of their cultural background, location and language group. For instance, a person who has been taught about plant medicines will have the knowledge based on their people's traditional uses of those plants native to a specific geographic and geologic location.

Traditional Ecological Knowledge and Wisdom (TEKW) and Indigenous Knowledge (IK): Refers to the land-based knowledge systems of Indigenous peoples. TEKW came as a way of introducing Indigenous knowledge into traditional Western science at a time when the field of environmental science was changing the approach to science learning to be place-based and experiential and furthered by Indigenous knowledge systems situated in specific territories.

Indigenous epistemologies: An inherent understanding that all things are connected based on knowledge and stories shared from birth within Indigenous communities that creates a specific worldview based on where people are raised and what connections they have to plants, animals and spirit in those places.

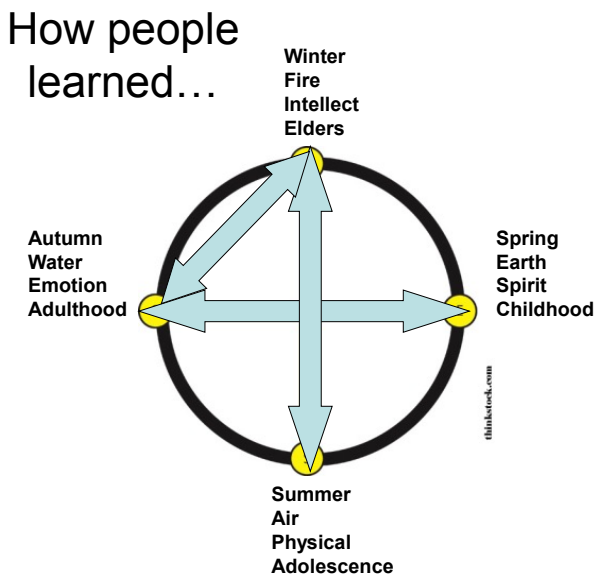
Place-based education: Think globally, act locally is the best way to summarize what place-based education refers to in this Project. Place-based education starts from the point of where people are geographically located in the world and how that local environment teaches or informs people and allows them to work within a specific framework; ideally, this education also helps students feel a sense of responsibility to their community and local environment.

Indigenous place-based education: Indigenous worldviews or epistemologies are situated within the term of place-based education such that spirit-based understandings of the world and relationships with the environment are included in the sense of responsibility that students learn.

Principles for the Development of the *First Nations Earth Science 11*

Indigenous Approach to Teaching

In the early 1990s I was gifted the knowledge of a medicine wheel teaching and understanding of how we learn as Indigenous people by an Elder in a course I attended in Vancouver. This teaching was from a Cree Elder living in a Coast Salish nation. He gave us permission to use the following model (see Figure 1) in our practices. While living on this territory, a second Elder came into my life and mentored me about his traditional Cree and Salteaux teachings for twelve years until his passing in 2005. These teachings along with my life experience as well as my training as an educator allowed me to design and share this figure based on these teachings.



(M. Tomasino, course slide, November 24, 2011)

The preceding figure shows how Indigenous populations have designated teaching according to knowledge, energy and experience. Adults are responsible for children while Elders are responsible for adolescents and in turn responsible for guiding the adults with their wisdom and experience. In many Indigenous cosmologies, the number four represents harmonious balance, a holistic balance between the physical, spiritual, intellectual and emotional self. The hands-on education provided by the Elders was meant to bring youth to that balance and understanding over time. Following Indigenous worldviews, one sees that education is a life-long learning process that is spirit-based (Battiste, 2005; Williams & Tanaka, 2006), which means that the journey of life is an inner process of discovery guided by the land-based teachings of the territory and the understanding that humans are connected to all that is living around them (Ermine, 1995).

Reasons for adding Traditional Ecological Knowledge and Wisdom

The Indigenous worldview formed the backbone to this proposed earth science curriculum. Adding Traditional Ecological Knowledge and Wisdom (TEKW) to the high school science curriculum propelled the momentum in the course to learn in a different way. One of the course

goals was to find out if this First Nations Earth Science course helped students connect to the land, to their Elders and to science: Would this approach allow for a cultural and experiential connection? And in doing so, would graduation rates improve for Indigenous students who enrolled in this course?

A number of scholars have researched and created programs to assist science education on traditional Indigenous territories, including Aikenhead (2006) and Chinn (2008). When the high school course researched in this Project was proposed in 2006, many Indigenous students reported that they could not see themselves reflected culturally in science textbooks (Krocker, 2004). Today, science textbooks in Northern and Western Canada include field studies and look at TEKW to explain science using the land that students know and where they already practice traditional methods of fishing, hunting and trapping. Canada's Northwest Territories' science curriculum (2006), for example, includes the use of TEKW in its Experiential Science 10-20-30 for Grade 10 to 12 students.

Involvement of Elders as Teachers

After spending two semesters with our Indigenous students in 2005-2006, I realized that learning from our Elders within the territory could add valuable learning experience for our students and connecting with Elders could encourage students to complete the course requirements. In field trips and classroom discussions with Elders and other specialists from the community, I observed the connection, the value, the acknowledgement, and the respect that was apparent in the student's' desire to listen and learn. Photograph 1: Traditional Herring Fish Traps.


(photo, Tomasino, 2008)

Teacher/Archaeologist and honorary Tseschat (Nuuchahnaulth) Elder Denis St. Claire shows traditional ways of "trapping" herring at low tide in the fish traps built by Tseschat ancestors in Barkley Sound.

Within the classroom and with the Elders, the students in the *First Nations Earth Science 11* course allowed themselves to become comfortable and "feel smart" because they were working with people they knew and trusted. In many classes, their classmates were family members and the Knowledge Keepers and Elders were aunts, uncles and grandparents.

A Place-Based Approach to Science Education

After having worked with this group of Indigenous students for the previous two years, I realized that it was important to build a cultural and experiential component to the course. I had observed, through our First Nations Outdoor Education course that Indigenous students needed to learn outside, beyond the classroom setting. Using their senses: touching, smelling and hearing, connected them to their learning in a tangible way, carrying their reading in the classroom to their experience in the field. In addition, the connection to place may help establish how the land is of the utmost importance in this model of science and how learning from one's own back yard may build a

connection to what exists locally and how it was used. Gruenewald (2007) reminds us that, "place-based educators are especially interested in the power of place as a context for diverse experiences that do not and probably cannot happen in the institution of school... places are powerfully pedagogical… to participate meaningfully in the processes of coming to know places and shaping what our places will become" (p.143). The connection to place is a fundamental aspect to transferring science-based knowledge to traditional territories and understandings. The place-based approach was necessary to the development of this course. Students grasped the scientific concepts in class and then were able to transfer their new knowledge into the field studies. Students often said that they understood the ideas and thus felt "smart" in learning science, sometimes for the first time. Learning science experientially allowed them to make connections between the textbook knowledge and its application in the field.

Blending of Science and Traditional Ways of Knowing

The goal of building connections to TEKW in science education is important in building relationships with Indigenous students and in building their connection to the curriculum. Students needed to find the confidence in themselves to make the connections, essentially to have those "ah-ha" moments that would propel their understanding of the lesson. In their study to enhance Indigenous participation in sciences in British Columbia, Snively and Williams (2006) wrote that the lack of Indigenous student participation in traditional Western science high school classes would not change unless:

> Science classrooms and teaching materials provide a meaningful context for Aboriginal students (as defined by their local communities), and unless Aboriginal knowledge coexists with Western science in the science classroom, many Aboriginal students will continue to find the science curriculum inaccessible and culturally irrelevant. At this level the lack of

> participation in the science graduation courses limits their options to pursue careers founded on science and mathematics. (p. 230)

The cultural connection had to be imbedded in the goals of the *First Nations Earth Science 11* course to help students succeed in science by offering a different, Indigenous approach to learning and practising science alongside the western science curriculum.

The Development of *First Nations Earth Science 11*

The course was conceptualized in spring 2007 for the 2007/2008 school year in an inner-urban school situated on the territory of two Indigenous nations. Initially the course combined part of the curriculum for the First Nations Outdoor Education class that had been in place for two years already, a course that was becoming too expensive to run and required too many hours of fundraising, and the existing Earth Science curriculum, in particular the units on geology, plant ethnobotany, and marine biology. The school district board approved this locally-developed *First Nations Earth Science 11* course in June 2007.

The idea for this course stemmed from my earlier experiences at this school while working in 2005 with at-risk students that had absolutely no interest in the material that they were expected to learn, whether it was Mathematics, Social Studies, or otherwise. From prior experience teaching in Inuvik, Northwest Territories, I decided that taking the students outside could be part of the solution to motivate them to want to learn better. I therefore proposed a *First Nations Outdoor Education 11 c*ourse after my first semester at the high school because, in my experience, the outdoors helps invigorate learning, in particular learning about where we live and the importance of what exists there; in other words, connections to place. The First Nations Outdoor Education course was filled every semester. Once I saw their interest in looking at trees and plants and asking questions about them, I started to incorporate some science curriculum/ethnobotany, as a way of

learning while we were hiking on traditional territories. The units in the First Nations Outdoor Education course included outdoor survival, winter survival in the mountains, ethnobotany, marine biology, and all of it included hiking to different local parks to learn about plants and the local terrain, including learning about traditional edible and medicinal plants as well as local ways of preparing various plants, fish and marine species. While hiking or paddling with Elders and Knowledge Keepers, we also learned about the value of our local territory and how the land had provided so much healthy foods and shelter to people for centuries. This approach is clearly place-based; as Gruenewald and Smith's (2008) note, "an education in place must also acquaint students with the way that their own health and security are co-dependant on the health and security of everyone and everything around them" (p. xxi).

After our high school Indigenous staff discussion on the failure rates with the Grade 11 science course, I proposed the development of a new, *First Nations Earth Science 11* course as a means to satisfy both needs; the physical aspects of First Nations Outdoor Education blended with the existing secondary science curriculum. This would provide a natural progression from learning outdoors to building a connection to the earth science that was evident all around us, and possibly allow students a way to build on their outdoor experiences while satisfying the learning outcomes of the science curriculum.

As the courses expanded, I added a similar course in outdoor education and environmental science for the students in French Immersion. We travelled together for some of our field studies. This helped build bridges between two cultural groups in the school. It made headlines. As a result, the students, both Indigenous and French Immersion, and I were invited to speak at the University of Victoria and to participate in a five-year study; *The Pacific Crystal Project* (Anthony et al, 2010*)*, a Centre for Research in Youth Science Teaching and Learning, a goal of which was to increase

participation in science education in collaboration with a number of scientists, including one of my supervisors, Dr. Eileen Van der Flier-Keller, and local scientists Cathy Carolsfeld and Nikki Wright, all of whom had worked with our classes on field studies in the community.

As the First Nations course and the French Immersion courses grew in popularity their curriculum expanded. Students started to work on ecological and social justice programs both at school and in the community at large, including the two Indigenous territories. The projects became bigger and involved more students. New courses were added and a whole new program started that included courses in Social Justice, Sustainability, and Renewable Resources for Grades 9 to 12, and were open to all students in the school. Gruenewald (2007) states that as students understand their local environment they begin to participate in it, "to learn how to live well together in a place without doing damage to others, human and non-human… (this) provides a local focus for sociological inquiry and action that, because of interrelated cultural and ecological systems, is potentially global in reach. In other words, place-consciousness suggests consciousness not only of my place, but of others, and the relationship between places" (p. 149).

Course Outline for First Nations Earth Science 11

What follows is the *actual* course outline given to students and their parents. As people in the community heard about this course, they called or came by to ask about the curriculum. As a teacher, I feel it is important to share my experiences with other teachers and give them the means to create courses of their own in this way (See Appendix 5). Teacher candidates in science education were invited to do their practicums with us. Visiting teachers, who were interested in finding out more about the course, were invited to take part with their students on some of our field studies. Over time, the course outline that follows was shared with many teachers locally. The idea

in this project was to encourage teachers to take the course outline below and start their own courses, or to incorporate this type of learning with both Indigenous and non-Indigenous learners.

The activities that were planned throughout the course were not necessarily linear or limited to the section in which they were found. The outcomes were developed and applied in a spiral fashion that integrated the theory and practice of field skills, deepening the students' understanding and experience as the course progressed. For example, our class had completed the marine biology unit when a local elementary school principal contacted us to work with their grade five class on the canoes as they were learning to canoe in a local waterway that was accessible to both our schools and using the same canoes. We dedicated four Wednesdays to canoeing with the younger students and to sharing our knowledge of the marine species in the local waterway. The students in *First Nations Earth Science 11* thus became teachers to younger students.

Students in the *First Nations Earth Science 11* course were also expected to participate in field studies in order to complete field projects in the community. Participation was vital and worth essentially one-third of the overall course mark. Students were evaluated on the classroom work that they did, how they chose to apply it in the field study, how important their portion of the participation was to the overall project, and the outcome for all learners, including the students that came to watch or participate in the school-wide projects. For instance, if students had to show how to monitor water testing, they were evaluated on their preparation to understand and teach this aspect, how well they explained it to younger students, how effectively their mentees understood and responded to the lesson and the overall participation of both student presenters and their audience. Students knew they had to be there to complete the work both in class and outdoors and they knew that they would be asked to mentor others in the process. By demonstrating to younger

students in our field studies, *First Nations Earth Science 11* students were able to better demonstrate what they had learned.

Aboriginal Earth Science 11 (2013 version) Course Outline

The purpose of this course is to explore Earth Science 11 with an Aboriginal perspective. The goal of the course is to complete credits in science in an environment that includes some outdoor activities and exploration with Elders, guest speakers and field studies through Traditional Ecological Knowledge and Wisdom (TEKW). The course packages for Earth Science 11 are to be completed with additional outdoor field studies including:

- Nature identification: trees and plants, root systems
- Star mapping and astronomy
- Exploration of the coastal rain forest
- Orienteering and topography mapping
- Avalanche awareness, understanding weather while snowshoeing and cross country skiing (winter trip)
- Stewardship and protection of the environment
- Understanding wildlife habitats, ecosystems and river systems
- Plant, animal and marine biology
- Traditional fisheries and coastal waters
- Understanding basic chemistry
- Industry and its influence on nature
- Types of rocks; geology and geologic time
- Weather, storms and land/mountain formations

The course is assessed using student PowerPoint and digital story presentations, outdoor projects, work and clean-up of marine waterways, in-class workbook assignments and chapter quizzes, group work and shared assignments, discussion and trip preparation, school-wide projects and presentations, participation and leadership.

Marks were distributed based on the understanding that participation, leadership and respect are as important as the work performed in the field and in the classroom; 35% for written work and chapter quizzes, 35% for projects and presentations, and 30% for participation, group work and leadership. Grading was linear across the school terms, meaning that students did not have to complete all units in a consecutive manner but could come back to missed units and complete them at a later date. Within the course expectations is the commitment to completing the workbook portion of the class work in order to take part in the field studies. Students needed to show respect and listen to instructions in order to ensure personal and group safety. This course maintained the zero tolerance policy of the school district: drugs and alcohol were not permitted during the course on any field activities. If illegal substances were found during an activity parents would have been contacted.

First Nations Earth Science 11 **Course Packages**

The course started in September 2007 with nearly thirty students, most of Indigenous ancestry; the course was open to all students, however, regardless of ancestry. Using the American Guidance Service (AGS) version of the *Earth Science* textbook (Marshall and Rosskopf, 2001), I created comprehensive packages, with information and questions from the textbook and review questions that students could read and complete for each of the fourteen chapters. The textbook language was easy to follow, at the appropriate reading level and provided the necessary format to be used for group lessons and discussion, or individually by students who were absent temporarily

depending on their commitments to their family ceremonies or their initiations. Some Indigenous communities in this study engage in a three-month initiation for young people who are ready to become leaders in their community. In keeping with local Indigenous worldview, the course flexibility gave these students the ability to leave the course and come back at a later date to complete it. The course packages offered students the necessary work to understand the material, answer questions based on the knowledge, make some inferences, as well as answer critical thinking questions. These packages proved to be valuable for students, as discussed later in this Project.

Students who were taken for initiation could come back into the class, continue with the course packages and fall into whichever unit was happening at the time, including participating in the on-the-land field study component. This flexibility provided a sense of continuity without disconnection to the learning, thus avoiding the sense of failure often associated with leaving a course temporarily.

The Experiential Connection

A very important component of the course, in following with the very popular First Nations Outdoor Education class, was to continue learning on the land with Elders and community leaders, including scientists. Applying the lessons learned in class in field studies in the outdoors, mimicking to some extent the job of a scientist was important to me both as a teacher and a learner. This allowed students to understand that the job of a scientist included being outside and performing field studies. The goal was to promote further interest in science and jobs in science by practising it at the high school level. The goal in this new science class was to be outside at least once per week. Kerr (2016) studied the effects of science learning outdoors and noted that, “learning outside the classroom is often cited as a panacea for both social and academic development. It is well documented that pupils enjoy and remember outdoor work (Dillon *et al*., 2006). Eaton (2000) also

found that learning experiences conducted in the outdoors were more likely to have cognitive impact than those conducted in classrooms" (Kerr, 2016, p. 28).

Some of the outdoor classes included going on hikes with a local Indigenous teacher/Knowledge Keeper and an Elder to learn about the parts of trees, plants, roots, which were edible and were traditionally used by the local communities. For example, during one session, the Elder and his colleague, an Indigenous School Community Counsellor, took us to the beach to show where people traditionally dug for clams offshore in the summer and how they gathered dentalia (*Antalis pretiosum*) and other important marine species, ancient and important practices. Not only were these outdoor classes important to our science learning but they also allowed us to see how traditional practices disappeared many decades ago. We discussed our sense of nostalgia for the past as we left the study site. Chinn (2008) states:

> In a manner that parallels the loss of biodiversity due to exploitation and habitat change for human activity, society stands to lose cultural, linguistic, and knowledge diversity under current education policies oriented to capitalism and globalization…Science teaching leading to communities of learners engaged in the study of locally relevant science issues holds promise for educational equity and environmental literacy. (p. 20)

Students did a number of outdoor projects with Elders from all nine local nations including learning about the pit-cook, a traditional method of cooking in the soil. As a result, six "first year" students (students who had taken part in the first course in 2007 and who had been hired for the summer in a traditional tourism-based student summer employment program) were hired by the school in 2012 to help with a school-wide class project. The pit-cook project met other cross-curricular goals as well as the culturally relevant student-led learning outcomes for *First Nations Earth Science 11* and *First Nations Studies 12*; for *Foods 9 to 12* where students helped make

bannock; *Computer Graphics 10* students designed the logo and stationary; and Art classes created the invitations and posters for this very large community and school event. The pit-cook included a traditional salmon barbeque and performances of traditional dance by students in First Nations 11 and 12 courses in our school. We celebrated our science unit in ethnobotany with a pit-cook for the entire school, therefore sharing our knowledge of the traditional uses of plants for food, throughout the school and making it a daylong event for all students in the school. Local CBC radio attended and produced a short documentary about the day and the course.

The outdoor-based and project-based course also included learning about local Indigenous protocol. For the pit cook, the Chiefs, Elders and Community members were invited following local tribal protocol, this included students' hand delivering invitations to each of these honoured guests. Additionally every class in the school was invited to attend the preparations outside and the ceremony inside to support their learning and watch the students at work, cooking while drumming, singing and dancing as the day went on. Pit-cooks are prepared for community celebration; in this case, several classes assisted in preparing a pit-cook for the entire school community where everyone enjoyed freshly cooked salmon, bannock, and vegetables from the pit-cook. The pit cook event thus brought the whole school together in experiential learning.

Students in the course arrived at 05:30 in the morning to start the events of the day; amazingly students who were always late for class showed up on time for all of the field trips and school wide events. Most Indigenous students are accustomed to helping in local feasts and events in their ceremonial longhouses and I observed that students demonstrated the same positive attitude towards cultural events in school; as Basso (1996) observed, "when individuals step back from the flow of everyday experience and attend self-consciously to places—when, we may say, they pause to actively sense them—their relationships to geographical space are most richly lived and surely

felt" (p. 107). The students' sense of working for the collective good and within the traditions of ceremony encouraged them to attend these events without hesitation. All of the students in the class attended this event and performed their self-determined participation in the day's events. These cultural events that Indigenous science students led were often the memorable events mentioned at their graduation.

Other experiential projects over the years included telling stories and legends about the stars and stargazing for the *Astronomy* portion of the course as well as visiting the local Observation Centre. Stories from the Elders that visited our class included mapping their way on the ocean based on the position of the stars in a particular month, and stories of migration, hunting and gathering based on the constellations and the position of the stars in their appropriate months. Students also toured the Observation Centre in Victoria, named the Centre of the Universe, to have a look at the stars through the large telescope and on the computer screens. University of Victoria Astronomy students led these tours. In the final year that the course was run with the author, students engaged in an eight-week community-based project with a knowledge keeper and plant ethnobotanist at the local band's community garden. The work included testing the soil for alkalinity and acidity while paying attention to which trees affected the soil in different parts of the garden, planting seeds for the summer season, repairing the chicken coop and creating new apparatus for the chickens to exercise, collecting and observing the worm composter, learning about local plants and their traditional uses, as well as the final project to create large multi-lingual labels with pictures of the plants in the garden. These labels were written in English, Senčoŧen and Hul'q'umi'num languages. Engaging the language and understanding the connection between the plants and the names given to them and the words used to describe them added to our knowledge and understanding of the plants. For example, the Knowledge Keeper in our Garden Project detailed the importance of the camas

plant to local people as both a food and medicine and described how it's name in the Indigenous languages explained its function.

Course enrolment

This course had an enrolment of over one hundred students during the five years it was offered. As the data will show, the majority of students completed the course. The research will show that *The First Nations Earth Science 11* course achieved the initial goal of getting students to complete the Grade 11 science curriculum requirement for graduation. The course also helped lower-level learners pass a course that had previously been too difficult for them in a classroom setting. The course also achieved an unexpected benefit through its school-wide projects in bringing the school community and the local community together and bridging the cultural gap within the school and greater community, reflecting Gruenewald and Smith's (2008) point that, "education must first lead children to recognize the assets found in the human and natural environments closest to them, including the understandings drawn from traditional cultural practices that emphasize restraint in the use of natural resources and support for social practices informed by mutuality," (p. xx). These projects helped to showcase the school's Indigenous learners both within the school where there may have been some racism experienced both within the school and the neighbourhood surrounding the school. When school students and neighbours saw this class's Indigenous students at work on their projects and educating through their own research and learning about local Indigenous practices, it helped open doors and break down the local cultural barriers.

Students showed interest and engagement with the material studied, with the field studies and projects on the land, and within their local communities and the local Indigenous nations. The teachers and support staff both in the school and in the community were familiar to students, culturally connected and in many cases were also family Elders and relatives of the students. Staff

provided context and cultural relevance to the science. Our Education Assistant is related to the Chief and always made sure to educate us on the proper protocol to follow for requests and events. It was important to her as a member of her nation and as part of the Chief's family that proper protocol was adhered to. As result we all learned to follow proper protocols to achieve our classroom and project goals and intrinsically connected history, the land and traditional knowledge into our course and our collective learning. For many students the cultural connections created in this science class constituted the missing link to understanding and learning the material through Indigenous perspectives and within western science.

Course Evaluation

Students were graded on the learning outcomes of this course for each chapter through their classwork and project work. In addition, the work performed by students was visible to the whole school, displaying the TEKW and IK learning in action. Students completed their written work, quizzes and their projects to earn marks and for the most part outdid themselves in participating in the large-scale events, thus displaying their learning outcomes for all to see. The purpose of this Master's research project was to consider additional ways to evaluate the course and show the validity of incorporating TEK and IK in science especially for Indigenous students. In the end, the pit cook event, among others, helped show the value of First Nations science education in our school.

Research approach

The questions I started with at the onset of the research were the following: 1) Did the curriculum address the learning needs of the class's Indigenous population? 2) Was the experience of this blended curriculum and experiential learning relevant or meaningful to the students? 3) Did the student's comprehension of science in general change as a result of this blended curriculum? 4)

Was this course a factor in students' choice to enrol in more science courses? With these questions, I intended to discover if students shared an educational experience that was more authentic to them and that validated the indigenized curriculum approach. The ultimate goal was also to find out if Indigenous students' graduation rates would increase through this *First Nations Earth Science 11* course and allow them to earn sufficient science 11 credits required for graduation.

Interviews with ten students, one Education Assistant and three administrators and documents related to the *First Nations Earth Science 11* course were used to assess the effectiveness of this course for this project. Students were also asked to complete a demographic form to determine some statistics including the year the student attended the course, whether they completed it or not, and whether they graduated from high school (Appendix 1). In order to find out if students completed the course and earned their credits towards graduation, a set of questions were written for the them to answer as they sat down to be interviewed. These were meant to give an idea of the class's demographics:

You were a student in the *First Nations Earth Science 11* class.

Did you complete the course?

Did you earn the Grade 11 Science credits for it?

Did you graduate from high school since that time?

Are you still in high school?

During the interview, students were asked the following questions in order to gain an understanding of what worked in the course and what didn't from their own narratives about it:

1. Can you tell me about the course?
2. Did you like or dislike the course? What made it likeable or not?

3. Did the First Nations/Aboriginal content in this course hold any meaning for you? Can you explain?
4. How did it make you feel to be in a First Nations/Aboriginal class?
5. What memories do you have of the course?
6. Did you take more science courses after this one?
7. Is there anything more that you want to add? (You can tell the story of what you remember or write a poem or song about it on the back of your information form).

The research questions guided the gathering of information about the students' understanding and their experience of the course. These questions were provided to both Indigenous and non-Indigenous students who had participated in the course.

Students were interviewed by a third-party interviewer, as they could not be interviewed by the author who was their teacher, in order for the author to evaluate and understand whether they liked the course and what motivated students to complete the course, if they did. In order to evaluate a course, it is important to ask the students what the course means to them. It is their experience of the course that matters. Krocker (2004) notes that students want to be involved in the design and evaluation of a course. She recalls in her thesis work an earlier study by Blades (1992) that found that high school students were willing to participate in the direction of their learning; citing Blades, she notes that "the results of the research reveal[ed] that students are willing and able to bring critical voices to curriculum discourses, and that they have a direct vested interest in the change process (p. 16)" (Blades, cited by Krocker, 2004, p. 28).

Conflict of Interest: Limitations and Ethics

The participants in the study were the author's students since this course did not exist anywhere else in the school district. One of the reasons this course was developed was specifically to allow students in this school the opportunity to try science in a different way. This school also

had and still has the largest Indigenous population in the district. The idea was to develop a course model that could be developed for other schools. In order to provide participants anonymity, a research assistant was chosen at the university to give students the questionnaires and do the interviews. This approach addressed the author's *power over* relationship and any possible influence over their responses. The author followed strict Indigenous protocols by informing the two local Chiefs and Councils, parents, administrators and district staff of the research proposed and had each sign documentation allowing the students to participate in the interviews. Meetings were held to explain to parents, the Chief and Tribal Council and all of the potential participants to assure them that the research was ethical, acceptable to all, followed protocol, did not cross any boundaries by questioning about the ceremonies or knowledge learned in the ceremonial Long House[1] and served the community of learners in the school system as well as the university researchers. Both Chiefs and Councils and the families granted permission to the author, which allowed the research to go ahead.

Participation Rates

The participants in this study were students in the *First Nations Earth Science 11* class at a High School in Southern British Columbia from 2007 to 2014 following a "stratified purposeful sampling" (Creswell, 2013, p. 158). This means that the sampling of students was not random in that students had been participants in the *First Nations Earth Science 11* course and were from only one school. This provides a small sampling and limits the findings specifically to this group, therefore generalizations are made for one group that may or may not represent all Indigenous students in science courses. Students were asked to participate voluntarily with permission from their parents and their Band Council. A sampling of past *First Nations Earth Science 11* students

[1] Some Coast Salish nations hold secret ceremonies in their Big House/Long House that they do not share with other communities during initiations and other rites of passage. The leaders need to be assured that the information is not shared, particularly in research situations such as this.

were interviewed to establish whether this class was a factor in their understanding of science or their desire to take more science courses and a factor leading to graduation for them.

Data Collection

The data collection includes questionnaires and interviews done with students (See Appendices 1 and 2), the Educational Assistant in the class, and three administrators that had approved the course. Anecdotal comments were gathered during the study and added to the data. These comments included stories and comments that the author remembered from the students over the years, either in random comments in class or in their course evaluations at the end of each course. All of the interviews were recorded with audio, transcribed, and added to the data collection.

Other data considered in the assessment of the course included digital film and photos of the classroom activities, field studies and guest speakers, taken by the students with their own cameras or phones as well as our classroom digital resources. Sample work and assignments from students were also collected to show some of the course content and work that students performed during class. Students in this study did not necessarily submit these, but the students interviewed may have completed some. The author kept them over the years of the course as samples for students to look at.

Interviews with administrators

Administrators that worked at the school or for the school district were asked to participate by completing a form to establish in what years they approved, took part or observed the *First Nations Earth Science 11* class. They were interviewed using a different set of questions (Appendix 3) and asked for their overall understanding of the course and its effectiveness based on their observations. The author did these interviews rather than an external interviewer. The interviews

with administrators were recorded, transcribed and the data analyzed and summarized in the next section. Their recommendations appear in last section of this Project.

Access, role, reciprocity, trust, rapport, ethical and political considerations

Permission was sought from the school Principal and District to use the class as a site for research. Due to the author's role as teacher and researcher, the interviews and the input of participants was assigned to a research colleague so as not to influence the outcome of the research. Permission was sought from parents of students under the age of 18 to use the data collected in my research from the outset. To establish rapport and trust is of the utmost importance in particular with Indigenous students as my experience shows. A Capilano Elder, Wally Awasis, taught me many years ago, what is important in working with people, students or participants, is not them, rather it is the relationship that you have with them. This teaching allowed me to work at establishing relationships with the students in the class, as much as possible. I did this first by opening the course with a traditional circle in order to learn more about each student in the hopes of building trust and a rapport that is important to the classroom environment, particularly in a course where a significant portion of the work is done outdoors. Using traditional understandings allows us to learn together in a respectful way, for example, treating the land as our Mother when out in the field by showing thanks for her teachings is an important Indigenous protocol.

Reciprocity is an important component of Indigenous protocol. In running these courses over a number of years, it was important for the author, assistant staff, and the students to give back to the community, the Elders and the science advisors by hosting luncheons at school and dinners at the ceremonial Longhouse for students, parents, staff, support staff, administrators and school district staff to show how students participated in the classes. Gifts were given to all of the adult participants in appreciation of sharing their knowledge and time with the class. The students and I also attended School District Board meetings and events at the University of Victoria to present our

courses and our experiences as we took part in the *Pacific Crystal Project* (Anthony et al, 2010). The school district office, as part of the approval of this course, needed its own data to assure that the course was valid and reasonable and that students were learning the outcomes of the curriculum for Earth Science 11.

Results

Student participation

In total ten students were interviewed that had participated in the class between 2008 and 2014. There were generally between ten and thirty students in each of these classes. This is an average of two for each twenty students in each year or about ten percent of the students. Many had moved away after graduating or leaving school. The timing of the data collection was difficult due to a labour strike by Teachers during the spring and summer of 2014. Ethics approval for this research was received on June 17th, 2014, the first day of the school strike in BC. This prevented the author and the research assistant from meeting the former students in a comfortable setting at the school, as the school was closed. Attempts were made to meet the students at a coffee shop, at a local wellness centre, and other local facilities within the first few weeks of the strike, but by then students were already engaged in summer activities. Attempts were made again in late August and September still during the strike. After many attempts to book interviews with the students through a Facebook page, in the end only a few former students attended to be interviewed. It was finally with the assistance of the course Education Assistant who is also, for many of them, a family relation or community mentor, that students returned to school after the strike to be interviewed. They were comfortable in answering the questions with her because they had an established relationship already, whether that was at the school or on the reserve. Her personal contact with them was a key in finalizing the interviews. Ten of the nearly one hundred students came forward.

Flexible scheduling

The *First Nations Earth Science 11* course was offered in the first semester of the school year so that students who were away for a portion of the school year for family or traditional initiatives could join the next course, fall into the current course or continue the course self-directed with the teacher's assistance by appointment until the end of the school year. This simple initiative in flexibility with the course helped a handful of students complete the course regardless of their other activities. One student in the five years also finished the course within two months so that he could complete his coursework for graduation and go to his practicum as a mechanic apprentice. He is still grateful for this opportunity and recalls it every time I see him in the community.

Another student split the course between two years in order to have a baby. She completed the course after her second baby in the spring of 2013. Another student suffered family difficulties in planning for their mother's fourth year funeral and was away a lot, so he also split the course between two school years in order to complete it while his brother, who excelled in the course, came to school to be a part of the course during that time. These stories help provide some information on how the flexibility within the course and in collaboration with the teacher helped them complete the course despite their circumstances and family or work commitments.

What the data shows

The following table reports the number of students that attended interviews for each year of the course years and whether these students completed the course or not. The survey/information sheet questions are included in the data.

1. In what year did you take part in the First Nations Earth Science 11 class?

Year	Number of students:
2008	1 student

2010	1 student
2011	5 students
2013	3 students

2. Did you complete the course and earn Grade 11 science credits?

Yes	**No**
9 students	1 student

3. Did you graduate from high school since that time?

Yes	**No**
4 students	6 students

4. Are you still in high school?

Yes	**No**
6 students	4 students

5. a) Did you take more science courses after this one?

Yes	**No**
1 student	9 students

5. b) If so which ones: There were no responses to this question.

The Grade 11 science credit is one of the courses necessary for graduation in BC and in most school jurisdictions in Canada. The data from the information sheet reveals that most of the students that took this modified and experiential earth science course geared to Indigenous students did complete the course (nine of ten) and earn their Science 11 credits for graduation credits. The fact that Indigenous students were having difficulty acquiring the Grade 11 science credits prior to the inception of this course was the main reason why the school agreed to start this course. This course provided a way to offer students a course that was potentially relevant to their experience while still allowing them to earn the required Science 11 credit. To collect data prior to 2008 would be very difficult in this specific school since students were not differentiated by ancestry *per se* in their classes. One student teacher that did her practicum in this Indigenous course and with another teacher in the regular Earth Science 11 course said in 2010 that one of the Indigenous students in that course was a "wall flower." He did not participate at all and sat near the window to look outside most of the time. We had our Indigenous counsellor rework his timetable so that he could join the *First Nations Earth Science 11* class, where he immediately became a leader in the class. He had taken other courses with the author prior to this one and was familiar with the teaching style and the class; most of them were his cousins. The student teacher said she saw him blossom in this class. This was an excellent anecdote to the benefits of familiarity and comfort levels within a school class and cohort.

The data shows ninety percent of students in this sample did complete the course for graduation. It also shows that one student, indicating a possibility of 10 percent of the students, decided to take more science courses as a result. There is no data to show how many students were

not succeeding prior to the implementation of this course and whether any of them were continuing to take science.

Prior to this research analysis, I observed that working with Elders, doing field studies, and participating in school-wide or community-based projects helped bring a sense of reality to science and gave students the opportunity to complete the course. Four Indigenous students, who participated in the course but were not part of this study, went on to take Biology and Chemistry courses after completing *First Nations Earth Science 11*. Two students had been interested in science prior to joining the course and gained the confidence to continue science after this course. One student had been told by the First Nations Counsellor to take the *First Nations Earth Science 11* prior the regular Science 10 in order to get familiar with science and gain the confidence needed to get through the rigorous Science 10 course. He was successful in doing it this way. Another female student was interested in nursing, but did not have the confidence to take sciences until she took this course. She was the first this researcher has heard to say that she finally felt "smart" in science. Following this Grade 11 course she decided to take the science courses that she needed in order to enter a postsecondary program in nursing following high school.

Fun, fact and family! What the students reveal

Connection.

The research from the interview responses reveals that all ten students "liked" the class and all found it to be "fun." They all noted that the "teacher's" connection to them, to the lessons, to "one-on-one help" in the classroom and to "family" was important to them. The *connection* proved to be a key factor between teacher and students according to their responses.

Course booklets.

The packaged booklets allowed everyone to follow at a pace that worked for them. Some students found it "fast-paced." One student noted that the "booklets helped me learn."

Experiential aspects.

The hands-on component appears in almost every student response as do the field trips and guest speakers. All three of these aspects were central to the course and happened simultaneously in many cases. Specific events are also evident in their responses, those being the pit-cook and the garden project, which shows that these events created memories for many of the students.

Another aspect that appears consistently in their responses is the canoeing. The class did parts of the marine biology in voyageur canoes with Grade 5 students one day per week for a number of weeks. Many of the younger students were related to the students in this Indigenous science class. This allowed the high school students to mentor and work with their younger siblings and cousins and created a fun and personal dynamic within each canoe. One student wrote that it "made me feel like a role model." In the 2013 cohort, one student in Grade 11 paddled in the same canoe with her sister in Grade 5 and all of her little friends. Following an inquiry-based model of learning, it was great to see how well they listened to her and asked questions to find out more from her. She was the authority on marine science for the entire hour in the canoe. She was proud of herself and of her younger sister and friends for taking a keen interest in what she had to teach them. The class sang local Indigenous songs in between the water testing, marine plant recognition and marine life and bird life recognition.

I feel good.

Furthermore and in regards to this connection, students indicated in their responses that they "felt good" and "comfortable" in an Indigenous class that included siblings of different senior grade

levels, cousins and friends. Several mentioned that the "small group" setting helped them "learn better."

Some said they could relate to the content that was "more interesting" than other science classes. A few students noted that there was "no other science class like it." One can deduct that all of the components noted by students made this course different and more interesting to them. The data shows that many of the participants said science was not as hard as they had thought prior to experiencing it in a different and more culturally relevant way.

Cultural pride.

One student noted that they were "proud to be in an Indigenous class." One student wrote that the local "Chief acknowledged the class" and that the "Chief was a tour guide to us" on a tour. The Chief of the local band (at the time of this research) is an anthropologist who assisted us in one class on understanding middens[2] and the history of the ancestors as shown in the bones and the products found in the middens that were discovered in three separate construction projects during one of the semesters of this course. Many of the guest speakers and mentors both in the classroom and field studies were Elders, Knowledge Keepers and local scientists.

To be continued.

One student noted in their responses that the "teacher kept records" which allowed them to put the course "on hold for cultural reasons" and for it to be "completed later." The student's responses reveal that they were able to take part in the "field trips" and see "a lot of guest-speakers related to the course" and yet still able to complete the course in the end. This was one of the

[2] Middens are mounds of soil and dung, or refuse hill that are often found behind homes on ancient Indigenous sites. These mounds are excavated by archeologists and anthropologists who find remnants of food sources, such as fish bones, and utensils, eating vessels, hunting tools and carving tools and other artifacts for instance, providing evidence of ancient cultures, and how they lived; in this case, Coast Salish ancestors.

important goals of the course, to include cultural understanding of the events that take place in the personal and community life of Indigenous students. Ceremonies are an important and fundamental aspect of Indigenous communities and are important in the way schools and programs are developed and presented to students in or close to Indigenous communities. Teacher education programs need to acknowledge this and inform future teachers of the importance of recognizing Indigenous understandings and worldview:

> Teacher certification has focused teacher education… mainly on classroom interactions between teachers and students. This focus tends to deflect attention away from a larger analysis of political economy, diverse cultural ways of being and knowing, and the relationship between education and specific geographical/cultural communities. (Gruenewald and Smith, 2008, p. 140)

This course provided that link as well as staff from various Indigenous nations and worldviews that allowed students to connect to their own understandings, protocols and traditional ways.

Creating community.

Finally, students revealed that they believed there to be a sense of "community" within and outside of the walls of the classroom. Not only did we have a sense of community and comfort within the classroom setting and on field studies, as the data shows, but as I observed, we often brought our sense of community to the Elders and Knowledge Keepers that helped us in various settings outdoors. Our various experiences together provided us with a strong sense of community that was often displayed in our larger projects, whether they were at school or in the local community. Gruenewald and Smith (2008) note that, "our cultural experience is 'placed' in the 'geography' of our everyday lives, and in the 'ecology' of the diverse relationships that take place within and between places" (p. 137). In a similar way, throughout our field studies we felt a sense of belonging

and connection to our community and Elders via the sharing of knowledge about our geographic place and space.

Data analysis of the Administrators interviews: "Creating that place of belonging"

Graduation rates.

One of the initial questions in this research was the success rate of this course in achieving the goals of getting students to complete their science credits, and increasing the graduation rate of aboriginal students as well as increasing their interest in science overall. The school's principal noted that,

> Definitely, the Aboriginal grad[uation] rate has gone up at the school, significantly, and I think it's going up at a steady rate across the District and yes, I would have to think that that's one of many factors that's played a part–Aboriginal Earth Science is part of that, even if a student isn't successful within that individual course, for all of the reasons I said, the appearance of something being offered for students and a recognition probably helps, not just in that course but in the school in general.

The former Principal, who was there at the inception of the course also noted:

> There's no question that there is a relationship between graduation rates of Aboriginal students and this course and courses like it. Because, once they can see themselves as a successful learner, they can be a successful learner where they engage in the curriculum and then they are encouraged to stay involved in their education. And the longer they stay with that, the better chance they have of graduating because there are all kinds of other things that kick in. What we can offer them that encourages them to come every day and stay with us for as long as they can, then we have a better chance of graduating them and it's courses like this that make that difference to them.

She also noted that students shared their thoughts on how the course made them feel a sense of belonging to the school:

> With the Science program, with the Aboriginal content, the graduation rate of Aboriginal students at the high school went up significantly. Now what the students told me and told their teachers was that the courses made their education interesting and encouraged them to stay with us and attend more regularly and attempt other academic courses.

At the district level, the Aboriginal Education Coordinator also observed graduation rates increase due to a number of different factors including the Aboriginal courses offered within the district like this one and the First People's English 10-12 and First Nations Studies 12. She reported:

> There is a higher rate of success in Aboriginal courses for Aboriginal students. These are critical courses, a springboard for students to challenge themselves to try other types of courses such as Biology 11 and awakening them to the local environment. For non-Aboriginal students it has been a fundamental awakening of their interest in Indigenous perspectives about the environment. Aboriginal and non-Aboriginal students work together and have their experiences together, it is very important. Non-Aboriginal follow you (the teacher) to the next class and have their interest piqued about Indigenous content. It is a laddering course but a foundation course at the same time that creates a sense of space and belonging within the school and curriculum. The experiential activities like the pit-cook or going out on the water activates people's learning and interests.

Comfort and belonging.

All three administrators noted that students had a sense of "comfort and belonging" to this course and other Aboriginal courses. One principal observed:

> What I've seen of the students when they are in that class over the number of years is just that comfort level amongst them when they are there, that's probably my most significant memory is just seeing how that group of students works together or how they feel when they are together and it's kind of a slightly different feel than what it's like when they are dispersed throughout a regular class.

A principal also found that,

> Instead of school being an uncomfortable place for them, they are places of comfort and security and a way for them to build their confidence as learners and then—if that's how school feels, they will keep coming every day so it's creating that place of belonging for them in the school.

The Aboriginal Education Coordinator noted that,

> Some students who go in and take this have a sense of place and belonging in the curriculum and in the school. It opens their door to realize that science isn't in a square box in school all the time…there are some students who have moved into other science courses because they felt such a fit with this one.

The Aboriginal Education Coordinator observed that the outdoor component of the course gave students the opportunity to mentor their younger siblings and gave them a sense of pride: "Being out there and paddling together with the elementary school kids and being on the water, singing songs and drumming and talking about science was a stone in the water that gets the ripple going." By teaching the marine unit on the water high school students gained a sense of ownership over their learning in the marine unit of this earth science course.

Learning by doing.

All three administrators interviewed also noted the "connection to learning" that happened with the experiential component of the course. As the Aboriginal Education Coordinator noted the experiential focus of the course "provided a shift in getting our children out of the classroom to actually experience and learn from the land and having some understanding of what is around them." This experience grounded students in their learning and helped them understand first hand how Elders cooked, played and learned from their environment as they were growing up, connecting the students to their families and their heritage. Students noted that the school wide pit-cook event, the Indigenous Games event, the physical work and learning with Knowledge Keepers, aunts and uncles and former grads of the school helped them gain a first hand understanding of the science involved in the course activities. These activities not only connected the experiential hands-on understanding but also the pride at the wealth of knowledge in the Indigenous communities and provided a validation of many teachings and understandings. As one Principal noted,

> It's the giving of value to that information or that knowledge or those ways of learning that I don't think we do on a day-to-day basis or the system traditionally hasn't done on a provincial level—I think it shows a recognition at that level on their part that that has equal value to other things that are done in the system because it is recognized—it is a Ministry-approved course.

Another Principal noted, "The Aboriginal content is an important part of it because that's their world. That's where they can demonstrate their learning. And I think that's what helps engage them in learning."

Connecting to the greater community.

One of the other positive aspects of this course is the "connection to community" that was created. As one Principal noted, the course "allows them to go back into their community and talk to their Elders about what they are learning in school about something that really makes sense for all of them. It starts those conversations in the community." Another Principal felt that "one of the other successes is that connection to the Aboriginal community through the course." By being on site for several weeks at a time the classes had the opportunity to work with band members, Knowledge Keepers, the Chiefs and Elders and learn first hand knowledge by getting their hands dirty and digging, planting or paddling with them. Students connected to their community leaders with a new understanding of what these people knew, their educational background, their work as career professionals and leaders, their political points of view, their shared history and so much more.

Citizenship science bridges the age gap.

One observation from an Educational Assistant in the course was that there was a sense of citizenship science within the class and in the field activities for many adult participants. This means that local people take part in scientific experiments whether they are scientists or not, creating a sense of science that belongs to everyone and is shared amongst people. Our class created this sense because of the different guest speakers that taught us. One unexpected finding is that the course created a sense of belonging for many participants whether they were students, assistants or presenters, as many researchers have found in place-based models of science and other courses. In a sense, guest speakers served as additional texts; a dynamic that Grunewald and Smith (2008) describe: "Place-based educators and community-based educators advocate using the community as its 'texts' for curriculum development…engaging teachers and learners in direct experience and

inquiry projects that lead to democratic participation and social action within the local environment" (p. 143). Dewey (1938) states in his research that everyone that participates in a class, lesson or learning environment can learn together regardless of age and level of education since, "basing education upon personal experience may mean more multiplied and more intimate contacts between the mature and the immature than ever existed in the traditional school, and consequently more, rather than less, guidance by others" (p. 21).

Connecting to worldview.

Another unexpected outcome was the connection for non-Aboriginal students to the course, its content and the Indigenous worldview. For many students this was the first time that they had experienced something like this course, which connected to the two Indigenous communities on whose territory the school resides. Both students and administrators noted this very serendipitous connection and its value to making meaningful connections with students in the school and the community. As one Principal observed:

> For the non-aboriginal community, it's a kind of tangible or visible expression of recognition of that culture in the school, in a formal, on-going way, more than just a one-off event—the kind of recognition that it does have academic value. I think that helps to keep Aboriginal people and the culture visible within the community and probably outside as well, when we talk about the Aboriginal courses the school offers, it suggests to the broader community that there is recognition of that group of people.

Though this comment ironically positions Indigenous students as the "other" within their own traditional territory, it provides at least an acknowledgement that there is more and more value being placed on Indigenous knowledge and TEKW. This acknowledgement could and hopefully will lead to a greater understanding within the younger generation and help to break down the barriers of

racism and prejudice that still exist within schools today, helping to create a generation of allies and friends. As the former Principal noted:

> Some of the other successes is for non-Aboriginal students who really got to understand Aboriginal cultures in a very different way—in a way that's very meaningful for them and it was a way for all of our students to come together, both Aboriginal and non-Aboriginal students—just to increase that cross-cultural understanding which I think is really important going forward and because it was an ongoing class, it wasn't kind of just one day where we had a salmon BBQ or something, this was really a way to talk about culture in an on-going way. That helped them develop relationships with each other and just have those casual conversations where they start to understand other people at a deeper level.

The Aboriginal Education Coordinator noted, "For non-Aboriginal students it has been a fundamental awakening of their interest in Indigenous perspectives about the environment. Aboriginal and non-Aboriginal students work together and have their experiences together, it is very important."

An Indigenous Earth Science for all.

Finally and perhaps the most surprising success of the course is the idea of making *First Nations Earth Science 11* the only course credit at this level and phasing out the regular *Earth Science 11* course in this school. Two of the three administrators noted this. The Principal informed me that:

> Ideally, what we'd like to see happen is those two courses merge and be one so we'd just offer Aboriginal Earth Science and everybody, everyone that wants to do Earth Science does that and everybody feels that that's okay. It is just the way it is and they are happy with that as an option and that would maybe help us address that challenge (of adequate enrolment).

Two of interviewees noted that the course should be the only course taught replacing the non-Indigenous Earth Science 11 course offered in the school. The Aboriginal Education Coordinator at the district level noted that, "The biggest success would be if it (the *First Nations Earth Science 11*) became an Indigenous Earth Science 11 credit and moved away from regular Earth Science only."

For the long run.

The course ran for five years, which allowed many members of the community, local bands, administrators, teachers and students to observe the relationships created during the time of the course, the community connections that were built and the meaningful learning that happened. This is the type of course that fits in a high school science curriculum on many different levels, academically, holistically, and experientially, permitting students to understand culture, feel pride and break down cultural and racial barriers. The author agrees with the administrators, and together with the reasons stated by the students, feels that this course should be the only option for a Grade 11 Earth Science class, for communities where Indigenous students make up a significant portion of the student population. It makes sense on many different levels. I would have to say that having experienced the course many times over with students and communities, it is a valuable and healthy approach to science curriculum that helps build community, providing a win-win situation for schools, communities and curriculum implementation.

Recommendations based on the Literature

Looking back at the positive outcomes: *"I felt smart for the first time in Science class"*

The purpose of this study was to determine if the First Nations Earth Science 11 course accomplished its three goals:

1. Increased the graduation rates of Indigenous students
2. Provided a cultural connection to the land and local environment through science

3. Encouraged continued interest in science beyond this class

Goal 1: Increase graduation rates

The qualitative and quantitative data from the interviews with students and administrators reveals that all three goals were successfully achieved, although the sample size of students that responded to the survey and interviews is small. Nine of ten completed the *First Nations Earth Science 11* course and all of the students' comments regarding the course were positive. In addition, based on evidence communicated by the administrators, this course and others like it did help increase graduation rates for Indigenous students both at the school where this course was offered and at the district level, where interest in Indigenous courses overall has helped students engage in their learning, stay connected to their learning environment and their school, which provided them the impetus to carry on and finish courses for graduation.

Brian Neill's dissertation in 2015 at the University of Victoria involved two case studies. In his first case study he looked at the current state of underperformance of Indigenous students in secondary school sciences and math in British Columbia. His second case study:

> Sought to establish criteria, identify, and document a model project that incorporated the methods of western modern science (WMS) knowledge and ways of knowing represented by traditional ecological knowledge and wisdom (TEKW), local ecological knowledge (LEK), and indigenous knowledge (IK) in a local environment (place-based) and that was culturally responsive to students and faithful to science education principles. (Neill, 2015, p.iii)

What he found in the first case was that:

> Indigenous students in BC—and indeed nationally and internationally—must bridge between different culturally based languages and the language of science upon which standardized science assessments are based… The use of standardized science tests needs to

> be reassessed and replaced with authentic assessments of student knowledge, accomplished by adaptation of the classroom experience to become more community-based. Science education needs to connect with the communities of Indigenous students that it serves. Students' everyday lives are the entry point for a humanistic, constructivist approach to learning. (Neill, 2015, p. 76)

In the second case, Neill summarizes that:

> The overall pattern that emerged from this case study resides in the interactions that occurred for the interns (students) when WMS (Western science) and TEKW were embedded in authentic place-based experiences. The interns were engaged with field-based scientific research that had a technological basis and became excited by the possibilities that they encountered when viewing their home territory through the technoscientific lens of WMS. It is not surprising that their engagement with the technological aspect of science led to an overarching perspective that supported this theme. However, Culture, although not stressed by the program coordinators, was seen to weave its way through the experience… Overall, the intern voices reflected a dynamic interplay between TEKW and WMS that witnessed several students desiring to continue the scientific stewardship within their territorial lands. (Neill, 2015, p. 115)

This researcher found similar results in his case study to this study in that Indigenous students can connect their science learning with their community values and cultural understandings.

Goal 2: Provide a cultural connection through science

The evidence in this study reveals that the course did provide students with a cultural connection to the land and the local environment through the study of Earth Science. In addition, students connected to their communities, their Elders and Knowledge Keepers, their families and family traditions through the Pit-cook event, the Indigenous Games Day event, the Garden Project

and the marine explorations while canoeing with elementary school children in the community. The comments by research participants reveal that the course helped validate traditional ecological knowledge to the students, the school, the band and the community at large. This course could be called Traditional Ecology 11 today, but at the time it was based on the Earth Science textbook and the approved British Columbia Earth Science curriculum for Grade 11 graduation credits. Comments also show that the course provided a visible presence of the TEK learning in the community in a very tangible way and in some cases, as with the Pit Cook, a very high profile way, as the media was on site to witness and report on the event. As the data revealed, the course also validated the traditional learning in a real and hands-on way for the students themselves as these students experienced their traditions.

Introducing TEKW into the science curricula amounts to a paradigm shift in Science education. There is a need to recognize the traditional ecological knowledge that has existed for millennia. The *First Nations Earth Science 11* course provided that learning and understanding for students in a real and practical way. Indigenous and non-Indigenous scholars and practitioners advocating for such TEKW inclusion in science curriculum include Kawagley (1995), Norris-Tull and Norris-Tull, (1998), Cajete (2000), Aikenhead (2001), Gruenewald (2004), Snively and Williams (2006), Blades (1996), and Chinn (2008), among many others, and these scholars remind us that the goal of this approach to science education is to understand the experience of students involved in a curriculum guided by an Indigenous approach. To ignore the knowledge of Elders may be a disservice to students: “Such a narrow view of science not only diminishes the legitimacy of knowledge derived through generations of naturalistic observation and insight, it simultaneously devalues those cultures which traditionally rely heavily on naturalistic observation and insight” (Cobern & Loving, 2000, p.52).

Indigenizing curriculum has been practiced around the world for decades now, as shown by many researchers. Similar to this research project, Glasson (2010) interviewed course participants following the implementation of traditional ecological knowledge within the agricultural practices of farmers in Malawi. The research project also included training Indigenous teachers to teach the Indigenized curriculum to students. In his study, *Developing a Sustainable Agricultural Curriculum in Malawi: Reconciling a Colonial Legacy with Indigenous Knowledge and Practices*, Glasson (2010) showed the different steps he and his team took to establish the knowledge, put it into practice, and create an education program for elementary school students:

> The legacy of colonization and the continued global influence of western agricultural practices have led to a loss of indigenous farming practices that are in many cases more ecologically sustainable than western farming methods. To better understand Indigenous farming practices in Malawi, our research team interviewed rural farmers in both their native tribal languages of Chichewa and Chiyao (Glasson et al., 2010). These interviews revealed sustainable practices of rural farmers that were passed down through generations. … Most notably, these sustainable practices were embedded in the vernacular languages of the community. (Glasson, 2010, p. 154)

In a similar way in the *First Nations Earth Science 11* course, students completed field work with a plant Knowledge Keeper in the final year of the course, where they learned about local plants for several months and worked at building and fixing a local garden as well as learning to write the names of the plants in the local languages, a project that we gifted to the local Knowledge Keeper and the Songhees Community Garden at the end of our eight one-week sessions. Similarly, the Malawian project led to courses for students at the elementary school level to incorporate

agricultural traditional knowledge by building and sustaining a garden. In addition, the local Malawi teachers were given the new curriculum and encouraged to teach it in their science courses:

> The sustainable farming practices of Dr. Chinkhuntha and his family were used to develop a sustainable agricultural curriculum at a Malawian primary school (Glasson et al., 2008), referred to as the Mobile Malawi Project (www.mmp.soe.vt.edu). As the curriculum included background information and knowledge of the hybridized farming practices of Dr. Chinkhuntha, effort was made to develop lesson plans that were delivered using mobile phone technology. The lessons included information about sustainable agricultural practices from Freedom Gardens such as gravity-fed irrigation, composting, sunken plots, and organic pest control. (Glasson, 2010, p. 157)

Another approach to Indigenizing curriculum and incorporating TEKW is demonstrated in Larkin, King, and Kidman's (2012) case study of middle-school students in a geology class in Australia, *Connecting Indigenous Stories with Geology: Inquiry-based Learning in a Middle Years Classroom.* While reading local indigenous stories to his children the researcher in that study realized the connection he could make with his students in the classroom. He created a unit using local stories and rock sampling research while getting the students to research their geology and created presentations with the help and understanding of Elders to enrich their learning. This is similar to ways the author developed different modules in the Earth Science curriculum presented in this research project. The writers and researchers in the Australia study were looking for ways to integrate indigenous perspectives in junior high science through links between indigenous stories and science concepts. Larkin, King & Kidman (2012) highlighted the learning and engagement of students during this unit and the researchers were inspired to do a case study:

> The connections the students made between the indigenous story and science concepts were encouraging in this unit of work. Also, the inquiry framework provided a useful planning

> tool for the unit. Further connections could be explored through inviting indigenous members to speak to students or connecting with remote schools by utilizing Web 2.0 technologies such as blogs or Skype… Overall, the unit piqued the engagement of all the students in the class. It is hoped that this engagement leads to new understandings of indigenous ways of knowing that ultimately contributes to closing the gap between indigenous and non-indigenous peoples of this country. (Larkin, King, Kidman, 2012, p. 43)

The move to Indigenize curriculum benefits all students. In British Columbia, the Ministry of Education, in conjunction with an Aboriginal advisory committee, developed and implemented *Shared Learning's: Integrating BC Aboriginal Content K-10* (2006). This document includes approaches to Indigenizing curriculum in all subject areas from Kindergarten to Grade ten. It also explains the role of non-Indigenous educators and how to access Elders and knowledge holders. Concurrent to this, at the university level in the Indigenous Education program at the University of Victoria, Dr. Lorna Williams developed a pedagogically indigenous course, open to all students, both undergraduate and graduate. In this course students learned how to carve a spirit pole. The course was taught by a Coast Salish master carver and Professor Williams. Graduate student Michele Tanaka participated in the course and co-authored an article on the approach and success of this course. They interviewed participants to determine the need and the impact of this spirit-based curriculum:

> The Indigenous pedagogy course is a step towards building a different narrative into the spaces of academia. By creating a place where Indigenous ways can exist unhindered, a narrative develops that crosses over cultures and creates curriculum that truly combines two very different ways of teaching and learning. It is not a question of choosing one pedagogical perspective over the other. Rather, it is finding a way to make space for both—and to be

> enriched by both. This is a process that requires the dominant academic discourse to pause, listen, and make room for a discourse that may seem incongruous and dissonant at times. It is an inefficient and often messy process. (Williams & Tanaka, 2006, para. 68)

Grounding students in Indigenous place-based education.

Gruenewald (2008) states that in place-based education "educators… can be responsive through local inquiry and action" (p.137), and by working with students in a context that is familiar to them, learning can become a way of giving back to one's community taking "historical colonizing practices of schooling away from the learning experience and striving to teach for equity, social justice and democracy" (p.139). He notes that a "culturally competent and responsive teacher is one who can help an individual from one of these "othered" groups succeed in schools or universities" (p.139). Based on this author's experience in developing local First Nations Outdoor Education and Earth Science courses for Indigenous students, the wealth of knowledge and experiences acquired from learning within a cultural context of place and from those with whom we live establishes a context for cultural experiences and answers questions about how people adapted to their environment, flora and fauna, climate, topography and place. In order for teachers to develop culturally relevant and place relevant curriculum, our education system needs to be "engaging teachers and learners in direct experience and inquiry projects that lead to democratic participation and social interaction within the local environment" (Gruenewald, 2008, p.143).

In his chapter, *Grounding Culturally Responsive Teaching in Geographical Diversity,* Gruenewald (2008) says that our cultural experience is placed in the geography of our everyday lives, and the ecology of the diverse relationships that take place within and between places" (p.137). In other words, learning is based in the world that we experience around us, and by leaving

the classroom and using all of our senses to experience our environment, our place, we can truly begin to understand it.

Prior to Gruenewald's work, Aikenhead (2001) presented the notion of 'cultural border crossings' based on his experience working with Indigenous students in communities in northern Saskatchewan. He describes the process of students learning as: "coming to knowing engages Indigenous students in their own cultural negotiations… students reflect on their own understanding of the physical and biological world… and come to know the Indigenous common sense understanding held by their community" (Aikenhead, 2001, pp. 339-340). This 'coming to knowing' becomes a "multi-science education" (Ogawa, 1995, as cited in Aikenhead, 2001, p. 340).

Others have studied Indigenous places of knowing in a number of case studies such as Michael Benedict, a Mohawk Forester Plant Ecologist from Akwasasne, New York (a member of the Six Nations, to which the author belongs) who did a case study of incorporating traditional knowledge into plant sciences. He and his fellow researchers, recount an anecdote that points out in a very simple but real way that Indigenous people relate to the land and how plant knowledge comes about, when asked about the first person that ate a tomato:

> "Whoever it was, they probably saw a bear eat one first." Behind my statement was knowledge that in many tribal traditions the bear is recognized as the "plant gatherer," bestower of the secrets and mysteries of plants (Rockwell, 1991, p. 6). Among indigenous peoples of the northern American forests, bears are sometimes regarded as creator figures, partly because the highly protective nature of female bears makes them seem exemplary mothers. In these cultures, diets of both humans and bears overlapped extensively. It is virtually certain that these two species often foraged together in the same areas, and that humans entering new habitats learned which plants were edible from close observation of

> the foraging choices and tactics of the bears. In addition, bears eat certain plants for their medicinal properties. (Benedict, Kindscher, Pierotti, 2014, p. 140-141)

Benedict et al. explain that the relationship between the bear and humans in the history of his traditional territory and other territories across North America (Turtle Island) and how naming or wording of bear in many Indigenous languages refers to the animal as a kin, or a close relative, most notably among the Blackfeet, Ojibwe, and Tlingit nations. He also discussed his particular focus in his case study on black ash, a bush plant that was traditionally used to make sturdy, long lasting baskets by Mohawk peoples for centuries. He notes that protecting black ash has become important to many nations (Mohawk, Ojibwe, Ho-Chuck, Penobscot, Micmac and others) in places where the plant grows on their territories. Through his own traditional knowledge and understanding, Benedict was able to research and later teach about the plants of his territory and in turn protect the species that have been important to his nation for millennia. Learning science through TEKW gives students the opportunity to truly become the protectors of their land. He notes that this becomes in the end a spiritual connection to the land:

> Traditional Ecological Knowledge combines the physical, spiritual, and social aspects of the natural world, in which humans are considered to be only a small part of that world (see also Anderson 2005; Pierotti 2011a). In contrast, Western science has sought to separate the physical, spiritual, and social aspects of society into separate disciplines... In spite of the differing views, Native scientists realize modern science possesses the tools needed to help solve environmental issues. Showing greater flexibility than the Western tradition, tribal scientists and resource managers do not have a problem combining Western scientific methods and traditional ecological knowledge to better understand the ecology of black ash and other modern issues. (Benedict et al, 2014, p. 135)

In another case study Jan Salick (2014) demonstrates the advantages of integrating traditional ecological knowledge into projects and curricula through her research with Tibetan students in China. In *Teaching Ethnobotany Through Field Research: A Case Study Integrating Conservation with Tibetan Traditional Ecological Knowledge* Salick presents her case study of teaching ethnobotany in the Tibetan Autonomous Prefecture of Northwest Yunnan, China. She first outlines the process and advantages of teaching ethnobotany in the field and then describes the training designed to integrate conservation using Tibetan traditional ecological knowledge over a four-year period (Salick, 2014). Salick is a researcher with the Missouri Botanical Garden in St. Louis. She writes that, "ethnobotany increasingly guides conservation to incorporate TEK" (Salick, 2014, p. 231-232). She defines the integration of TEK as the "application of traditional ecological knowledge to conservation including local cultural practices for maintaining and enhancing biodiversity" (Salick, 2014, p. 232). She describes the training site and location and it's practical and spiritual connection to the people of that specific place:

> The eastern Himalayas—verdant, snowcapped, and glaciated—are renowned for their biological and cultural diversity and endemism (Mittermeier et al, 1998). Tibetan people (*Kham*) have lived for millennia in this area, conserving, using, managing, and enhancing this diversity (Salick, Moseley, 2012). Native plants, including foods, medicines, fibres, dyes, oils, construction materials, and much more, are used by Tibetans in every aspect of their lives. From the mundane to the sacred, from subsistence to ceremony, plants are an integral part of Tibetan life. (Salick, 2014, p. 233-234)

Much like the *First Nations Earth Science 11* Garden project, Salick's project helped local people share their traditional knowledge and connect to the spiritual aspects of the land, in that it provided

participants, and in our case students, with the knowledge of the plants that their families protected and managed, such as the camas in our study, as a rich and important cultural food.

Goal 3: Encourage Continued Interest in Science

The qualitative data shows that the course did, to a much lesser extent, encourage students to take more science courses. Although the numbers were low for high school courses, there have been some other successes that came out of the course that weren't evident until more recently. These were not documented in the interview group but rather anecdotally by the author. One of the Indigenous students from the 2010 cohort told the author when she was asked to consent to do an interview for this research, that she "felt smart in science for the first time" in this course. She said that she enjoyed it, it was fun and it made sense to her. She also said that she remembered a lot of what she learned. A few summers ago she posted on Facebook that she had been accepted into a nursing program at the college level. This helped show to some extent that this science course had given her the confidence to do more science and to not be afraid of its challenges. Though the numbers may be small for students that did continue in science, the rewards, as revealed by this story, are ultimately why this course was created.

New Zealand researchers Elizabeth McKinley and Georgina Stewart (2012) critique and take a hard look at why some of these courses may not always succeed. They looked at the misappropriating that has occurred with the indigenization of curricula in certain areas, they name this "caricaturing." They also looked at the historical literature from the beginnings of the movement to indigenize curricula in the 1990s, including many of the authors noted at the beginning of this section. They argue that unless Indigenous knowledge education is properly done, it does little to serve the Indigenous students and may continue the marginalization of these students as being "othered." The authors postulate that New Zealanders have been at the forefront of

indigenizing curricula but are noticing now that without the proper understanding and worldview, the addition of these curricula is not as positive as it was hoped initially:

> It would appear that superficial or token attempts to incorporate Māori knowledge into science (or other areas of the high school curriculum) may only be of benefit in school situations in which Māori students feel a high degree of alienation. Māori students who are engaged more fully and have a healthier overall relationship with their school culture do not seem to feel the need for such measures, which may then be of little or no benefit in supporting their achievement in science. Some teachers were ambivalent about whether the inclusion of Māori knowledge in science lessons worked or not, or even whether it was appropriate to do it, and voiced this resistance, even while continuing with the Māori contexts in their classes. (McKinley and Stewart, 2012, p. 549)

This reinforces the notion stated earlier in this literature that an understanding and experience of Indigenous worldview (Benedict et al. 2014, Williams and Tanaka, 2007, Stewart, 2010) and a relationship to a teacher of Indigenous heritage (Chinn and Hana‘ike, 2010) may make the connection easier for both the students and teacher, but this is not necessarily true for all teachers of Indigenous ancestry and in many cases it is possible for non-Indigenous teachers to make a strong connection to traditional knowledge and to give the addition of TEKW credibility. Including local Elders and Knowledge Keepers that understand the worldview is important to incorporate in building a curriculum course that uses TEKW as its backbone.

Based on these three goals, the course had some successes to celebrate. The following are some reasons for the course’s success.

Reason for Success 1: The Teacher Connection and Lots of Work!

There were seemingly hundreds of consent forms sent home over the years which included parental consent for many activities on the water and on the mountains, approval by the school district, school administration, bands and the communities for local projects. The teacher had to maintain canoe instructor certification and a Class 4 driver's license to ensure the continuity of travel. This included maintaining the canoe shed and canoes in conjunction with the local canoe club where the canoes were located and stored. This was work performed by the teacher over the years notwithstanding the teaching and booking of guest speakers. Many guest speakers were contacted in person as per protocol. Many hours were spent calling and visiting the Elders and knowledge keepers to ensure that they would take part in the projects. Hundreds of booklets were photocopied. Though there is a lot of work involved, it was the connection with the teacher that stands out in the data from the students in this study. A teacher who has lived the Indigenous worldview and is flexible in programming based on an understanding of culture and ceremony may be more invested in creating curriculum that is well suited for the students, as Chinn and Hana'ike show in their research.

Pauline Chinn and David Maika'i Hana'ike (2010) in *A Case Study of David, a Native Hawaiian Science Teacher: Cultural Historical Activity Theory and Implications for Teacher Education* highlight the importance for Indigenous students to have Indigenous teachers that live spirit-based worldviews as mentors and role models. The case study is about Hana'ike's own teaching experience as an Indigenous high school science teacher. The research demonstrates that Hana'ike's connection and influence as a teacher with Hawaiian high school students was unmatched by teachers of other cultures. In their case study, Hana'ike writes:

> I use my indigenous status to promote a positive role model for my students. I allow my role as a teacher to mix with my strong image of myself as a kanaka maoli and I share that blending with my students… Not only language but all instruction should be contextualized in the child's experience, previous knowledge, and schemata (p. 355). ... In the absence of school/cultural compatibilities, the relationship between teacher and child becomes the ground for struggle ... absorb[ing] all of the energy that should be directed toward learning academic skills. (Chinn and Hana'ike, 2010, p. 229)

The authors note that, "these findings underscore the urgent need for culturally competent teachers" and that

> the persistence of stereotypes that marginalize certain groups suggests the need to study effective teachers and the experiences they draw upon to address complex issues of race, culture, language, and power in their schools and communities. (p. 230)

Preparing the course and inviting Elders necessitates knowledge of certain protocol and even for a teacher from a different territory this means learning the protocol so as not to disable the process before it even starts. Chinn established early on in her research career that working directly with Elders in the science classroom and on the land, or in her case, in the ocean, translated to an understanding of the importance of certain marine plants to a culture, but also how to harvest it sustainably, and how to name it properly among other components of the learning. Science education approached from a cultural and place-based perspective may encourage students to protect what has been shared for generations (Chinn, 2008). Chinn discovered that these connections allowed Indigenous students in her study to repatriate their cultural inheritance to the land and the sea. These students became aware of the changes to their local environment and undertook actions to protect the land on which their ancestors survived. Chinn comments that

"society stands to lose cultural, linguistic, and knowledge diversity under current education policies… science teaching leading to communities of learners engaged in the study of locally relevant science issues holds promise for educational equity and environmental literacy" (p. 23). The students in the *First Nations Earth Science 11* also learned to value their place and many took summer tourism jobs to promote the flora and fauna of their local spaces. They continued their learning beyond the classroom and the field studies and took it to the global community of visitors to their territory.

Suzanne Stewart, a Yellowknife Dene woman and professor at the University of Toronto, writes about the notion of indigenizing curriculum through the Indigenous lens and how to reconcile the two types of learning and teaching, western and indigenous, by looking at how she teaches and how authors like David Hana'ike construct their lessons and curriculum. She writes that, "much of the existing literature presents therapeutic interventions or theoretical frameworks for working with Indigenous populations within the public education system (Stewart, 2010, p. 248). Her understanding of what it is to change existing curriculum to honour the learning of all students, without the exception of Indigenous students, supports the case studies noted and this project. In each of these examples the authors are involved in creating that shift in paradigm to employ traditional ways of knowing and a place-based Indigenous worldview:

> The dominant western paradigm of education as practiced in most settings is not one of cooperative knowing and learning; rather it is a model of objectivity and competition. An Indigenous paradigm of education is focused on restoring balance to the self through relationship with others and the environment. This Indigenous conception of education is not new or innovative, it has been in existence and successfully employed by Indigenous people in Canada and other places for thousands of years, as David suggests in his case study when

> he states that relying on his Grandmother's wisdom and knowledge for structuring classroom activity and curriculum were integral to the success of his approach. What is new is the articulation and validation of this definition as legitimate in the context of university research and teaching within an overarching history of oppression. Since colonization, western paradigms have been forced on Indigenous peoples in ways that invalidated and disregarded successful epistemological and healing methods that had previously been available to Indigenous people. As a result, many Indigenous communities today flounder in attempts to deal with their education problems by utilizing the only resource currently available to them through the public education system, which is dominated by western models of education and psychology. (p. 253-254)

The Reasons for Success 2: Course Packages and Engagement of Elders, Knowledge Keepers and Local Scientists

Part of the success of the course, as indicated by the interviews with students, was the use of packaged chapters that were easy to follow and yet very informative and engaging. Each was anywhere from ten to fifteen pages with questions and a review section that led to a test for each chapter. Each chapter included a field study or outdoor component that focussed on TEKW from astronomy to mapping/tracking to chemistry, geology, marine systems and plant systems, among others. Each field study was delivered with the assistance of an Elder, Knowledge Keeper or local scientist. One of the Knowledge Keepers was proud to tell the students that he had graduated from the same school and was proud to have acquired the knowledge that he had on plant botany, from well-known University professors and Elders and other well-known Knowledge Keepers. He had learned in the traditional ways, through inquiry and practice, in addition to his westernized schooling. This further encouraged and mentored students while they learned from him in the

garden project. The data and anecdotes show that mentoring became an unplanned yet incredibly valid component of the program.

Reasons for Success 3: Scheduling and Flexibility

There were many challenges along the way both in establishing this course, including planning the course in the timetable, as noted by one of the Principals in his interview notes, for the staff and students to leave during the morning break and return at lunch so as not to impact any other classes. The course scheduling committee had to ensure that the course was always scheduled at the beginning of the year in the first semester to ensure that it could continue into the second semester for students that left for cultural or personal reasons and returned late. The Principal interviewed noted:

> Another part is the scheduling of the course, exactly where it falls within the timetable, which semester and which part of the day—but more importantly it is looking at other courses that those students might be interested in, particularly the other courses which are aboriginal courses, to try and make sure there are no conflicts so that if people want to take First People's English and the First Nations Earth Science, then they can do both.

Recommendations to Researchers with Regard to Research Challenges

The biggest lesson learned in doing this research was that trying to interview Indigenous teenagers; perhaps interviewing teenagers in general can be challenging. Teenagers have very busy lives with jobs, sports, family obligations, babysitting, picking up siblings in other schools, meeting friends and doing homework. This created some frustration when trying to meet with them one on one, initially with an Indigenous research assistant. It was important to the researcher and to the school team of Indigenous staff that the assistant be Indigenous. There is a comfort and trust factor in being interviewed about one's views and personal experiences and a need to be safe in expressing

one's thoughts. Students may be inherently shy to express their opinions or share anecdotes about their learning. Staff experiences revealed that it was vital that students trust whomever was going to interview them and that the person have some knowledge and practice with traditional skills and protocol. So long as teachers are trusted by students, responses would likely prove to be more authentic and thoughtful.

The attempts at interviewing students then moved to trying to do the interviews in one location on four different occasions at the end of a school year: twice during the summer, at the start of the school, and during the Christmas holiday, but all to no avail. The province-wide general teachers' strike in British Columbia started on the same day that the Ethics Approval was received which created another huge barrier by eliminating the school as a site for research interviews. It was finally the Education Assistant in the course, who is related to many of the students, that finally had success in rounding up the students one at a time and doing the interviews over a few weeks. The author is eternally grateful for her participation and willingness to access the students and interview them. Without her, this entire Project would not exist.

Perhaps the most important recommendation in the area of interviewing is in planning the research interviews with someone that students feel completely at ease talking too. The author had to perform this research under Western Research Methodologies that see teacher researchers as having "power over" students and therefore takes permission away from the research/teacher to interview their own students. In the end, due to the strike, students had completed the course, which diminished the issue of power over, in that students' marks were not a factor that would influence the interviews. More importantly, current Indigenous Research Methodologies (Battiste, 2013; Kovach, 2009) see the relationship between the teacher and student as an important part of the research, one that includes the experiences that teachers and students share in the classroom and in

field studies, in this case. It is a research of shared and live-experiences, a method of telling the story of the shared experience. An Indigenous Research Methodology that recognizes the value of educator/learner relationships should be used to enhance the research process and to allow the students and teacher to work in sharing a worldview. In the author's experience it is the relationship between the teacher and student that allows for student engagement and success. Students could be given a written portion in which to voice their critiques or recommendations for the program or course while sharing anecdotes with the teacher at the interview. Binda and Caillou (2001a) have challenged scholars and researchers to decolonize education by deconstructing "the ideological, legal, legislative, operational, textual and other institutionalized structures sustaining unequal and discursive relations of power between non-first Nations and First Nations citizenries" (p. 2). This further aids in decolonizing the Western protocols situated in graduate and post-graduate research and allows Indigenous scholars and researchers to research within and in community with Indigenous worldview.

Recommendations to School Boards/Districts and Educators

In the end, this research project shows that there is a need to decolonize education as it stands today. Western methodologies aren't the answer for all education systems particularly in Indigenous communities where many students are deemed at-risk of failing within the colonial framework and post-industrial model of education. Students in this study and in this course were not being successful at completing their Grade 11 science credit putting them at-risk of not graduating. Many Indigenous families value education and want their children to be successful in the westernized modern society. As this research shows, they can be, and often are also successful at living within their cultural context, whether it be hunting and fishing to providing for families or organizing community feasts and family ceremonies. Courses like *First Nations Earth Science 11*

need to be created and tailored to the traditional territories on which they will be taught. Variations will occur depending on topography, population, language acquisition and revitalization, climate and weather systems, and political will at all levels of band/tribal and provincial/territorial governments. There is a hope that future generations of students will have access to courses that recognize the values and skills of all learners and the ability to work outside where so much learning was acquired traditionally when Elders were responsible for the teaching of adolescents.

There is also a real need to teach the teachers about Indigenous ways in all teacher colleges as noted by Williams and Tanaka (2007), Chinn and Hana'ike (2010) and Stewart (2010). The author was fortunate to teach a methodologies course for language teachers at the university level in 2012. Student teachers were amazed at how little they knew about Indigenous matters after spending two days learning with the Aboriginal Education Coordinator and staff at the school in this study. They noted that in all their years of education no one had bothered to introduce key Indigenous concepts to them as well as local histories and protocol. These students left the course feeling more prepared for their future jobs knowing that they could introduce themselves in Indigenous communities and ask to be taught local protocol and traditions. This message is starting to be imparted in teacher colleges.

Over the years, while preparing this project, I had the opportunity to speak to future teachers in a number of Indigenous education courses in Teacher Education programs in order to discuss ways that new teachers could familiarize themselves with Indigenous protocols and learn about Indigenous communities. I presented with the Education Assistant in our class who is First Nations in our school catchment area, and two students from our class, one local First Nations student and one non-Indigenous student. I am Indigenous from Eastern Canada. The first thing students always wanted to know was who turn to for help in Indigenous communities. My first response was always

to tell them to go introduce themselves to the Band Council and Chief or the equivalent leadership organization in their community. Ask questions. Find out who the Elders are. Ask how to seek them out and what approaches to take to visit them. Find out if they should bring a gift, an offering, a bag of tobacco (more prevalent in Eastern North American Indigenous nations), a blanket or whatever is considered appropriate for that nation. Don't be afraid to speak to people. Find out the best approach to inviting people into the classroom and what the school protocol is as well as the local Indigenous protocol. By building on these relationships teachers will be appreciated for their respect and courtesy and for simply asking rather than staying isolated.

The second approach is to ask the school staff who are from the nation. They will have valuable information on protocol and can tell them whom to seek out. I was fortunate to have exceptional teams of coworkers everywhere that I have lived and worked. They have been incredibly helpful and passionate about their nations and were always welcoming and willing to help and teach about their nations and family connections. I learned that respect begets respect and that Elders are always willing to teach if they are asked properly. They are also quick to point out faux pas and to help you rectify relationships when mistakes are made. This has happened many times but it's all part of the learning process. New teachers can be appreciated in Indigenous communities as long as they are willing to do the legwork and learn about their communities.

Finally, a lot of money was spent on the key events to demonstrate the learning to the school and the community. For instance the pit cook cost upwards of $1000; for the food to prepare 750 pieces of bannock, one for every student in the school; propane for the barbecue to cook the donated salmon; stipends for the Pit Cook Knowledge Keepers and helpers; stipends for the dancers invited by a student, and the cost of the vegetables that went into the pit cook. There is no doubt that this

was a demanding course to create and run, but the outcomes were worth the work and the many hours of planning, not to mention the learning for the entire school community.

Reflection

The literature shows that there is a paradigm shift happening in secondary school systems around the world as TEKW is being introduced into science education. Teachers, administrators and scholars are working on ways to implement curricula to honour all students in as equitable a way as possible. It has also been shown that working specifically with Indigenous teachers is advantageous to students and to the implementation of such programs. The worldviews, understandings and teachings of the local Indigenous nations are also crucial to the implementation of TEK in courses such as *First Nations Earth Science 11*. Finally it is also important that these programs be assessed and studied regularly so as to maintain rigour and assure that they are being delivered following protocol and honouring the traditions of the traditional territories on which they are being delivered.

Benefits of Cultural and Spiritual Connections - Learning from the Four Directions

The publication *Aboriginal Worldviews and Perspectives in the Classroom: Moving Forward*, published by the BC Ministry of Education in 2015, acknowledges that learning in an Indigenous setting includes the understanding of family ancestry and spirituality. This resource includes involving the Seven Teachings, which is becoming more widely accepted by Indigenous people across Canada, even though the teachings originate from Ojibwe territory. One participant in the workshops that led to the sharing of knowledge in this publication said: “Make the Seven Teachings a principle of learning (Respect, Trust, Love, Honour, Humility, Bravery, Truth). They are sometimes referred to as the Seven Grandfathers. Focussing on the “Seven Teachings” helps students self-correct their behaviour much faster (p. 32, Participant, Williams Lake, BC, 2015). Another noted:

> Aboriginal perspectives start with protocol and end with protocol. Even just a little bit of awareness and observance goes a long way. Traditional values as reflected in the seven teachings are gifts that are given to us. We need to encourage students and build on strengths ...send students off to reflect on their behaviour and how others feel—how they are impacted by our words and actions. (p. 32, Participant, Williams Lake, BC, 2015)

These understandings that many Indigenous educators share, in the author's experience of teaching, are invaluable in the teaching of courses such as the course discussed and researched in this Project. To understand learning from Indigenous eyes one needs to include an understanding of the world as connected; to nature, to people, to the cosmos, to all living beings and to respect them. Indigenous peoples throughout the world, as many ancient cultures, have always viewed education as a much broader, lifelong concept that encompasses physical, mental, emotional and spiritual growth (Battiste, 2005; Wilson 2008; Kovach, 2009; Anuik, Battiste, George, 2010; Absolon, 2011; Battiste, 2013; Kirkness, 2013). Canadians have come to equate the notion of education with formal schooling. Education within Indigenous knowledge systems involves a broader, lifelong notion of experience "gleaned from interaction with one another, with all of nature (seen and unseen) as well as with all of the cosmos" (LaFrance, 2000, p. 101). This lifelong learning process is an inner journey that encompasses people's physical, mental, and emotional development, culminating in the spiritual self. In an Indigenous worldview, it is from this space of spirituality that growth and learning emanates (Battiste, 2005; Wilson 2008; Kovach, 2009; Anuik, Battiste, George, 2010; Absolon, 2011; Battiste, 2013; Kirkness, 2013). For example, in the author's field trips with students, the first lesson was to give a strand a hair to the ground to replace the leaf taken, or the flower petal or the eelgrass; this activity helped students establish an understanding that anything taken is a living entity that deserves respect.

A Move Towards Decolonizing Science Education

It is important that we recognize in Indigenous communities the need to decolonize education and to refocus the process of learning to that which existed and in many cases still exists in many communities. Trying to make students fit into a system that doesn't work for them is like trying to fit round pegs into square holes. By recreating and reimagining education as an experience in learning rather than simply a process of reading and writing, we can transform our own experiences in learning as both teachers and learners: "Increasingly, First Nations and Aboriginal educational processes and epistemologies need to be at the centre of place-based, culturally responsive teaching. Only through studying Native experiences will educators understand the enduring legacy of colonization and the possibility of diverse cultural ways of being" (Gruenewald, 2008, p. 151).

There needs to be recognition that the education of Indigenous young people should and can include traditional skills and knowledge. As shown in the comments by the students, seeing science through the use of traditional skills and knowledge helped students feel a sense of pride, success and understanding that meshed with Indigenous worldview. Students commented in many of these courses that they felt "native pride" in the class. Indigenous worldviews have endured for millennia and still continue to be important in Indigenous communities. In order to maintain focus on TEKW and IK, we must convince leaders and politicians that Western understandings can work hand in hand with Indigenous understandings and that they need to be present in curriculum, not just as tokenism, but in a real and tangible way. There is a place for mixed or blended curricula within our education systems, particularly where there are large Indigenous populations. Indigenous scholar Michael Marker (2004) notes in his research:

> If educators and politicians were to consider seriously the discourse of Aboriginal Elders, they might slow their thoughts and actions to a more cautious and measured state of consideration. Such a change would frustrate neo-liberal sensibilities about hurriedly preparing students for competition in a globalized marketplace. Many Indigenous communities, in evaluating the assortment of difficult choices and dilemmas about education and economic development, often take the view that 'over the long term, the loss of local knowledge and patterns of moral reciprocity essential to traditional communities will become more significant to the world's ecological well being'. (Bowers, cited in Marker, 2004, p. 193)

An Impending Paradigm Shift in Education

John Dewey, a great educational theorist wrote:

> Learning means acquisition of what already is incorporated in books and in the heads of the Elders. Moreover, that which is taught is thought of as essentially static. It is taught as a finished product, with little regard either to the ways in which it was originally built up or to changes that will surely occur in the future. It is to a large extent the cultural product of societies that assumed the future would be much like the past, and yet it is educational food in a society where change is the rule, not the exception. (Dewey, 1938, p. 19)

His goal, as I understand it, was to embrace change and allow learning to be more connective, meaningful, changeable and variable. As noted by revered scholar Paulo Freire (2000) in his book *Pedagogy of the Oppressed*:

> Education either functions as an instrument which is used to facilitate integration of the younger generation into the logic of the present system and bring about conformity or it becomes the practice of freedom, the means by which men and women deal critically and

> creatively with reality and discover how to participate in the transformation of their world. (p. 34)

Until we can accept and acknowledge all Indigenous people and their traditional teachings, we will struggle in a system that creates barriers for many students rather than success for all students. The greater goal in education is to devolve, deconstruct and decolonize existing restrictive systems in order to ultimately evolve to a creative education system that fits all learners and allows everyone to succeed and do so with pride. The *First Nations Earth Science 11* course shows that this is possible.

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Appendix 1

Aboriginal Earth Science 11: A Case Study
Tomasino/Principal Investigator
Wesley Price/Research Assistant-Interviewer

Information Sheet

Welcome and thank you for volunteering your time today.
Your information and answers are completely anonymous. Your name does not appear on any documentation and the Principal Investigator (Michèle Tomasino) will not hear the interviews, they will be transcribed and then stored. She will not know what you answered and how you answered the questions other than to see the nameless printed information later.

Check or circle the appropriate answer:

1. In what year did you take part in the Aboriginal (First Nations) Earth Science 11 class?

   2008 _____ 2009 _____ 2010 _____ 2011 _____ 2013 _____

2. Did you complete the course and earn the Grade 11 Science credits for it?
   yes / no

3. Did you graduate from high school since that time? **yes / no**

4. Are you still in high school? **yes / no**

5. Did you take more science courses after this one? **yes / no**

   IF so, which ones: _____
   _____

You can return this form to the Research Assistant. **Thank you so much for answering these questions and for making the time to be here.**

Appendix 2

Interview questions for students

Aboriginal Earth Science 11: A Case Study
Tomasino/Principal Investigator
Wesley Price/Research Assistant-Interviewer

Interview Questions
Welcome and thank you for volunteering your time today.

Preface: **Have you completed the Information sheet? Do you have any questions about the Information sheet?**

Your information and answers are completely anonymous. Your name does not appear on any documentation and the Principal Investigator (Michèle Tomasino) will not hear the interviews, they will be transcribed and then stored. She will not know what you answered and how you answered the questions other than to see the nameless printed information later.

We will be recording the information so that it can be transcribed after our interview.

1. You were a student in the First Nations (Aboriginal) Earth Science 11 class. Did you complete the course? Did you earn the Grade 11 Science credits for it? Did you graduate from high school since that time? Are you still in high school?

2. Can you tell me about the course?

3. Did you like or dislike the course? What made it likeable or not?

4. Did the First Nations/Aboriginal content in this course hold any meaning for you? Can you explain?

5. How did it make you feel to be in a First Nations/Aboriginal class?

6. What memories do you have of the course?

7. Did you take more science courses after this one?

8. Is there anything more that you want to add? (You can tell the story of what you remember or white a poem or song about it on the back of your information form).

Thank you so much for answering these questions and for making the time to be here.

Questions based on the medicine wheel interview process from the four quadrants of the medicine wheel
a. Context (culture, community, family, school, social history),
b. Mind (cognitive, thoughts mentoring knowledge) and emotion (feelings, defenses and self esteem)
c. Body (all physical aspects, gender, genetic aspects, sleep, substance use)
d. Spirit (positive and negative teachings and practices, positive and negative innate forces) (Chilisi, 2012, p. 216-17)

Chilisa, B. (2012). *Indigenous research methodologies*. Los Angeles, CA: Sage.

Appendix 3

Interview questions for administrative staff

Aboriginal Earth Science 11: A Case Study
Tomasino/Principal Investigator
Wesley Price/Research Assistant-Interviewer

Interview Questions/Administrators

Welcome and thank you for volunteering your time today.
Your information and answers are completely anonymous. Your name does not appear on any documentation and the Principal Investigator (Michèle Tomasino) will not hear the interviews, they will be transcribed and then stored. She will not know what you answered and how you answered the questions other than to see the nameless printed information later.

We will be recording the information so that it can be transcribed after our interview.

1. What was your role in helping implement or facilitate this high school course?

2. Now that you have seen the completion and failure rates of this course? What is your opinion of the course?

3. Do you feel that it has been a valuable course to offer, in particular to Indigenous students? Why or why not?

4. Are you aware of the some of the Indigenous content in this course? Does that mean anything to you? Can you explain.

5. What do you feel are some of the successes or challenges of this course?

6. Do you feel that this course helps Indigenous students reach their goal towards graduation? The Indigenous graduation rates are attached. Do you feel that there is a correlation between the completion rates in their course and the grad rates?

7. What memories, if any, do you have of the course? Is there anything more that you want to add? You can tell a story or write some thoughts on the back of paper if you wish to say more.

Thank you so much for answering these questions and for making the time to be here.

Questions based on the medicine wheel interview process from the four quadrants of the medicine wheel
a. Context (culture, community, family, school, social history),
b. Mind (cognitive, thoughts mentoring knowledge) and emotion (feelings, defenses and self esteem)
c. Body (all physical aspects, gender, genetic aspects, sleep, substance use)
d. Spirit (positive and negative teachings and practices, positive and negative innate forces) (Chilisi, 2012, p. 216-17)
Chilisa, Bagele (2012). *Indigenous research methodologies*. Los Angeles, CA: Sage.

Appendix 4

BA Proposal for First Nations Outdoor Education 11/Later became Earth Science 11 Course

District Name: Greater Victoria School District
District Number: 61
Developed by: Michèle Tomasino
Date Developed: June 2006
School Name: École secondaire Esquimalt High School
Principal's Name: Deb Courville
Board/Authority Approval Date:
Board/Authority Signature:
Course Name: First Nations Outdoor Education 11
Grade level of Course: 11
Fine Arts or Applied Skill: "FA" □ or "AS" ☒
Number of Course Credits: 4 credits per semester
Number of Hours of Instruction: 120 per semester
Prerequisites: nil

Course Synopsis
This course is designed to give students the opportunity to develop their individual and collective sense of personal and social responsibility through the acquisition and application of outdoor skills and theory. Students will develop self-esteem, team-building skills, public speaking skills and conflict resolution skills. They will understand group skills, cooperation and the skills necessary for outdoor survival. They will perform school and community service, and become aware of nature and the environment. This program will allow students the opportunity to set and meet goals, challenge themselves and overcome barriers to success. They will be expected to present and promote their new skills in school and community presentations using various forms of technology. In addition, evidence and documentation will be added to their graduation portfolios.

Rationale
"Change is a modern reality. The education system is being challenged to adjust and adapt most every day and in every manner" (Hargreaves, 1997). Outdoor education and leadership is a proactive approach to dealing with the challenging reality of change in our society. It also breaks down the classroom barriers and allows students to learn experientially. "Direct student involvement means more collaborative learning, more student responsibilities, more opportunities to seek personal relevance, more integration of head/hand/heart and more action in the preparation for and direct input to a changing world." (Henderson, 2003)

ORGANIZATIONAL STRUCTURE

Unit	Title	Time
Unit 1	**Personal safety skills**	B/F Block (10:15 – 11:35)
Unit 2	**Outdoor shelters and weather survival skills**	
Unit 3	**Outdoor cooking, edible plants and reading maps**	
Unit 4	**Teambuilding and Outdoor recreation**	
Unit 5	**Communication and Community Involvement**	

The activities that are found throughout the course are not necessarily linear or limited to the section in which they are found. The outcomes are developed and applied in a spiral fashion that integrates the theory and practice of outdoor skills, deepening the students' understanding and experience as the course progresses.

LEARNING OUTCOMES

Unit 1: Personal safety skills

Students will become familiar with First Aid and Food Safe practices. They will earn certificates in both of these courses and will be able to perform these safety skills throughout the course and in their personal lives.

CURRICULUM ORGANIZER

It is expected that students will:

- Demonstrate an understanding of the components of personal safety and survival
- Demonstrate an understanding of teamwork and cooperation
- Demonstrate an understanding of what makes an effective and positive leader

Unit 2: Outdoor shelters and weather survival skills

CURRICULUM ORGANIZER

Students will move from a general knowledge of the concept of outdoor education through an introduction to general practices, theory and application of skills in an outdoor setting. A wide range of tools will be used to help students explore their skills; a variety of planning and management skills will be presented to help students cope with the practical demands of building shelters and practising survival skills outdoors.

It is expected that students will:

- Demonstrate an understanding of effective planning
- Demonstrate an understanding of time management and organization skills
- Develop a stronger sense of personal responsibility
- Demonstrate and apply decision making skills
- Demonstrate and apply goal development skills in a more challenging outdoor setting

Unit 3: Outdoor cooking, edible plants and reading maps

Students will be able to understand and apply effective individual and team skills in cooking with a variety of tools in an outdoor setting. With the help of various leaders specializing in identifying plants, trees and shrubs, they will understand which are safe and edible and how to prepare them. They will also learn to use maps, compasses and GPS equipment to find designated locations for both learning and survival.

CURRICULUM ORGANIZER

It is expected that students will:

- Demonstrate an understanding of conflict resolution skills

- Demonstrate an understanding of effective planning and preparation
- Demonstrate and apply problem solving skills
- Demonstrate and apply effective goal-setting and follow-through skills
- Develop and apply learning with both ancestral and technological tools
- Develop and demonstrate the qualities of a positive and effective leader.

Unit 4: Team-building

Students will become familiar with the principles of team building. They will work together in a cooperative and collaborative environment to develop the basic skills required to build connections and relationships with others. Fundamental to the success of student leadership in an outdoor setting is the development of teamwork and personal leadership skills beyond the classroom and into the school and greater community. Through a variety of physical outdoor activities, students will learn to work together in a trusting environment to achieve success in challenging activities such as hiking, rock climbing, canoeing, kayaking, and a variety of winter sports.

CURRICULUM ORGANIZER

It is expected that students will:

- Develop and demonstrate enhanced interpersonal skills
- Demonstrate an understanding of team/group dynamics through the application of collaboration skills
- Demonstrate an understanding of the value of interdependence
- Develop and demonstrate an ability to carry out fundamental teamwork in organizing, preparing and carrying out challenging physical activities
- Demonstrate the ability to put safety above personal success and satisfaction in an outdoor setting

Unit 5: Communications and Community Involvement

Students will be able to demonstrate the planning, implementation, evaluation of individual/group projects while incorporating marketing and community relations skills. They will present material using a variety of technological tools to enhance and promote their activities to and with the community. They will assist in organizing, promoting and participating in an environmental impact program from which they will learn to manage and protect the environment.

CURRICULUM ORGANIZER

It is expected that students will:

- Demonstrate an understanding of the importance of communication skills for effective leadership (verbal, nonverbal, written, listening)
- Develop and demonstrate enhanced public speaking skills
- Demonstrate leadership skills through application and reflection on individual and/or group projects at the school, local or global levels
- Demonstrate a variety of marketing strategies in the promotion of project implementation
- Increase understanding of techniques used to develop positive school and community climates

- Design and implement assessment tools for personal, peer and teacher evaluation with regard to project planning and implementation

INSTRUCTIONAL COMPONENTS
Direct Instruction
Indirect Instruction
Peer and Partner Instruction
Interactive Instruction
Experiential Learning
Modeling
Brainstorming
Group Work
Independent Study
Guest Speakers
Guest Instructors
Use of technological resources (videos, DVD's, Powerpoint, I-movie, etc.)
Use of outdoor equipment and tools (paddles, skis, snowshoes, axes, fire-lighting sources, etc.)
Analysis of Self/Peer feedback/performance
Self-Evaluation
Outdoor Education Theory and Resources
Stories, legends, songs and traditional teachings from Elders and Community Leaders
Portfolios

ASSESSMENT COMPONENTS

Type of Assessment	Category	Details	Weighting/%
Self and Peer Evaluation	All	Various assessment tools will be introduced in the class and in the field	10%
Class Participation	All	Important aspect to all activities	40%
Written work/Projects	All, particular Units 1 and 5	Important to show the learning acquired and community involvement	30%
Service	All, particularly Unit 5	Necessary to provide community service to protect and enhance the environment	20%

LEARNING RESOURCES
Videos
Resource Books
Newsletters/Website
Various Instructors (Local, Tribal, Provincial, National)
Specialized instruction and training manuals (First Aid, Food Safe, etc.)
Conservation material, guest speakers and instructors
Internet
Computers and specific programs (Powerpoint, I-Movie, Pagemaker, etc.)
Authentic Documents (magazines, newspapers, etc.)
Journals and Periodicals

Specialized use of tools and equipment for outdoor activities

ADDITIONAL INFORMATION

- the program will be offered on a year-round basis (2 semesters) for the First Nations Program (available to students from grades 9 to 12) and will include additional First Nations instruction and traditional teachings (songs, stories, legends, drumming, and craft-making)
-offered inside the timetable

WORKS CITED

Hargreaves, A. (1997). Rethinking educational change: Going deeper and wider in the quest for success. *Rethinking educational change with heart and mind.* (pp1-26). Alexandria, VA: ASCD.

Henderson, B. (2003). Teaching in and out of the box. *Pathways: The Ontario Journal of Outdoor Education*, *Vol 15(3),* 4-11.

Appendix 5

Course Outline (2013 version)

Aboriginal Earth Science 11
Esquimalt High School

This course will explore Earth Science 11 with an Aboriginal perspective.
The goal of the course is to complete credits in science in an environment that will include some outdoor activities and exploration with elders, guest speakers and field studies through traditional ecological knowledge and wisdom (TEKW).
We will be using course packets for Earth Science 11 and will add some of our own outdoor field studies including:

- Nature identification: trees and plants, root systems
- Star mapping and astronomy
- Exploration of the coastal rain forest
- Orienteering and topography mapping
- Avalanche awareness, understanding weather while snowshoeing and cross country skiing (winter trip)
- Stewardship and protection of the environment
- Understanding wildlife habitats, ecosystems and river systems
- Plant, animal and marine biology
- Traditional fisheries and coastal waters
- Industry and its influence on nature
- Chemistry of rocks; geology and geologic time
- Weather, storms and land/mountain formations

Projects will include

- Powerpoint and digital story presentations
- Outdoor project work
- Clean-up of marine waterways

Evaluation: In-class workbook assignments and chapter quizzes
Group work and shared assignments
Discussion and trip preparation
Projects and presentations
Participation and leadership

Expectations: Commitment to completing the workbook portion of the class work is essential in order to take part in the field studies. Students will need to show respect and listen to instructions in order to ensure personal and group safety. This course requires "0" tolerance; drugs and alcohol will not be permitted during the course or on any outdoor activities. If substances are found during an activity your parents will be contacted to pick you up from the activity and we will require a written contract between you, your parents and the school to return to the course.

Grading:

- Linear marking across terms 1 and 2

Mark distribution:

- 35% for written work and chapter quizzes
- 35% for projects and presentations
- 30% for participation, group work and leadership

Supplies: Binder and paper
Pens and pencils
Outdoor clothing and camping materials will be required for trips and outdoor activities, lists will be sent home prior to the trips

☺ Welcome to a new look at science!