PISUKVIGIJAIT - WHERE YOU WALK: INUIT STUDENTS' PERCEPTIONS OF CONNECTIONS BETWEEN THEIR CULTURE AND SCHOOL SCIENCE

by

M. Alexander Tufts

B.Sc., Dalhousie University, 1977
B.Ed., Dalhousie University, 1979

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Supervisor: Karen S. Sullenger, B.Sc., M.Sc., MNRM, D.Phil.

Examining Board: Keith Radford, B.P.E., B.Ed., M.A., Ph.D. (Chair)
Robert M. Leavitt, B.A., M.A.T.
Pierre Demers, B.A., B.Ped., M.Ed., Ph.D.

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ABSTRACT

Exploring students' perceptions of connections between their culture and school science provides information that might assist in improving science curricula and increase the number of Inuit students enrolled in academic, college preparatory science. With the reality of a new territory, Nunavut, in 1999, there will be a need for Inuit doctors, engineers, and other science-related professionals and technologists, and these people will need to be graduates from an academic science program at the high school level. The purpose of this study is to determine whether a group of Inuit students perceive connections between their culture and the culture of their school science. The study was conducted in a community within the Nunavut Settlement Area. Information was collected using a modified Talking Circle, a method adapted from those of First Nations peoples, from two groups of young Inuit: a group of grade twelve students and a group of grade twelve graduates. Each Talking Circle was audio-recorded and described in field notes by the researcher. Data analysis involved identifying meaningful categories within data and organizing the data according to central topics. This study suggests that Inuit students see Western science as being irrelevant to their lives and that they see Inuit science, based on traditional knowledge and experience, as practical and valuable knowledge which should be developed and taught in secondary school science.

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> Students who are provided with opportunities and assistance to take control of their own learning will become partners in their own education. They will have input into what they will learn and how, and will set their own goals and evaluate their growth. In that way, students are encouraged to take responsibility for their learning, to become the self-directed problem-solvers they will need to become as adults (Department of Education, Culture and Employment, GNWT, 1991, p. 21).

Introduction

I have been associated with school land programs in the NWT for the last thirteen years. During that time, I have experienced many memorable trips, but one trip in particular always comes to mind. We left our home community with twelve students from grades nine through twelve and traveled by snowmobile and kamotik (Inuit sled) to a neighboring community. The ten-hour trip took us over plateaus, mountains, and river valleys. We saw hundreds of caribou and came across the only area on Baffin Island where there are miniature trees, four- to five-foot arctic willows.

The morning after arriving at our destination, we traveled for two hours to the floe-edge with a local hunter as our guide. Within twenty minutes, he had shot a beluga whale. For some of our Inuit students, this was their first time seeing a beluga whale. After the whale was harpooned and pulled onto the ice with help from the students, everyone gathered around, closely inspecting it. They immediately noticed an abnormality in one of its pectoral

fins. The students started theorizing what this abnormality was and what could have caused it. When the hunter cut into the enlarged area around the fin, a white fluid spurted out and covered everyone. Again, the students hypothesized as to the nature of the white substance. Upon closer examination of the dissected fin lying on the ice, the students noticed that the ball-and-socket joint was calcified. Again, they hypothesized about how this might have occurred.

The students stood in a circle, surrounding the beluga whale, quietly chattering among themselves. Speaking in Inuktitut while skillfully butchering the beluga whale, the hunter shared traditional knowledge about whaling as the students listened attentively to every word. Aware that the hunter had finished talking, students took turns quietly asking questions, in Inuktitut, to which the hunter responded at length. Among the many experiences on the ice at the floe-edge that day was this bicultural (Inuit and Western) science lesson which we all experienced.

The experience with the beluga provided for follow-up in-class science lessons for weeks. It turned out the whale was pregnant with a term fetus, which was approximately five feet in length. The students took the fetus to various classes in the school to show to their schoolmates as they shared their beluga experiences. They dissected the fetus, which also involved learning the traditional and non-traditional names of the external body parts and internal organs of the whale. They learned the location and function of whales in the northern food chain and traditional uses Inuit make of whales. I had never witnessed such student enthusiasm and interest in science. These experiences demonstrated the effectiveness for

Inuit learners of active participation, student-initiated exploration of culturally relevant material and subject matter, and student-teacher collaborations in science education.

Unfortunately, the reality is that most of our students spend most of their science periods at school reading and writing at their desks by themselves or listening to lectures. There are dismally few Inuit students enrolled in academic, college preparatory science courses, as well as limited number of grade twelve academic graduates. Western school science as we know it has failed the Inuit student.

As a result of my experience with the beluga whale at the floe-edge, I had a number of unanswered questions about possible connections or relationships between the students' school science experiences and their cultural experiences outside of school. To answer these questions, I conducted a qualitative study to learn whether students perceive such connections and how they describe them. The purpose of the study was to describe young Inuit students' school science experiences from their cultural perspective. As a teacher of Inuit adolescents who is interested in the interaction of culture and science, I believe that we can use knowledge of these connections to improve science education by making it more culturally appropriate in content and teaching methodology. With attempts by the NWT Department of Education to promote culture-based schooling (i.e., increased control of education at the community level focusing on the students' cultural identity) and my personal attempts to emphasize Inuit history, traditional values and beliefs in my science classes, I believe that students should be able to identify connections between their culture and school science.

The study has theoretical, educational and social implications. It was initiated with a view toward exploring the broad, theoretical implications of the research methodology for further application. From an educational point of view, it yields information about the validity of current instructional approaches and content within the present science curricular framework for northern high schools. From a social perspective, it also provides information from which to consider whether Inuit science should be taught separately or integrated with Western science to create a "hybrid science" which reflects the rapid changes within Inuit society, particularly in the Nunavut Territory, where for the first time Inuit will have total autonomy in their education.

Background

Formal education for the Inuit of Canada's Arctic began shortly after the end of the Second World War, when the Government of Canada opened Federal Day Schools. The rationale for providing education to northern aboriginal children was cultural and linguistic assimilation into southern Canadian life and the training of northerners for migration to southern Canada to ensure job security (Crowe, 1974). Early northern education was deeply rooted in mainstream, Western culture. Science and science education were no exception.

As education came under aboriginal control and direction in the late 1960's and early 1970's, a new perspective on aboriginal northern education emerged. This new educational perspective began to focus on aboriginal northern cultures and customs for the first time. It was accelerated by a hard core of concerned individuals in the media, in various government agencies, and in aboriginal organizations at the national, regional and community levels.

In the Northwest Territories, six important developments over the last fifteen years have had a direct impact on education:

The creation of Divisional Boards of Education and Community Education Councils to assume responsibility for the operation of NWT schools.

The establishment of the Baffin Divisional Board of Education, in 1985.

A philosophy of shared responsibility among students, parents and the community (NWT Education, 1989). It states that collectively, students, parents and the community will promote the skills, abilities and attitudes of each student to insure they are responsible and confident members of the NWT's rapidly changing, multicultural society.

The development of *Piniaqtavut*: *An Integrated Program* (Piniaqtavut Committee, 1989). This thematic program, developed for kindergarten to grade nine, was designed to meet the cultural, linguistic and academic needs of Inuit students by integrating subject areas such as science, social studies, health, language arts and mathematics.

The framework for education in the NWT, *Our Students, Our Future: An Educational Framework* (NWT Education, 1991). This document promotes schooling which incorporates and reflects the child's cultural identity and endorses more control of education at the local level.

Most recently, in 1996, the draft curriculum, *Inuuqatigiit* (Inuuqatigiit Committee, 1995-96), representing ten years of work by representative Inuit from the four Inuit regions across the NWT. *Inuuqatigiit* focuses on the enhancement and enrichment of Inuit language and culture. It also promotes the integration of the Inuit world-view with the existing school curriculum.

Despite these changes, especially to the Kindergarten - Grade 9 northern education system, secondary academic (science) education is still predominantly based in Western culture and is characterized by disproportionate low enrollment and achievement levels among Inuit students. Of particular concern is achievement in secondary academic science because it is a prerequisite for the post-secondary science and science-related programs which Inuit students will require if they are to become Nunavut's next generation of science professionals and technologists. Inuit and other aboriginal peoples are severely under-represented in the science, mathematics and engineering professions (Assembly of First Nations, 1988; Kirkness and Bowman, 1992; Science Council of Canada, 1991; Urban Native Education Society, 1987).

Current Western science education is simply not meeting the needs of aboriginal people--especially the Inuit. On-going attempts to improve the academic success of aboriginal students in the area of science education have included the creation and implementation of culturally relevant teaching strategies (Allen & Seumptewa, 1993; Garcia & Ahler, 1992; Gilliland, 1992a, 1992b; Hoffman, 1992; Hirst & Slavik, 1989; Ovando, 1992; Swisher & Deyhle, 1992) and the development of culturally relevant educational programs and curricula (Cajete, 1994; Jordan, 1984; Ovando & Collier, 1985). For example, Gilliland claims that "group problem solving is part of Native American culture" (1992b, p.151). Hirst and Slavik (1989) suggest that using cooperative learning groups in science improve not only science learning but also the learning of language. Ovando (1992) and Gilliland (1992b) also suggest that the teaching of language through science activities may be an appropriate and effective strategy to support the use of cooperative learning groups.

One suggested explanation for the ineffectiveness of science education for aboriginal students is that they possess cultural world views that are significantly different from those of Euro-Americans (Cobern, 1991). Cobern (1991) defines worldview as the "foundation upon which cognitive and perceptual frameworks are built" (p.22). Cobern (1991) suggests further that "adapted to science education, worldview theory argues first for an understanding of the world as students understand it" (p.115). A number of researchers have focused their research on the differing world views of non-Western students and Western teachers, and their compatibility with modern Western (science) education (Cobern, 1991, 1993, 1994; Glasser, 1991; Jegede, 1993; Ogbu, 1992; Waldrip & Taylor, 1994; Yager, 1993). Cajete (1986) reports that differing world views directly affect students' perceptions and receptivity to science. From a worldview perspective, Simonelli (1994) explains the difference between Western science and indigenous science as follows.

> Indian science, or "indigenous science" as it's sometimes called, is "full-spectrum science". It draws freely on all four of the gifts that have been given to us as human beings: the spiritual, emotional, mental, and physical. By contrast, Western science dwells mostly on the physical and mental, often rejecting the spiritual and feeling or emotional qualities of life with great arrogance and finality (p. 37).

Acknowledging the differences between the two sciences provides science educators with better understandings of how people view their world(s).

Another explanation for the ineffectiveness of science for aboriginal or indigenous students is that educators often fail to realize and acknowledge the actual science and technology local indigenous people have been using for centuries, the knowledge and skills people have and what they feel is relevant to them (Knamiller, 1989). To this end, research

has focused on creating culturally relevant programs and curricula. Marinez and Ortiz de Montellano (1988) provide their rationale for creating and implementing a culturally relevant curriculum for aboriginal students.

> A culturally relevant curriculum provides teachers with resource materials and approaches allowing them to enable students to: develop pride in their culture's contributions to science, learn science from a familiar cultural base, be motivated to consider science as a career, and recognize the importance of science in their life (p. 2).

According to this view, connecting science education to aboriginal science provides students with the benefit of connecting new learning to prior knowledge and experience. But more than that, connecting science education to aboriginal science shows students that science is not just "a white-man's thing" (Greer, 1992).

> It is important that Indian students understand what science is and learn to appreciate how science affects their daily lives. By doing so, Indian students can see that science is something that is useful to them and not something which only relates to non-Indian culture. (ORBIS Associates, n.d.).

Williamson (1994) reports that an aboriginal curriculum must be based on students' experiences. However, meaningful experiences for aboriginal students can occur only "if native culture is treated not as subject matter but as the basis of pedagogy itself" (Leavitt, 1991, p. 266). As Leavitt (1991) points out, integrating elements of aboriginal traditional skills, related knowledge and beliefs into non-aboriginal curriculum may appear to give validity to aboriginal culture but in fact may cause more harm than good by segmenting aboriginal life in non-aboriginal ways. A researcher of Australian aboriginal education believes that bicultural schooling, or two-way schooling, is rare but possible, and is in fact necessary to ensure the long term survival of a minority culture (Harris, 1988).

Connecting science education to aboriginal science based on aboriginal people's special relationship with the land is a prominent theme found in the literature on aboriginal science (Cajete, 1994; Gilliland, 1992b; Ovando, 1992). Northern educators realize that Inuit students need elements of the past and the present to create a future based on who they are (Stairs, 1994).

Educators of Eastern Arctic Inuit students have been encouraged to integrate aspects of Inuit culture into their science programs. For example, land trips, including caribou hunting and trips to the floe edge for seal and whale hunting, provide excellent opportunities to learn both Inuit science and school science, and to "turn students on" to science. These real-life experiences demonstrate the effectiveness of active participation, student-initiated exploration of culturally relevant material, and student-teacher collaboration in meaningful learning. Otherwise, science students simply memorize meaningless facts and explanations with little or no understanding of science concepts (Tasker, 1981).

There has been increasing literature demonstrating the connection of Inuit indigenous knowledge to Western science as it is practiced in the Arctic (Anawak, 1989; Cruikshank, 1981, 1984; Feit, 1988; Freeman & Carbyn, 1988; Johnson, 1987; Merculieff, 1990; Nakashima, 1988; Waldram, 1986). However, there are in fact few reports which actually demonstrate the integration of science and culture into local culture and school curricula (Haukoos, 1991). In particular, the reviewed literature is void of students' perceptions of curricular and teacher attempts to help them make meaningful connections between aboriginal cultural knowledge and Western science (Costa, 1995). The reviewed literature

suggests that research approaches which provide students with opportunities to share their experiences and opinions are more informative.

The Field Study

My research took the form of a qualitative study in which students were given an opportunity to share their life and school experiences. I was specifically interested in finding whether Inuit students perceived any connections or relationships between their school science experiences and their culture. A number of related questions helped explore this problem.

- What is the nature of these connections / relationships?
- How do students describe these connections / relationships?
- Do the students talk in terms of specific or general connections / relationships between science and culture?
- What is their understanding of science?
- How well do these understandings match teacher expectations?
- How successful are the efforts of interested people to make the connections and to make science curriculum more culturally relevant?

The study was conducted in a Nunavut Settlement Area community of the Northwest Territories. Since it is a relatively large Inuit community with Inuit from various surrounding communities, excellent transportation links, telecommunication capabilities, educational and training resources, and a local labour pool of skilled workers, the students were more likely

to be exposed to connections between culture and science on a daily basis. For example, they have direct access to the Internet.

A pilot study was conducted with three grade twelve students from an eastern Arctic high school in late June 1996 to test the appropriateness and efficiency of two proposed research strategies: focus group interviews and dialogue journals. Results from the pilot study indicated that these strategies were culturally inappropriate. For example, of the three pilot study participants, one dropped out because of a disagreement with another participant over a response to one of the interview questions. This was the very thing I had hoped to avoid if at all possible. I also found the interview questions to be too structured and closed-ended to elicit adequate student response. Moreover, the students felt they had to reach consensus in the focus groups. As well, dialogue journals were not well received. They demanded writing, to which the students were not willing to devote time and effort. A revised methodology was required.

As I searched for a culturally appropriate methodology for this study, I was reminded of characteristics of Inuit elders I have had the privilege of knowing over the past thirteen years of living and teaching in the Eastern Arctic. A few of these characteristics include

- not talking too much, too often or too long,
- speaking only about what they knew or were familiar with, and
- if the point they wished to make was important, repeating it in different forms.

Having participated in Talking Circles during my graduate studies, I was aware of the power of the spoken word during such a respectful sharing of feelings, experiences and

points of view. Graveline (1996) notes that an essential norm of a Talking Circle is to listen attentively so that the wisdom contained within the speakers' words may be heard. Graveline (1996) also believes that "through respectful listening we are better able to enter into another's experience through their words" (p. 178).

As the intention of this study was to listen respectfully to Inuit students' feelings and experiences, and their perceptions of connections between their culture and science, a modified traditional First Nations Talking Circle was utilized as the sole research strategy. This goes against the Western research belief of triangulation, but I believe very strongly that the power of the Talking Circle is that it permits participants to speak in their own voices describing their own school and life science experiences and to reflect on these.

I gave a brief description outlining the sacredness and power of a traditional Talking Circle ceremony as practiced by First Nations people at the initial meeting of both participant groups. A set of basic rules was articulated and was adhered to by all participants and the researcher throughout the initial and subsequent Talking Circle sessions. These rules were

- one person speaks at a time
- no one is forced to speak
- no time limit is placed on what the speaker has to say
- everyone in the circle listens respectfully to the words of the speaker
- the person on the speaker's left is the next one to speak
- no one is permitted to criticize or speak negatively of what is shared in the circle

Each Talking Circle began with the researcher stating clearly the intended theme for discussion. This was as an attempt to help participants understand what was expected of them, to collect their thoughts and remain focused throughout the Talking Circle session.

Eight students participated in the study, four (two male and two female) current grade twelve students and four (two male and two female) former grade twelve students, hereafter referred to as "the graduates". The graduates requested that the study be conducted at the home of the researcher, while the grade twelve students requested that the study be conducted in a school setting. The study was carried out over a two-month period, November and December 1996.

I conducted two Talking Circle sessions for each group. The Talking Circle was semi-structured, with a brief orientation to ensure that the main issues were addressed. Each Talking Circle session lasted for about two hours. All students were encouraged to share their thoughts and experiences in their own way. As researcher, I was required by the protocol to be a respectful listener as well. This helped me to gain access to students' thoughts and experiences. The format also provided the students opportunities to make additional comments beyond their original responses. The Talking Circle thus became a reflective exercise, of which all students spoke positively. On occasion I repeated or rephrased questions in order to clarify meaning for students.

Each Talking Circle session was audio recorded. I also made written notes as suggested by Hopkin (1985), Krueger (1989), and Patton (1987), so as to avoid missing any relevant information such as body language, which is commonly used among Inuit (see Appendix D).

Talking Circle sessions were structured in the following manner. The first round of the Talking Circle focused on students' memories of growing up, how and what they learned in family settings prior to attending school. This round of the Talking Circle involved two strategies: the historical interview and the interview about specific events (Osborne and Gilbert, 1979). Historical interviews began with each student's memories of growing up. Students were encouraged to recall and relate learning experiences in general.

The second and third rounds of the first Talking Circle session explored students' school experiences and school science experiences, respectively. Some of the students talked about both Inuit science and Western science when discussing school science experiences. I took this opportunity to ask them to elaborate more on Inuit science and Western or Qallunaat (i.e., white man's or Western) science.

The first round of the second Talking Circle session focused on students' perceptions of the extent to which Inuit culture is reflected in their school science classes.

The second round of the second Talking Circle session focused on students' perceptions of connections between Inuit culture and science. In this session I wanted to know whether Inuit students understood that culture and science were interrelated, and if so, how.

Data Collection and Analysis

The Talking Circle, having been audio-recorded, was then transcribed for analysis. The field notes kept by me during each Talking Circle were supplemented with detailed observations and reflections immediately after each session. Findings were shared with each

participant for reactions and feedback at the beginning of the next Talking Circle session. By their nature, the Talking Circles were essentially a series of vignettes of students' thoughts and experiences.

Note: Excerpts from the Talking Circles are referenced in the following sections by the numbers of the Circle, round and speaker; for example, 1/2/4 indicates the first Circle, second round, speaker no. 4. Excerpts from the researcher's field journal (FJ) are similarly coded.

Findings

The two groups of students interviewed, the graduates and those still in grade twelve, share many perceptions about the connections between Inuit science and Western science. Their observations address four aspects of these differences: (1) involvement in learning, (2) the role of respect, (3) the transmission of knowledge, and (4) the spiritual nature of Inuit teachings. Given the differences, the students talked about why they find learning Western science difficult, what distinguishes the two kinds of science, and what schools might do to help bridge the gap. In general, the graduates had had direct experience with traditional Inuit teachings, while the grade twelve students had only heard about these teachings. Nevertheless, they joined the graduates in asserting the necessity of maintaining them in practice as well as teaching about them in the school setting.

Traditional Learning and School Learning

According to the participants, Traditional Inuit Knowledge involves observation skills, hands-on activities and oral history. The graduates talked of how they learned while growing up in their home settings. They all spoke of the role observation played in their pre-school learning. Whether they were directly involved with the hunting of animals or witness to the carving of a harvested animal, everyone spoke of intently observing everything their parents did. They talked of their culturally oriented learning, "traditional knowledge," often involving hands-on activities.

> We learned from observation. In the traditional way, we learn better by observations, by examples, and by demonstrations. (2/4/2)

> I would spend a lot of time observing what my mother and father were doing, especially when we were out camping and hunting. (2/2/1)

> Everything my mother or father did, I would observe it closely. When my father would butcher or cut up a seal, he would cut certain joints, or certain areas he would avoid cutting because he didn't want sour tasting meat. I was amazed whenever he would cut without hesitation, even when the area he was cutting was completely covered with meat, he knew exactly where the joint was. (1/2/1)

Early learning was also from an oral history in the form of stories, legends and songs, which encompassed knowledge and skills to ensure their survival. As one graduate recalled, "When my grandmother or mother would tell us stories, it was one way of making us think, knowing that we hadn't experienced it yet. Stories were part of the learning cycle" (1/2/1). Parents, older siblings or relatives then determined when children were ready to be actively involved in a task they had spent time observing. One graduate recalled, during a Talking Circle, that "my older sisters and both my parents taught me. I was taught when I was ready

to learn in certain areas. My parents determined this. I wasn't scheduled to do anything at all; my learning was unlimited. When I was ready to learn something, then I received it; not later but right then and right there" (1/3/1).

Learning and evaluation occurred simultaneously, with immediate and positive feedback in the form of praise and encouragement as essential elements. Children were also shown or told how to improve their work or task, encouraged to persist and practice towards excellence. Self-evaluation was encouraged. One graduate said, "I can remember my mother encouraging me to make it by myself with hardly any help from anyone. She would tell me to try to solve my own problems but with encouragement, lots of encouragement from her" (2/2/1).

The graduates often spoke of their traditional knowledge and experiential learning opportunities through fishing, hunting, and camping trips. In particular, graduates spoke of doing science when they used traditional birthing methods to help deliver babies out on the land, carried caribou meat over the tundra, gutted fish, navigated water and land by wind and stars, and fermented walrus meat, to name but a few at-home experiences. (Additional experiences are included in Appendices D and E.) The grade twelve students, however, did not speak of any similar home traditional knowledge and experiential learning activities.

Involvement in Learning

Both the graduates and the grade twelve students reported that their school science often had little to do with "real things" or "hands-on" activities. They perceived that the teachers compensated for this by providing students with related pictures or drawings. They

reported, however, that looking at pictures and drawings was not the way they learned. Without experience, their science learning was "incomplete." As one graduate said, "without experiencing it, I don't get the complete understanding."

All the graduates reported that they did not feel their school science reflected their culture to any measurable extent. Yet, despite this claim, the graduates spoke of being able to make connections between their culture and Western science, but they maintained that this ability was something they developed and not the result of teacher or other assistance.

> At home I learned in a traditional way, and in school that was completely changed. I can't say it caused problems for me understanding science things, because I was always trying to make connections between the cultures. The teachers never made those connections. (1/3/2)

> I don't know exactly how I made those connections but the teachers didn't make the connections for me. (1/4/2)

Three graduates provided specific examples of connections between their culture and Western science but were unable to articulate just how it was they were able to make these connections.

> I have seen my Dad use a lever. Big rocks, boulders were used to cover the cached meat. We couldn't move a rock so Dad used a stick. He just leaned into the stick and was able to move the rock. (1/4/1)

> We don't live in igloos or qamauqs anymore. These buildings were constructed in a way which was environmentally friendly. We used natural building materials, nothing was shipped up from the south. These buildings, especially the qamauq, will disintegrate over the years. You can still see the qamauq rings but everything was environmentally friendly. But today, if we abandon houses it is more damaging to the environment. (1/3/1)

> When my father would butcher or cut up a seal, he would cut certain joints or certain areas he would avoid cutting because he didn't want sour tasting meat. I was amazed whenever he would cut without hesitation even when the

> area he was cutting was completely covered with meat, he knew exactly where the joint was. In a sense he was a ...what do you call it? ... a doctor of anatomy. (1/1/1)

The graduates spoke of the role science and technology played historically throughout Inuit culture. As one graduate said, "Our ancestors didn't see that what they were doing was science. They didn't say, 'Oh! This is science!' It was their survival. They use their knowledge, traditional knowledge in order to survive. Yet, to me, the traditional knowledge practiced by my ancestors was science!" (1/4/1).

Respect

Both the graduates and the grade twelve students spoke of the value of respect when asked to reflect on their pre-school childhood experiences. While not everyone commented directly on this topic, all expressed strong agreement with the statements made by others. Everyone agreed that subsequent to attending school, respect was the number one value in their family settings. This respect was not restricted to immediate family members or other Inuit. It was also extended to include animals and the environment. In fact, the graduates added that they felt that respect for people, animals and the environment ensured, in part, the survival of the Inuit. For example, one graduate stated, "When I was growing up, respect was always there in Inuit society. You always gave respect ... even to a person you didn't know or to one you just met. Respect was your doorway to a person, in a way" (1/1/1). Another graduate explained, "If our ancestors never had respect for the animals, they would never have survived (1/4/1).

The graduates all strongly believed that successful hunts were directly connected to the degree of respect the hunter had for the hunted animal. They believed that if animals were killed cruelly, abused or mistreated in any way, then the animals would not reciprocate respect for the hunter by offering themselves to be sacrificed. However, the grade twelve students expressed some skepticism with regard to hunter respect for the animal and animal respect for the hunter.

The graduates referred to respect once again when asked to reflect on their school experiences. They spoke of the difference in respect at home and at school. I had not expected this. I was surprised when graduates spoke of how respect from teachers at school had to be earned whereas respect from parents peers and elders was unconditional at home. Respect at school was gained through good marks and performance. These comments from graduate #4 and #1 drew nods of agreement from everyone (FJ: 1/1).

> I knew my parents and family respected me, but I had different respect from the teachers. If I did a really good job at school, the teachers rewarded me with materialistic rewards, but at home it was a verbal reward. I began to like the materialistic rewards at school much more (1/4/1).

> Respect was always there in Inuit society when I was growing up, but I found respect had to be earned in the Western society. Respect in school came mainly when you got good marks (1/1/1).

The grade twelve students did not make reference to respect. Respect or absence of respect was only one of the many values the graduates claim have changed over time. As one graduate reported "Respect is different now; especially towards parents and towards each other, like with siblings. There is less respect today than when I was growing up" (1/4/1).

Transmission of Knowledge: Active Involvement in Home Learning Versus Passive Involvement in School Learning

Both groups spoke of losing interest in school or being less successful as they progressed from elementary to junior high to high school. No one remembered more than a handful of experiences before junior high and few of these were positive.

With regard to junior and senior science, attitudes ranged from indifference to boredom and disappointment -- disappointment in the sense that they did not feel they were academically prepared to cope with the type of work they encountered in junior and senior high school. As one graduate reflected, "Thinking back to grades seven to nine, I don't think they prepared me academically to go into the natural sciences in high school" (1/1/1). Another graduate recalled, "My school science experiences (laughs)... I used to sleep through science classes. I was one of those people. I think part of the problem was that I don't remember any of our school science material being culturally oriented to our lifestyle" (1/2/1).

Both the graduates and the grade twelve students spoke of their junior and secondary school science experiences as consisting mainly of "just sitting in science class and copying notes." Along with school science being mostly paperwork, all but three graduates spoke of never getting to do "real things" in school science, e.g., formal science labs as well as out-of-school science activities such as field trips. Although these three graduates spoke of experiencing very few "hands-on" school science activities, they did speak very positively of archeological field trips. In fact, they report these archeological field trips as being their "most meaningful school science experiences."

Spirituality

There was a sense of uneasiness among students in both groups when the subject of spirituality was raised. This was the first and only occasion on which I was aware of any sense of hesitancy in discussing a variety of topics during the Talking Circle (FJ: 1/2). This sense of uneasiness, which relates to the lack of respect that Inuit students believe Qallunaat teachers have for Inuit mythology, is best exemplified in the following discussion between a graduate and myself.

> Researcher: But if the Qallunaat teachers were informed of this knowledge (Inuit legends) by Inuit teachers and elders, do you think they would pass it on to their students?
>
> G: No! Because I know a lot of Qallunaat teachers are suspicious, skeptical about our Inuit mythology.
>
> Researcher: They don't believe it?
>
> G: Well, they do and they don't. It is the same with the new generation now, especially at the high school level. Would you pass it on to your students?
>
> Researcher: You mean me, personally?
>
> G: Yeah.
>
> Researcher: Yes, I would.
>
> G: Then what percentage of people like you who are Qallunaat teachers would do this? (G does not wait for researcher to answer) I don't think very many!

Learning Science in School Is Difficult

The graduates and the grade twelve students spoke of the difficulties associated with learning school science. The main problem area reported was the technical language associated with school science. As one graduate explained, "science jargon, all those words

that we have never seen before and will probably never use again, it just wouldn't stick to my head ... no matter what the teacher did!"

> My school science was pretty bad because I couldn't understand what the teacher was saying. (2/3/1)
>
> They (science teachers) had to be really specific in order for me to understand science. I needed examples that I could relate to. (2/3/1)
>
> Every time the teacher started talking about science and tried to explain it on the board without any examples to explain it, that was the hardest thing for me to understand. (2/3/1)
>
> I could understand science better if they taught (science) using their hands instead of just writing in my notebook from the board. (2/3/1)
>
> Drawings of science didn't really help. (2/3/1)
>
> I've got to see it to believe it. (2/3/1)
>
> Our learning is mostly about the teachers and how they teach. People have different ways of teaching, but instead of just writing on the board, if they would teach them by their hands, showing them how to do it. (2/3/1)

All the graduates stressed that Inuit science should be integrated with Qallunaat science. This, they claimed, would ensure they received the best understanding of science. The graduates, however, went on to say that they felt Inuit science would be difficult to teach in present school settings for the following reasons.

> Traditionally Inuit science is not taught in a structured way or in a school classroom setting.
>
> If we are learning about caribou, we need to experience the hunt; we need to see the caribou being cut up, the parts being named. We need to feel and taste the parts. You can't really do that in a classroom. (1/3/1)
>
> It involves values and beliefs, which some teachers (mainly Qallunaat) don't believe in.

> I think a lot of Qallunaat teachers are suspicious, skeptical of our Inuit mythology. (1/4/1)
>
> Teachers would have to experience it (traditional knowledge - Inuit science) before they could teach it effectively.
>
> Reading about it (traditional knowledge - Inuit science) only from a book would result in partial or incomplete learning.
>
> Because you have experienced it (traditional knowledge), I don't think you can ever forget it. Just reading about something is really different. (1/2/1)

In contrast, the grade twelve students strongly suggested that Inuit science and Western science be kept separate. Their rationale was that the students would find the integration confusing. As well, the students suggested that keeping the two sciences separate may be one way for Inuit students to retain, and in some case regain, elements of their Inuit culture.

Inuit and Western (Qallunaat) Science

Both the graduates and the grade twelve students proclaimed the existence of two sciences -- Inuit science and Western, or Qallunaat, science. Inuit science was not expressed in a school course context but rather in the context of their own experiences and lives. One graduate described the difference between Qallunaat science and Inuit science in the following manner: "Science to me is western science or it is traditional Inuit science. Western science means something to me in a western way... it's finding out things ... but I can't make any connection to them. Inuit science is different. I can relate to that science. Like science to me is exploration, finding out things and experimenting. That's what my/our

ancestors were doing" (1/4/2). Another graduate recalls, "I can remember stories our grandfather used to tell us, and then I started making connections. I realized that what they did was part of their survival skills, Inuit science" (1/3/2). Another graduate commented that "there is no word in Inuktitut which can be translated as "science" as it is defined in modern Western society. Actually we (Inuit) don't have terminology for many western science things because we never used them before" (1/3/1). Cajete (1986) reports that the same is also true in any traditional Native American language.

> Rather, the thought process of "science," which includes rational observation of natural phenomena, classification, problem solving, the use of symbol systems, and applications of technical knowledge, was integrated with all other aspects of Native American cultural organizations. (p. 4)

The students also judged their school science to be Western Qallunaat science, i.e., biology, chemistry, and physics. Initially I was disappointed with the small number of comments the students made regarding Western science. For example, comments varied from "Western science means something to me in a Western way" to "science is hard to define" and "I don't know." In retrospect, the students probably said more about Western science indirectly by contrasting its characteristics with those of Inuit science. The students also claimed they would prefer learning Inuit science to learning Qallunaat science. The graduates provided characteristics of Inuit science, which are summarized in the following list.

- involves using all of the human senses
- was what their ancestors did to survive
- describes animal behaviour better than biologists do
- is experiential and culturally relevant

- has a spiritual component

The following comments by the graduates are representative of those illustrating characteristics of Inuit science.

> If my Dad goes out to study polar bears or a herd of caribou with a bunch of biologists, then I'm positive his knowledge is much broader and higher than the biologists'-- in the Inuit way. And I know that he knows something about the animal just by the way it moves. He knows when not to disturb that animal and when to stalk that animal. That is Inuit science!

> "Culture and science" makes me think of traditional knowledge. To me traditional knowledge is when you have actually experienced it; you have lived it; the knowledge is there with you, it is part of you.

> Dropping melted snow into the mouth of the caught seal gives it back its soul. That is showing respect for the animal. Doing this means there will be more food for everybody to share in the future.

All the graduates stressed the importance of knowing "both ways" of "doing science." As one graduate commented, "I think it is important that students see there are two ways of doing science." Another graduate remarked, "I think it is very important to receive science from the Qallunaat and Inuit perspectives." In doing so, the graduates claimed they would receive the best understanding of science.

Two graduates spoke specifically of living in two worlds: a traditional world at home and a Western world at school. This caused them some degree of frustration as they tried to find a balance between the two differing worlds. One graduate said, "I'm kind of stuck in between. I don't really know which side I belong in." This graduate wanted to pursue his education toward a health science profession because, as he said, "I thought that was the natural thing to do." Yet he felt he had to choose between his traditional worldview and a Western worldview. For him, border crossing between the two worlds was not an option. (He

had to choose one side or the other.) "I needed to back myself up in education, and that meant going the Western way." He was able to provide specific examples of connections between his culture and science, but he acknowledged that they are of not much use to him since he has adopted a Western worldview. His comment represents an "assimilative border-crossing" (Aikenhead, 1996). It is assimilative because it has "forced that student to abandon or marginalize his or her indigenous way of knowing and reconstruct in its place a new (Western scientific) way of knowing." (Aikenhead, 1996, p. 66)

Many of the grade twelve students were uncertain of the extent to which their culture was reflected in their school science. As one grade twelve student said, "Sometimes they take us out and teach us to survive on the land ... survival skills. A few of the survival skills we are taught could be considered traditional skills, I guess." One graduate stated, "I cannot recall any time in school where I felt I was being taught our traditional ways. When it comes to traditional (Inuit) application, I was not really taught about it." Another graduate recalled, "I remember our school science material was not culturally oriented to our lifestyle; none of it was. None of the material we had, none of the things we had; there was no relation given to it." Yet, despite this claim, all the graduates spoke of being able to make connections between their culture and Western science, but they maintained that this ability was something they developed themselves, and not the result of teacher or other assistance.

One graduate however, spoke of how she developed skills that enabled her to "cross-reference" her school science with specific cultural examples. For instance, she was not making much sense of a school science lesson about bacterial and fungal activity. She reported that instead of simply accepting the school science explanation, she found an

example from her culture which best exemplified bacterial and fungal action: fermenting walrus meat.

> We were taught in school that if we leave meat out it will rot and we could get poisoning from it. But Inuit had also discovered using fermentation, that is, using fungus and bacteria to make fermented--or "aged" meat is what we call it. (1/4/2)

This graduate has borrowed the term "fermentation" from Western science and incorporated it into her understanding of an aboriginal activity. She does not modify her preferred cultural orientation towards rotten meat despite acknowledging Western science's explanation of the risk of poisoning from eating rotten or "aged" meat.

Aikenhead (1996) refers to this border-crossing as an example of "anthropological learning" (Peat, 1994), i.e., the graduate has learned to "raid the repository of Western science," enhancing her science understanding without altering her preferred orientation.

The students spoke strongly of their desire for schools (Western culture) to acknowledge the existence and validity of Inuit science. In doing so, they would show respect to individual students for the knowledge, skills and experiences that they bring to the science classroom. Student knowledge, skills, and experiences should be the basis of their science education and not merely an alternative to Western science.

Discussion

I may have been aware of respect and how it is related to achievement in school but certainly not of the significance it had in people's lives outside school setting. From the students' comments about how it impacts every aspect of their lives, I now realize that

respect is highly valued because it helps Inuit children develop a strong sense of self, of who they are both in and out of school.

John Amagoalik, a prominent public figure in Inuit affairs and the man often affectionately referred to as "the father of Nunavut," acknowledges that physical elements of Inuit culture have changed and even eroded away, but he stresses the importance of preventing the erosion of the non-physical elements of Inuit culture, for example, respect.

> [But] the non-physical part of our culture--our attitude towards life, our respect for nature, our realization that others will follow who deserve the respect and concern of present generations--are deeply entrenched within ourselves. The presence of our ancestors within ourselves is very strong. (1977, p. 52)

Inuit today are attempting to revive past values and beliefs that have helped to sustain their survival for thousands of years. These attempts are channeled mainly through the current educational system in the north. There is a recognized need to create an educational link between the past and the present. Another well known Inuit leader and politician, Jack Anawak (1989), claims that "we as Inuit are taught that all things stem from and continue to be tied to the past, and that it must continue to be respected and preserved" (p. 45). Unfortunately, in some places in the north this link has been lost. For this reason, elders, parents and dedicated educators continue to work hard to incorporate key elements of the past into school curricula.

Unstructured learning often involved repeated observations. Multi-sensory learning was encouraged in an attempt to show that learning involved the whole body and not just parts of it. Tasks were often repeated, incorporated into play, and practiced in order to provide a sense of accomplishment and pride. These tasks were meaningful to lifestyle,

environment, and ultimately survival. As Anawak notes "children quickly come to understand in my culture that time-honoured skills and attitudes can never be relegated solely to the past; that they ensure a way of life and survival in the present and for the future" (p. 46). Inuit believe their children need to relate their learning to their family and environment. Children also learn by "relating to others and by hearing positive stories about their namesakes and family" (Inuuqatigiit Committee, p. 10). Anawak (1989) details the importance of a namesake in the following way.

> From the earliest possible time an Inuit child is given an Inuktitut name by which he or she will be known. This name is bestowed and "twins" him or her with someone else much older, who may be living or deceased, and who is of importance to the child's family or group and was also known by that name. This name may have come to the child's parents or close relative in a dream or a penetrating thought. In any event the child is thenceforth dealt with by all as bearing that name. All members of the family and extended group then respond to the child according to the relationship they had with the previous bearers of that name. (p. 45)

Of all the obstacles experienced by students of traditional indigenous backgrounds in learning Western science (i.e., school science), I would suggest that language, with its effect on learning, is the most significant. Students must first make sense of teacher instructions while at the same time attempting to gain some understanding of this thing called science. The Inuktitut language these students may use on a day-to-day basis in their lives is very different from the language of science. I recall a physics class where the students seemed to understand the concept of acceleration after observing a variety of repeated demonstrations. But when I introduced units of acceleration, the students simply could not understand m/s^2 because there is no such thing on the speedometer of a snowmobile. The

student is unable to relate new learning to previously learned cultural knowledge until he/she makes sense of what is to be learned. This language obstacle is often exacerbated if the teacher is not familiar with English Second Language techniques. If there is no common understanding, i.e., a shared language between teacher and student, then little meaningful learning seems possible (Tobin, 1996). I believe this is to be the case in eastern Arctic schools, yet students do receive science credits. How is this possible? Larson (1995) refers to this situation as "Fatima's rules." These are rules devised by students enabling them to get passing or even high grades without ever understanding science in a meaningful way. In other words, it is possible for students to obtain a passing grade in school science yet remain unable to relate anything learned in school science class to their culture.

The students reported that their school science often had little to do with "real things" or "hands-on" activities. They perceived that the teachers compensated for this by providing students with related pictures or drawings. The students reported that looking at pictures and drawings was not the way they learned. Without experience, their science learning was "incomplete." As one graduate said, "without experiencing it, I don't get the complete understanding." This appears to support Bielawski's (1990) epistemological belief that "how Inuit know what they know is more often expressed through what they do than in any description of it" (p.63). For example, one graduate was sharing an event he witnessed involving the medicinal value of fermented meat when he said,

> You can't really put a full scientific definition on what exactly science is in terms of Inuit knowledge but you can see it from the (Inuit) lifestyle. The lifestyle speaks for itself in terms of scientific accomplishment or the reality of science being applied in our culture.

Historically, Bielawski likens Inuit knowledge to Borofsky's (1987) description of Pukapukan knowledge: "People learn about canoe building while building canoes. They learn the names of places by going to those places. Little need exists for moving cognitive skills applicable to a broad array of contexts" (p. 128). The Inuit, much like the Pukapukans, "lack experience in stepping outside their normal everyday contexts. They appeal to concrete examples and particular circumstances...in making decisions and resolving problems" (p. 129). All students recognized that Inuit science could be learned only by "doing it." For example, you cannot teach people to ferment meat, to navigate their way across the tundra, sea-ice or water, or to cut up a seal without their actually doing it. All types of overheads, charts and even videos can be used as teaching strategies, but you cannot fully understand any of these without experiencing it.

Three of the graduates spoke about archeological field trips as being their "most meaningful school science experiences." This finding is not surprising, as northern archeological field courses are often meaningful to Inuit students from a socio-cultural perspective, in that they mirror respect by acknowledging the actualscience and technology local ancestors used for centuries and recognize the knowledge and skills of the present day local people. Northern archeological field courses demonstrate the integration of science and culture into local culture and programs. It is a shame more students do not have access to such courses.

It is important to note that although few students spoke directly about the topic of spirituality, they were all adamant that spirituality not just be included in science programs but be an important component. Eber Hampton (1988) identifies spirituality as one of twelve

standards for an aboriginal science curriculum, a standard that enables reflection on science. Any incorporation of spirituality into a school classroom would have to be done with the utmost respect. Research by Snively (1990) demonstrates that it is possible to increase a student's knowledge of beach ecological concepts without altering the student's preferred spiritual orientation to beach ecology. Although I believe with Snively (1990) that student's preferred orientations could be used as "bridges" to teach science concepts, the incorporation of any aspect of Inuit spirituality into a science curriculum would have to be approved by community education authority officials.

I was surprised by the graduates' in-depth perceptions of Inuit science, especially since high school science is taught predominantly from a Western perspective. A possible factor was the traditional upbringing each of them lived and continued to live during and after their school years. This contrasts greatly with the limited traditional experiences of the grade twelve students.

All the graduates stressed the importance of knowing "both ways" of "doing science." This, they claimed, would ensure they received the best understanding of science. "If the culture of science generally harmonizes with a student's everyday culture, science instruction will tend to support the student's view of the world, and the result is enculturation" (Aikenhead, 1996, p. 222). Aikenhead (1996) reports that enculturation or assimilation of students into the culture of science is one of the conventional functions of school science. Although they did not directly mention assimilation, the grade twelve students must have had it on their minds when they suggested strongly that Inuit science and Western science be kept separate. As one grade twelve student stated, "Trying to integrate

modern science with my science, I wouldn't feel comfortable integrating the two of them together. Just the idea of putting the two of them together, I don't know." Their rationale was that the students would find the integration confusing. As well, the grade twelve students suggested that keeping the two sciences separate may be one way for Inuit students to retain, and in some case regain, elements of their Inuit culture.

The disempowering effects of the assimilative nature of school science (Western science) on large groups of world peoples, including the aboriginal peoples of Canada, have been well-documented (Battiste, 1986; Ermine, 1995; Gallard, 1993; Hodson, 1993; Jegede, 1995; MacIvor, 1995, Maddock, 1981). Ideally in any cross-cultural education, students should be able to cross cultural borders from the culture of their everyday world to the subculture of their school science classroom. But as Hennessy (1993) concluded, "Crossing over from one domain of meaning to another is exceedingly hard" (p. 9).

Constructivist theorists support this approach of "bridging the differences" between students' orientations and Western scientific concepts. Central to this approach is the teacher encouraging the student to allow for the possibility of differing beliefs and values (Brooks, 1987; Cobern, 1991; Driver, 1983, 1987; Driver & Erickson, 1983; Osborne & Wittrock, 1983). Whatever strategies constructivist educators utilize to create such an opportunity for students must be modified in such a manner as to acknowledge and reflect the social and cultural qualities of the individual communities (Cruikshank, 1981; Hewson & Hewson, 1981; Beck, 1982; Wangler, 1983).

Aikenhead (1996) maintains that enculturation is enhanced when the teacher plays the role of a culture broker i.e., a person who helps students cross back and forth between

aboriginal cultures and the culture of science. Yet, the graduate who conceptualized fermentation claims it was not the teacher who enabled her to conduct such border-crossings. I believe that traditional knowledge (the experience of actually living it), not the teacher, is the culture broker which enables this graduate to move back and forth between Inuit science and Western science and technology. McNeley (1994) reviewed literature regarding attempts to make connections between traditional Navajo and Western knowledge and came to the following conclusion.

> The pattern which connects may be but need not be built into the curriculum. The pattern which connects is in the mind of each student and each individual who is guided by, and lives by, the traditional (Dine) teachings... (p. 14).

A Case for Teaching Inuit Science

This study implies a strong case for teaching Inuit science, based on my research and my own thoughts, experiences and affirmations of what I believe are the issues currently facing Inuit students in science education.

Research investigating connections between knowledge gained from science education and cultural survival have been less than promising. For example some researchers (Cross & Price, 1992; Johnson, 1992; Simonelli, 1994; and Solomon, 1994) have found no correlation between achievement in environmental education and environmentally responsible action. Other researchers (Knamiller, 1984; Layton et al., 1993; MacIvor, 1995; Swift, 1992) have all reported the knowledge, skills, and values found in the typical Western secondary school science curriculum are often isolated and irrelevant to the everyday events that affect cultural survival. Explicitly, Medvitz (1985) reports, "Science learned in school

is learned as science in school, not as science on the farm or in the health clinic or garage" (p. 15). Furnham (1992), Hennessy (1993), Layton et al. (1993), and Wynne (1991) have all reported that science learned in school can seldom be applied to enhance a student's understanding of his/her everyday world, which is often filled with science-related problems. As well, the American Association for the Advancement of Science (AAAS, 1977) reported that the primary reason for the low number of aboriginal students involved in science and science-related carriers is that school science often has little relevance to the everyday lives and cultural survival of aboriginal students.

Science is many things to different peoples. Descriptions of what constitutes science are numerous. For example, Malinowski (1954) defined science as

> a body of rules and conceptions based on experience and derived from it by logical inference, embodied in material achievements and in a fixed form of tradition and carried on by some sort of social organization (p. 54).

Based on this definition, Malinowski found many principles of traditional knowledge to be scientific. Restrictive definitions of science can only limit the scope of science taught. Aikenhead (1996) acknowledges that "if science education is going to contribute to First Nations cultural survival, students will need to learn, and eclectically use in practical everyday situations, many ways of knowing: Aboriginal common sense, Aboriginal and Western technology, and Aboriginal and Western knowledge of nature" (p. 228).

Curriculum Implications for Aboriginal Students: Constructing Bridges to Connect the Two Sciences

The students in this study perceived Inuit science as both practical and valuable knowledge. For the graduates, Inuit science is an extension of the traditional way of life they lived before, during, and after their formal schooling. For the grade twelve students, Inuit science may be one way to retain or regain eroding or lost traditional Inuit ways of thinking, believing, and valuing.

Inuit science is not new, and this should not be forgotten. Inuit science has existed as long as the Inuit themselves. After completing school, most Inuit continue to live and work in the Arctic and continue to use the resources of the air, land and water. Inuit still travel the land and water routes of their ancestors and still require survival skills.

This is not to suggest that schools abandon Western science for the sake of Inuit science. On the contrary, both sciences should be recognized for their values and the contributions they can make toward improving aspects of Inuit life. The ideal science curriculum that supports cultural survival is one in which science, technology and indigenous knowledge are integrated in such a fashion so as to allow the student to construct "situation-specific knowledge" (Layton, 1991; p. 58) for everyday science-related problems.

In her review of cross-cultural science education literature, Pomeroy (1994; quoted in Aikenhead, 1996) identified nine research agendas where attempts have been made to counteract the assimilative nature of school science: (1) science and engineering career support projects; (2) an indigenous social issues context for science content; (3) culturally sensitive instructional strategies; (4) historical non-Western role models; (5) demystifying

stereotype images of science; (6) science communication for language minorities; and (7) indigenous content for science to explain; (8) comparing and bridging students' world views and the worldview of science; and (9) exploring the content and epistemology of both Western and aboriginal knowledge of the physical world. Aikenhead (1996) claims that agendas 1-7 lead to the assimilation of students into Western science, whereas the agendas 8 and 9 may lead to enculturation.

Measures need to be taken to develop a science curriculum which avoids the assimilation and acculturation of aboriginal students into Western science. MacIvor (1995) proposes to redefine science education this way: to "transform the science curriculum from one which is essentially assimilationist to one which honours, respects, and nurtures our traditional beliefs and life-ways, and which presents science and technology in a more authentic way" (p. 90).

One curriculum implication is to develop culturally-sensitive instructional materials and strategies that (1) explicitly respect students' personally and culturally constructed ways of knowing; (2) initiate and promote community-based student research; (3) facilitate border crossings through the use of traditional talking circles; (4) teach the knowledge, skills, and values of both aboriginal and Western science and technology in the context of social and cultural qualities of individual communities.

MacIvor (1995) suggests integrating aboriginal and Western science education to ensure the survival and well being of aboriginal peoples. The students in the present study suggested that integrating the two sciences would cause confusion for them. Integrating the two sciences could also create an assimilative situation where students may feel they have

to choose one science over the other. For example, one graduate reported that he felt he had to adopt the Western perspective on science because he wanted to study medicine. Yes, he would definitely require a Western science background to study medicine, but not solely a Western perspective. As culture brokers (Stairs, 1995), teachers must avoid this situation of students feeling they have to choose one worldview over the other. Keeping the two sciences separate does not force students to choose between one and the other. Rather, it provides them the opportunity to raid the knowledge repository of each science worldview so as to increase their existing science concepts without altering their preferred orientation (Peat, 1994).

Inuit science and Western science are based on different epistemologies, and should therefore be kept separate and not integrated so as to produce a "hybrid science" of traditional aboriginal and Western world views. Inuit science and Western science should be taught in their own domains. Inuit science should not be viewed as a "viable alternative" to Western science but rather an equal discipline.

As the graduates in this study noted, many aspects of Inuit science could not and should not be taught within a school setting. Bringing culture into the school under non-Inuit control and in a non-Inuit context trivializes and devalues Inuit culture.

As seen by the community, teaching traditional cultural science may be problematic. If such is the case, then the non-aboriginal teacher can serve as a facilitator in recruiting local people to conduct the teaching from the traditional perspective.

Other cultural jurisdictions have taken different approaches to curriculum development. For example, a curriculum for Navajo students is based on Navajo thinking.

Their curriculum is developed from a Navajo approach to education, developed for and from the Navajo culture. This will increase students' chances of being successful and help them stay in school longer and learn things that will help them to be successful in and outside of their home communities (Rhodes, 1994).

The Akwesasne Mohawk Board of Education (1994) chose an alternative approach to Western math and science curriculum development. They produced a series of modules, Circles & Lines, for Mohawk students in grades 7 to 9. They integrated several school subjects (science, math, social studies and language arts) within an aboriginal framework. This approach was a shift away from a subject-matter orientation to curriculum integration to a student-centered focus.

Some researchers have also proposed alternative curriculum designs. For example, Aikenhead (1996) proposes a cross-cultural STS science curriculum, i.e., a science-technology-society curriculum. This STS curriculum is a student-centered, critical, and environmentally responsible approach to science and contextualizes Western science in the social and technological settings relevant to aboriginal students.

Conclusion

Students need a strong sense of self if they are to succeed in school. Not everyone may believe that in school the road to success begins with the teacher and his/her relationship with the student, but the nature of the relationship often determines the degree of student success. A relationship built on fundamental, mutual respect is critical. For the science teacher, this means respecting Inuit students' worldview and life experiences as they pertain

to traditional knowledge (indigenous knowledge, ethnoscience). To broaden students' concepts of science, the teacher must be willing to enter the world of the students. That means beginning with the knowledge and experience the students bring to the science classroom.

I believe the bridge that connects Inuit science to Western science is one built on respect. If the science teacher asks an Inuit elder to explain to the students the anatomy of a seal and the function of its organs from an Inuit perspective, this helps reinforce the students' traditions and teachings. If the science teacher also has the students investigate another cultural perspective on seals, for example, using biological interpretations of anatomy and organ functions, the students then learn both science perspectives, and at the same time validate their own Inuit culture.

As educators schooled in Western culture, we seem to be preoccupied with our role as culture brokers in creating bridges or links for our Inuit students between the two sciences. Perhaps it is time we stop building bridges and focus our energy on providing Inuit students the tools, i.e., traditional knowledge and experience, to create their own bridges, from their own perspective. Our contribution to the building of those bridges would be the pillars--respect.

PART II: SUPPORTING DOCUMENTATION

APPENDIX A

A Review of Related Literature

Introduction

The purpose of this section is to review how teachers and curriculum developers have attempted to improve science education for aboriginal students. These attempts arise from the recognition that valid and relevant science knowledge exists within both aboriginal and Western cultures. However, cultural epistemological differences may lead to a process of acculturation, assimilation or enculturation for many aboriginal students. Therefore this review of literature related to the study is divided into four categories:

1. Science Education for Aboriginal Students
2. Relationships between Home and School Cultures
3. Inuit Epistemology
4. Building Cultural Bridges

Science Education for Aboriginal Students

Improving Science Curriculum and Instruction

North American aboriginal peoples are under-represented in science and technology careers (Matthews & Smith, 1991; Nelson-Barber & Estrin, 1995). First Nation educators, such as Madeline MacIvor (1995), want First Nation students to learn Western science, but not at the expense of being assimilated into Western culture. Commenting on the state of science education for Canadian aboriginal peoples, MacIvor (1995) reports that

> Information regarding the state of science education for our peoples suggests that little is being done. While some schools incorporate Aboriginal content and even Aboriginal languages in the science curriculum, this is atypical. At the secondary level, science education is characterized by low enrollment and achievement levels among our students. This limits the number of our young

> people who can gain entry into post-secondary science, technology, and health-related programs. Not surprisingly, Aboriginal people are very under-represented in science, technology, and health-related programs and professions. (p. 74)

In the literature, conflict of cultures is often given as the fundamental reason for lack of success by aboriginal and other minority students in science. Haukoos (1986) believes that the "origin of such low representation derives from a variety of intermediate sources yet culture is fundamental to them all" (p. 194). Underlying the position of universalism (i.e., one science applicable to all cultures) is the assumption that the culture of the dominant society is superior.

Wangler (1983) is blunt about the contrasting perspectives of Western scientific and traditional aboriginal thought on nature and man: "The world view of Western scientific cultures is predicated upon the Aristotelian notion that there is an absolute and necessary distinction between man and nature; between the subjective and the objective; between the knower and the known" (p. 46). He reminds us that Western scientific thinkers such as Sigmund Freud, John Dewey and Julian Huxley firmly believe that Western scientific thought is the "only way of knowing" (p. 48). This presumption demonstrates the hegemonic, assimilating influence of Western science. By contrast, Wangler uses Carlos Castaneda's Don Juan's worldview to suggest that "we move toward much greater tolerance if not downright acceptance of other ways of knowing or being" (Wangler, 1983, p. 50). Cajete (1986) reports that "in many cases because they have a different worldview, the Indian student has a great deal of difficulty relating to the very technical Western approach to science" (p. 3).

Deloria (1986) believes that these cultural differences carry over from formal schooling to university:

> One of the most painful experiences for American Indian students is to come into conflict with the teachings of science which purport to explain phenomena already explained by tribal knowledge and tradition. The assumption of the Western educational system is that the information dispensed by colleges is always correct and the beliefs or teachings of the tribe are always wrong. (p. 3)

Aikenhead (1996) claims that the two main goals of school science in Canada have been the transmission of Western science and the transmission of the dominant Euro-Canadian culture by means of enculturation or assimilation. Students have devised ways to resist teachers' efforts to enculturate or assimilate them. One such method is like a game which has explicit rules. Larson (1995) refers to these rules as Fatima's rules, named after an articulate high school chemistry student. Fatima's rules tells the student how to pass school science courses without understanding the subject matter in a meaningful way, the way the teacher assumes the student will understand it. For example, the student memorizes only the boldface words or phrases in a textbook without reading the textbook. As a result, the student does not connect science concepts to his/her everyday thinking. With regard to school science, Latour (1987) states that "most schooling is based on the ability to answer questions unrelated to any context outside of the school room" (p. 197).

An ideal situation for aboriginal students is to understand scientific ways of knowing without sacrificing their individual and cultural ways of constructing knowledge (MacIvor, 1995; O'Loughlin,1992; Snively, 1990). This requires the integration of aboriginal science and Western science and necessitates students' crossing cultural borders. Wolcott (1991)

suggests that, for aboriginal students, learning science involves culture acquisition and, therefore, crossing culture borders. Aikenhead (1996) maintains that the ease with which students cross cultural borders determines the degree of success they achieve in understanding Western scientific ways of knowing without sacrificing their individual and cultural ways of knowing. These border-crossings, however, tend to be difficult for most aboriginal students because science instruction may disrupt their worldview by forcing them to abandon or marginalize their traditional way of knowing and replace it with a new, Western way, of knowing; the result is assimilation (Aikenhead, 1996). Therefore, in an attempt to resist this assimilation, Aikenhead (1996) suggests developing curriculum and instruction that

1. make border crossings explicit for students
2. facilitate these border crossings
3. validate students' personally and culturally constructed ways of knowing about nature
4. teache the knowledge, skills, and values of Western science and technology in the context of societal roles (for example, social, political, military, economic, and ethical roles) (p. 68)

Believing that Western science cannot be taught successfully through enculturation and assimilation, Aikenhead (1996) proposes an alternative cross-cultural science and technology curriculum. Autonomous acculturation and anthropological instruction could achieve this alternative to the conventional Western science curriculum. Aikenhead (1996) defines autonomous acculturation as "a process of intercultural borrowing or adaptation in which one borrows or adapts attractive content from another culture and incorporates (assimilates) it into one's indigenous culture" (p. 69) . Anthropological instruction teaches

the student to treat Western science as a repository to be raided in order to make sense of Western scientific concepts (ibid.).

Other reasons given for the lack of success by aboriginal students in science focus on appropriate teaching strategies and preferred learning styles. It is important to note that no single definitive learning style exists for aboriginal students. Rather, "aboriginal students may tend to utilize certain learning styles" (MacIvor, 1995, p. 79). For example, northern educators are often encouraged to utilize cooperative learning or group problem solving. Swisher and Deyhle (1992) suggest that there is evidence that aboriginal students learn better from a cooperative learning approach and setting than in conventional competitive school classrooms. Garcia and Ahler (1992) claim that cooperative learning is an effective teaching strategy for Native American students because it is culturally compatible and may even help achieve cultural continuity. Hoffman (1992) reports similar results for Native American students using small-group problem-solving activities. Other researchers have suggested that using cooperative learning groups in science improves both science and language learning (Hirst & Slavik, 1989).

Another teaching strategy used successfully with aboriginal students is active, experiential, hands-on learning. Inuit students have repeatedly suggested to me that the best way to learn science is to "do" science. Gilliland suggests that "most Native American children learn much more readily when instruction is multisensory, relevant and active . . . and they have the memory of concrete experience to which they can tie the principle" (1992a, p. 59). Another strategy is teaching science by integrating it with other subjects, not teaching it in isolation, as this approach may be more appropriate than the conventional Western

discipline-based approach to the way knowledge is organized by aboriginal cultures (Ovando, 1992). For example, others (Gilliland, 1992b; Hirst & Slavik, 1989; Ovando, 1992) have endorsed the teaching of language through science activities.

Relationships between Home and School Cultures

Many theories have been suggested over the years to account for the under-representation of aboriginal peoples in the sciences. One such explanation was a cultural-difference hypothesis of the late 1960's and early 1970's that attributed the low academic achievement of minority students to differences between the students' home learning methods and environments and those of the dominant school culture. Dumont (1972) described the gap between home and school culture for Sioux students this way:

> Inevitably, the days were long periods of desk work, teacher monologues, or lectures and rhetorical questions ... these same children were amazingly different outside the classroom: they were noisy, bold, daring and curious. (p. 346)

Research suggests that school and home cultures are often not compatible and in fact are often in conflict with one another (Philips, 1972). At the same time, if teachers help in "bridging the gap" between the school and home culture, ethnic minority students could improve academically.

The nature of these cultural differences can be seen clearly in this description of the situation faced by Alaskan Aboriginal Educators

> The native student who aspires to success is forced with the difficult and often dissonant task of marching to more than one drum. The dilemma of not rejecting one's own rich, cultural heritage while preparing to be successful in a context which at best ignores or at worst contradicts such a heritage along with its inherent values and ethics is not a simple one. It is little wonder

> that the native and non-native student (or teacher) finds it difficult to recognize, least of all appreciate, each other's orientation, efforts, purpose and values (S.W. Johnson and Suetopka-Duerre,1984, p. 49) .

Culturally relevant educational programs or curricula could make the difference between success and failure for ethnic minority students. By creating a bridge between the school culture and the home culture, the discrepancies between the two are minimized (Ovando, 1992). In fact, Williamson (1994) suggests that a science curriculum for aboriginal students must be based on their experiences. Such was the thinking of Paul Robinson, NWT's first Chief of Curriculum Services (1969-74) (Department of Education, GNWT, 1991). In fact, the NWT department of education has adopted the philosophy of culture-based schooling (Department of Education, Culture and Employment, GNWT, 1991) .

This approach implies that decisions about educational activities are directed and driven by local individuals and groups who represent the culture. The philosophy of culture-based schooling brings about an awareness of the uniqueness of the aboriginal students' cultural and environmental backgrounds by basing instructional programs in aboriginal culture as opposed to including aboriginal culture simply as content. Culture-based schooling also recognizes and promotes the value of students' cultures and creates pride in them by providing not only more meaningful experiences for students, but also enhancing their self esteem and providing them with greater opportunities for success.

On a cautionary note, meaningful experiences for aboriginal students can occur only "if native culture is treated not as a subject matter but as the basis of pedagogy itself" (Leavitt, 1991, p. 266). As Leavitt (1991) points out, integrating elements of aboriginal traditional skills, related knowledge and beliefs into an existing non-aboriginal curriculum

may appear to give validity to aboriginal culture but in fact may cause more harm than good by segmenting aboriginal life in non-aboriginal ways.

As shown in a study by Lipka (1989), incorporating community concerns into the school curriculum serves to illustrate how formal schooling can become a supportive resource for an aboriginal community. In this particular case, non-aboriginal educators appear neither to be teaching the community its own culture nor to be repeating the usual dominant-subordinate relationship pattern (Lipka, 1989).

At the risk of oversimplifying, there are two schools of thought when it comes to aboriginal and non-aboriginal world-views. One opts to integrate aboriginal cultural knowledge into course process and content. The other keeps the two cultural domains separate, with curriculum content and classroom practice representing each culture equally. This bicultural schooling or "two-way schooling" is required, some maintain, to ensure the long-term survival of a minority culture (Harris, 1988).

I recall several of my colleagues informing me, upon my arrival in the north many years ago, that teaching Inuit children was no different from teaching non-Inuit children. I was told that the difference lay only in the content taught to each group. In fact, differing scientific world-views do not have to mean mutually exclusive approaches to formal science lessons. As educators, however, we must attempt to understand the world as our students understand it. Only then can we begin to appreciate and respect cultural and environmental differences.

Learning science through the scientific processes is not exclusive to Western science. In fact, people from all cultures, regardless of their scientific sophistication, have used

scientific processes in distinctive cultural forms to develop technologies enabling them to survive. For thousands of years, these scientific processes have been reflected in aboriginal agriculture, medical practices, astronomy, art, ecological practices, and hunting (Cajete, 1986).

Regardless of the culture, all children bring to school a base for scientific knowledge, skills and experiences. Often this base can be related to the schools' existing curriculum. For example, aboriginal knowledge and experiences of "country" or traditional versus Western food can be applied to health and nutrition; conservation practices can be applied to the study of ecology.

What varies across cultures is how people perceive the environment, how they classify it, and how they think about it (Cole & Scribner, 1974). Western science has acknowledged and accepted the emergence of "Ethnoscience" as offering alternative ways of viewing and explaining our world (Burton, 1993; Cajete, 1986; Deloria, 1992). The inclusion of traditional knowledge, values and beliefs into mainstream science is long overdue. However, Deloria, (1992) has expressed his concern regarding any Western science framework which attempts to interpret and understand traditional knowledge and asserts that Western science is not responsible for "validating" current findings or beliefs of ethnoscience science. Cajete (1986) defines ethnoscience, within the context of Native American culture, as

> the methods, thought processes, mind sets, values, concepts, and experiences by which North American groups understand, reflect, and obtain empirical knowledge about the natural world. (p. 1)

In the school science setting, both aboriginal and non-aboriginal students and teachers have something to contribute to and learn from each other. For example, curricula and teaching methodologies should reflect all the students' world views and recognize an aboriginal conceptualization of an independent universe. As well, the aboriginal community can adapt practices or concepts from the non-aboriginal school curriculum, which may have relevance to solving some of their community problems. Scribner and Cole (1973) note that

> Changes in textbooks, curricula, and teaching techniques are all needed and important, but they cannot be counted on to bridge the gulf between school and practical life by themselves. A two-way movement is necessary here. The first, which is already under way in some experimental schools, is to move everyday life into the school so that subject matter and activities deal with some of the same aspects of social and physical reality that the pupils confront outside of school.
>
> The second has been little attempted. The techniques of the modern school need to be introduced into the context of recognized practical problems. Education must be stripped from the classroom and made instrumental in traditional settings. (p. 558)

Perhaps part of the problem of having the aboriginal community adapt non-aboriginal practices or concepts taught in the school is the fact that local people, including elders, may not have been asked into the classroom to speak on topics about which they have intimate knowledge. Perhaps aboriginal traditional knowledge, beliefs and skills have not been acknowledged and respected by the school or scientists. Take for example, the case of the missing caribou in the eastern Arctic. The Kaminuriak herd of caribou is the easternmost of the four great herds of barren-ground caribou on the NWT mainland. In the late 1970's, biologists thought the herd was on the verge of extinction. They reported that this was due to improved hunting techniques by the Inuit, which had led to an over-harvesting of the

caribou. But Inuit elders knew differently. Finally, one of the scientists decided that maybe they should ask the elders their opinion. When they looked where the elders told them to look, guess what they found! Approximately 300,000 barren-ground caribou which had mysteriously reappeared! The Inuit knew all along that the caribou herd had changed its migratory route just as anecdotal records had suggested. The same sort of story is true of recent polar bear surveys. Biologists reported a very low number of polar bears on the east coast of Baffin Island. This conclusion was inconsistent with the experience of local hunters, who maintained that there were far more bears than the scientists' survey suggested. In Igloolik, NWT, many Inuit elders insist that polar bear quotas imposed by the Department of Natural Resources are quite unnecessary. The reason, they claim, is that bears are killed only when they want to give themselves to the hunter. Bears, when reluctantly pursued, can transform themselves into blocks of snow or ice, or even owls, and so elude capture. Biologists doubting this are considered by Inuit elders as knowing very little about polar bears (personal communication, B. Rose and B. Rigby, 1996).

A number of researchers have focused their research on differing student / teacher world-views and their compatibility with modern Western (science) education (Cobern, 1991, 1993, 1994; Glasser, 1991; Jegede, 1993; Ogbu, 1992; Waldrip & Taylor, 1994; Yager, 1993). Cobern (1994) best summarizes the role of culture in science education by stating that "science education is successful only to the extent that science can find a niche in the cognitive and socio-cultural milieu of students." Yager (1993) believes that science and culture are inseparably linked, in that science has always existed within a cultural context. In Africa for example, one of the reasons why school science has remained foreign

to most children is that educators often fail to realize and acknowledge the actual science and technology local people have been doing for centuries, the knowledge and skills local people feel are relevant to them (Knamiller, 1989).

In fact, there are few reports which actually demonstrate the integration of science and culture in local curricula (Haukoos, 1991). Snively (1990) has shown that by adapting teaching materials and strategies to tap into students' interrelated (traditional) beliefs and values teachers can help students gain greater understanding of Western science concepts without altering the students' preferred orientation. (Orientation is the tendency of an individual to understand and experience the world through a particular framework, embodying a coherent set of beliefs and values. [Snively, 1990, p. 44]). Current constructivist curricula support this approach because they focus on creating an opportunity for students to identify and articulate the differences between their own orientations and those of Western science. Central to this approach is the teacher's encouraging the student to allow for the possibility of differing beliefs and values (Brooks, 1987; Driver, 1983, 1987; Driver & Erickson, 1983; Osborne & Wittrock, 1983). The strategies constructivist educators utilize to create such an opportunity for students must be modified in such a manner as to acknowledge and reflect the social and cultural qualities of the individuals (Cruikshank, 1981; Hewson & Hewson, 1981; Beck, 1982; Wangler, 1983).

It is interesting to note that St. Mary's, a successful Alaskan boarding school, had no special curriculum for aboriginal students (Kleinfeld, 1979). The close relationship between the students and staff, as well as the teachers' emphasis on character development, seemed to account for student success. This suggests that a culturally relevant and compatible science

curriculum which has been carefully adapted to reflect home experiences may not be effective unless teachers are genuinely committed to the academic and personal growth of their students.

Building Cultural Bridges: Connections to Aboriginal Science

The literature suggests that connections can be made between Western science and aboriginal science in the following ways.

1. Include the contributions made by native people worldwide. Native cultures, worldwide, have developed knowledge, which has enabled them to survive for millennia (Carrasco, quoted in Williamson, 1994). Other researchers advocate the teaching of science principles and concepts by utilizing local cultural examples, knowledge and experiences (Cajete, 1994; Gilliland, 1992b; Ovando, 1992).

2. Examine science from a broad perspective so as to include aboriginal ways of knowing the world. Aboriginal students' understanding of science can be enhanced if they are made aware of the differences between Western science and aboriginal science. Simonelli explains the difference this way:

> Indian science, or "indigenous science " as it is sometimes called, is "full-spectrum science" which draws freely on all four of the gifts that have been given us as human beings: the spiritual, emotional, mental, and physical. By contrast, Western science dwells mostly on the physical and mental, often rejecting the spiritual and feeling or emotional qualities of life with great arrogance and finality (1994, p. 37).

Students should have the opportunity to explore phenomena from a Western science perspective as well as an indigenous perspective. If a coexistence is possible, it must not be at the expense of violating or denigrating traditional cultural values. Mutual respect and understanding of teacher and student cultures seems obvious but yet rare in practice. Nowhere is this more evident than in schools. Science education in elementary and secondary schools is often presented from a white, male perspective. Women, visible minorities and non-Western cultures are generally not portrayed as being involved in science (Murfin, 1994).

3. The focus of aboriginal science education should be on the study of environmental science themes i.e., ecological concepts and how these themes can help relate Western science to aboriginal environmental knowledge and its relationship to the earth. Cajete (1994) refers to the special relationship Native Americans have historically had to the land. This relationship is exemplified in scientific knowledge, spiritual beliefs, and traditions. Many aboriginal cultures are rich with legends, myths and other stories and these may provide an entry into the study of science (Gilliland, 1992b). In fact, Cajete (1994) challenges students to create new legends and myths to connect newly acquired scientific knowledge with traditional knowledge.

A few researchers have noted the importance of being aware of local cultural taboos. These should be addressed during orientations for new teachers (Allen & Seumptewa, 1993). Alcoze (quoted in Greer, 1992) also cautions teachers avoiding the use of scientific

experiments involving local cultural taboos. It is extremely important that students not be forced to conduct or participate in scientific experiments, which go against cultural beliefs and opinions.

Connecting science education to aboriginal science often provides students with the benefit of connecting new learning to prior knowledge and experience. But even more than that, by connecting science education to aboriginal science shows students that science is not just a "white-man's thing" (Greer, 1992).

> It is important that Indian students understand what science is and learn to appreciate how science affects their daily lives. By doing so, Indian students can see that science is something that is useful to them and not something which only relates to non-Indian culture (ORBIS Associates, n.d., p. 2)

Inuit Epistemology

Inuit Values about Learning

Inuit today are attempting to revive past values and beliefs that have helped to sustain their survival for thousands of years. These attempts are mainly channeled through the current educational system in the north. There is a recognized need to create an educational link between the past and the present. Anawak (1989) claims that "we as Inuit are taught that all things stem from and continue to be tied to the past, and that it must continue to be respected and preserved" (p. 45). Unfortunately, in some places in the north this link has been broken. For this reason, elders, parents and dedicated educators continue to work hard to incorporate key elements of past traditions into school curricula.

This has been done in an attempt to help Inuit students to develop a strong sense of self, of who they are. Inuit children in the past, received mainly home schooling. They were

taught through an oral history in the form of stories, legends and songs encompassing knowledge and skills to ensure their survival. They were also taught by example and observation, beginning at a very young age. Multi-sensory learning was encouraged in an attempt to show that learning involved the whole body and not just parts of it. Tasks were often repeated, incorporated into play, and practiced in order to provide a sense of accomplishment and pride. Inuit children learned tasks that were meaningful to their lifestyle, environment and ultimately survival. As Anawak (1989) notes, Inuit "children quickly come to understand in my culture that time-honoured skills and attitudes can never be relegated solely to the past; that they ensure a way of life and survival in the present and for the future" (p. 46). Inuit believe their children need to relate their learning to their family and environment. Children also learn by "relating to others and by hearing positive stories about their namesakes and family" (Inuuqatigiit Committee, p. 10). Anawak (1989) details the importance of a namesake.

> From the earliest possible time an Inuit child is given an Inuktitut name by which he or she will be known. This name is bestowed and 'twins' him or her with someone else much older, who may be living or deceased, and who is of importance to the child's family or group and was also known by that name. This name may have come to the child's parents or close relative in a dream or a penetrating thought. In any event the child is thenceforth dealt with by all as bearing that name. All members of the family and extended group then respond to the child according to the relationship they had with the previous bearers of that name. (p. 45)

Learning and evaluation occurred simultaneously. Immediate and positive feedback in the form of praise and encouragement were essential elements. Children were also shown or told how to improve their work or task, encouraged to persist and practice towards achieving excellence. Self-evaluation was encouraged.

Inuit Epistemology

Bielawski (1990) has conducted extensive northern research dealing with Inuit epistemology. His evidence for Inuit epistemology is drawn from a series of interviews with Inuit elders in 1985. I have summarized his findings in the table below.

According to one interviewee:

1. There are 4 ways of knowing:
   - i. hearing it (e.g., knowing about dangerous ice and snow conditions because she had heard about it)
   - ii. seeing it (e.g., knowing the toxicity of kidney fat because she saw a man die from eating it)
   - iii. learning by direct instruction "he used to teach me" (e.g., I was told to do something in order to learn or I was taught)
   - iv. learning by actually "doing it" (e.g., hunting)

Another interviewee talked of:

1. The application of knowledge overheard (e.g., a young boy overhears a female elder talking about childbirth to a group of young women; years later, the man uses this overheard knowledge to help deliver his own son)
2. Learning today (e.g., "Young people can learn about them (algae) by seeing them as well as what they're called. I tell young people about those but I never show them. They should be shown the real things so that they may learn better. They're not going to learn anything if we don't show them. They will probably be more curious than learn if we try to tell them orally" (p. 63).

Bielawski concludes that "in Inuit knowledge, there is a difference between direct instruction and stories told to carry knowledge" (p. 63), and "how Inuit know what they know is more often expressed through what they do than in any description of it" (p. 63).

Contrasting Inuit Knowledge (Indigenous Knowledge) and Western Science

Ogawa (1995) argues that the western value system perpetuates the notion of the inseparability between the theoretical world of western science and its application to real

world issues. He proposes that separation of the western science worldview from its applicability to the real world is necessary to allow for a broader definition of science. In fact, Ogawa (1995) identifies and distinguishes three types of science:

(1) indigenous science

- is the science of a specific cultural group, not of a specific individual
- may be of a nature that individuals of a culture may neither recognize its existence nor be aware of being governed by it tacitly
- might be tacitly transferred from generation to generation through daily social and cultural events
- is only collectively lived in and collectively experienced by the people of that culture

(2) personal science

- is a rational perceiving of reality, which is unique to each individual
- is science at the personal level

(3) western modern science

- is a collective rational perceiving of reality, which is shared and authorized by the scientific community
- is justified only by the scientific community itself
- all other institutions are expected to accept it without objections or doubts

On the other hand, Bielawski (1990) believes that indigenous knowledge must be contrasted with Western science for the purpose of its validation. Specifically, Bielawski has contrasted Inuit knowledge with Western science, as it is practiced in the north. I would

suggest the manner in which science is taught in our northern high schools is not significantly different from Bielawski's description of science as it is practiced.

Bielawski describes Inuit knowledge as being consensual, replicable, incorporating, and to some extent experimental and predictive. He also contends there are only four clearly discrete distinctions between Inuit knowledge and Western science:

1. the lack of the concept of controlling conditions for experiment
2. increasingly accurate measurement of space and time
3. Inuit knowledge not effectively intercultural
4. little description of or activity about unexplained phenomena, beyond the necessity of daily life

He contends that other distinctions between Inuit knowledge and science, while real, are distinctions of scale and time (p. 64).

Bielawski notes the basic premise of Inuit knowledge that "human activity is a part of nature and not separate from it" has had detrimental social and environmental consequences for the Inuit (p. 64).

Historically, Bielawski likens Inuit knowledge to Borofsky's (1987) description of Pukapukan knowledge: "People learn about canoe building while building canoes. They learn the names of places by going to those places. Little need exists for moving cognitive skills applicable to a broad array of contexts" (p. 128). The Inuit, much like the Pukapukans, "lack experience in stepping outside their normal everyday contexts. They appeal to concrete examples and particular circumstances...in making decisions and resolving problems" (p. 129). Today with the creation of the new territory of Nunavut, Inuit experiences are changing

at a rapid pace. This will necessitate Inuit knowledge to expand beyond local and regional levels. These changes will affect the way in which science is taught and practiced in the north. Bielawski contends that this will be accomplished through cultural readaptation. "Cultural readaptation will be expressed in how Inuit shape the process I call research (for want of an appropriate term that describes what Inuit research might become) using the framework of their indigenous knowledge" (p. 65).

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APPENDIX B

The Field Study: Research Procedures

Background

A radically different paradigm for conducting research in the Northwest Territories (NWT) is the result of years of inappropriate, unacceptable and degrading research about Canada's northern aboriginal peoples (pers. comm., B. Rigby, 1996). Central to this new research paradigm is the NWT Scientists Act, which ensures community control over research processes based on the principle of self-determination. The Nunavut Research Institute administers the Scientists Act within Nunavut. Research licensing and research protocol is a collaborative partnership involving northern communities, land claim organizations, federal and territorial government agencies and researchers.

A review of recent literature reveals growing concern for appropriate methods and practices in aboriginal educational research. McTaggart, 1989 (in Williams & Stewart, 1992) reports that participatory action research is an appropriate and powerful methodology in aboriginal educational research. Yet a dearth of information exists about concrete, culturally appropriate research methods in aboriginal education. It may be that indigenous knowledge systems have been ignored by researchers in part because they do not have a formal methodology for collecting, assessing, and using these types of a knowledge.

Researchers in the north must be aware that they may be asked to modify their original proposed research design so that it is culturally appropriate and acceptable to the community (Chrisjohn, Towson, & Peters, 1988; Stevenson, 1996). For example, Inuit partners of the research licensing agencies may feel that questionnaires are an invasive

and insensitive strategy for documenting Inuit traditional knowledge. Historically, Inuit have been aware of research methodologies which resulted in traditional Inuit knowledge being taken out of context, reduced to unrelated bits of information and devalued. Stevenson (1996) suggests that Northern researchers should avoid asking too many questions, as this is considered by many Inuit to be disrespectful and therefore an inappropriate strategy for gaining information about Inuit traditional knowledge. Stevenson also suggests that during the data collection phase, the researcher assume a passive, listener's role as a sign of respect. As well, he reports (1996) that Inuit request that their shared traditional knowledge and information be interpreted and presented from balanced Western and Inuit perspectives.

In other jurisdictions, the National Aboriginal Education Policy (1985) of Australia also advocates the construction and implementation of appropriate research methodologies in aboriginal education. This position was adopted in a direct attempt to secure self-determination for Australian aboriginal peoples. "Emphasis should be placed on action-oriented research and on research relevant to the needs of Aboriginal people as defined by Aboriginal people" (p. 5).

With this background information in mind, the present qualitative study was designed to describe a group of Inuit students' perceptions of connections between their school science experiences and culture. This qualitative study reflects a balance of emic (Inuit culture as seen from the inside) and etic (an outsider's, non-Inuit, point of view) perspectives. A strong emic dimension of this study is the use of a modified Talking Circle as a data collection strategy.

Pilot Study

A pilot study was conducted with three grade twelve students from an eastern Arctic high school in late June 1997, at the end of the school year. The purpose of the pilot study was six-fold: to test the very nature of the interview questions, i.e., did the interview questions elicit responses on the issues of concern; to observe participant interactions; to test my efficiency in note-taking and interviewing techniques; to test the length of the interviews; and to test audio-recording instruments. Because this was a cross-cultural study, I wanted to test the efficiency of focus group interviews and the use of dialogue journals.

As the students were already writing school exams and preparing for departmental exams as well as graduation ceremonies, I found it very difficult to recruit pilot study participants. Of the three pilot study participants, one dropped out because of a disagreement with another participant over a response provided to an interview question. This was the very thing I had hoped to avoid if at all possible. As well, dialogue journals were not well received. I found the interview questions to be too structured and closed-ended. In addition to the poor timing of the pilot study, the strategies were counter-productive. Consequently, a second pilot study was organized over the next four months and conducted in early November 1997. Because major changes were made to the research design and methodology, the results of the first pilot study were set aside and not used in the later analysis.

Revision

Over the summer and early fall of 1997, the research design and methodology were completely revised. A modified Talking Circle as used by First Nation peoples was adopted to ensure each of the research participants' voices were heard.

While formulating a compatible cross-cultural research design, I envisioned a series of four concentric circles. Each circle corresponded to an open-ended invitation for each research participant to share his or her thoughts and experiences. For example, the outermost circle corresponded with the first invitation for research participants to introduce themselves, to talk about themselves in terms of where they grew up, how and what they learned within their family setting prior to attending school. The next circle corresponded to an invitation to share school experiences followed by school science experiences. The third circle corresponded to an invitation to consider the extent to which their culture was reflected in school science classes. The center of the circle represented each participant's perceptions of connections between school science experiences and Inuit culture.

The idea of using the Talking Circle appealed to me for the following reasons.

1. I wanted to keep my talking to a minimum and my listening to a maximum.
2. Each participant's voice would be recognized in a non-threatening, non-intimidating manner.
3. The Talking Circle seemed to be culturally appropriate and acceptable.

The study utilizing the revised methodology proved to be successful and the results were incorporated into the analysis.

The research design for this study describes the participants and setting, research strategies, data analysis, and research concerns.

Participants and Setting

I obtained a research licence from the Nunavut Research Institute (Licence #0103096N-M) which enabled me to conduct my study. The study was conducted in an Inuit community in the Nunavut Settlement Area. Participants were selected from a group of students who indicated an interest in science and culture. This selection resulted in a homogeneous group of participants with respect to level of interest (Kreuger, 1989; Lederman, 1990; Patton, 1989).

The group of participants was next divided into one group of recent school graduates and one group of grade twelve students. From each of the subgroups four students were randomly chosen. Coincidentally, the number of males equaled the number of females in each of the two groups.

Research Strategies

Initially, I had proposed to use focus group interviews as a data collection strategy. This research strategy was pilot-tested and found to be inappropriate for reasons which can best be explained by contrasting it with the Talking Circle.

In a Talking Circle (see Appendix C), no one person is considered "the leader" whereas the researcher in a focus group interview is often considered "the leader." The

notion of a leader is dispelled in a Talking Circle by virtue of its very design--a circle. In a circle, there is no sense of hierarchy: everyone is equidistant from the middle. The notion of there being a leader in focus group interviews is often established by the seating arrangement. Most times, the researcher faces the participants, implying a superior-subordinate relationship.

Silence in a Talking Circle is not an uncomfortable state but rather denotes a time of reflection. Silence in a focus group interview is often regarded as awkward, an empty space to be filled quickly with words. Listening skills need to be practiced consciously in focus groups, whereas in Talking Circle, listening occurs naturally as a result of the group structure.

As every participant in the Talking Circle listens respectfully, energy flows from speaker to speaker, creating, as Graveline (1996) says

> an opportunity for a different kind of focusing and a different type of awareness about the relationship to self, to one another and to the whole. We experience having more authority when we sit in circle, compared to when the energy is focused on one person at the front, the expert, the authority, the one who is imparting to us knowledge -- what we need to know" (pp. 171-172).

The Talking Circle promotes interconnectedness among participants. The multiple interactions within a focus group often interrupt the flow of energy and conversation, ultimately disrupting any interconnectedness among participants.

The Talking Circle promotes a sense of calm and relaxation among participants. In focus groups, the researcher consciously has to be alert so as to avoid distractions or anxieties, which may adversely affect his or her ability to concentrate on the group.

In addition to contrasting Talking Circle and focus group interviews, I reflected back to the beluga whale experience (see pages 1-3) and realized that the students had arranged themselves in a circle around the whale and the hunter. I was also reminded of Stevenson's (1996) suggestion that the researcher assume a passive, listener's role, but this is not to say the researcher cannot be involved in limited dialogue with the participants. This was easily accommodated within a Talking Circle, whereas in a focus group it is the researcher's responsibility to keep the conversation going.

The Talking Circle in This Study

The Talking Circle sessions for one group of participants took place in my home. This was the choice of this particular group of participants as they preferred a quiet but warm and inviting setting for the sessions. The participants and I sat at a table with a fire burning in the background. Everyone appeared relaxed and attentive and showed interest in the discussions.

The Talking Circle sessions for another group of participants took place around a table with chairs in a quiet school facility. This was their choice of meeting place. It is important to help make the participants feel comfortable in a familiar setting (Kirby & McKenna, 1989; Powney & Watts, 1987).

As communities in the eastern Arctic are small in both size and population in comparison to communities in southern Canada, everyone knows one another. All of the participants knew me directly or indirectly because I have lived in the eastern Arctic continuously since 1982.

I conducted two Talking Circle sessions for each group. The Talking Circles were semi-structured in nature, with a brief introduction to ensure the main issues were addressed. On occasion I repeated or rephrased questions in order to clarify meaning for students (see Appendix C for a description of the Talking Circle protocol). The format allowed me to gain access to participants' thoughts and experiences as expressed in their own voices. This format also provided the participants the opportunity to make additional comments beyond their original responses (Patton, 1987). Each Talking Circle was a reflective exercise of which all participants spoke positively.

Each Talking Circle session was audio recorded. I also made written notes as suggested by Hopkin (1985), Krueger (1989), and Patton (1987), so as to avoid missing any relevant information such as body language, which is commonly used among Inuit.

At the beginning of each of the first Talking Circle sessions, I introduced myself formally to the participants. I then provided them with the background and ground rules for the study so that the participants felt at ease sharing their thoughts, opinions and experiences. They were then invited to share their thoughts and their school and out-of-school experiences.

I then informed the participants their participation was voluntary and they could withdraw from the study at any time without any questions being asked and without repercussions of any type. Verbal permission to participate and proceed with the session was then asked of each participant.

The Talking Circle sessions were structured in the following manner: the first round of the Talking Circle focused on participants' memories of growing up, how and

what they learned in family settings prior to attending school. This round of the Talking Circle involved two strategies: the historical interview and the interview about instances (Osborne and Gilbert, 1980b). Historical interviews began with each participant's memories of growing up as well as any experiences associated with growing up. Participants were encouraged to recall and relate learning experiences in general.

The second and third rounds of the first Talking Circle session explored participants' school experiences and school science experiences respectively. Some of the participants talked about Inuit science and Western science when discussing school science experiences. I took this opportunity to ask them to elaborate more fully on Inuit and Western (Qallunaat) science.

The first round of the second Talking Circle session focused on participants' perceptions of the extent to which Inuit culture is reflected in their school science classes.

The second round of the second Talking Circle session focused on participants' perceptions of connections between Inuit culture and science. In this session I wanted to know whether Inuit students understood that culture and science were interrelated.

Data Analysis

"Analysis of any kind involves a way of thinking. It refers to the systematic examination of something to determine its parts, the relationship among parts, and their relationship to the whole." (Spradley, 1979, p. 92) As this research and analysis involves culture, Geertz (1973, p. 20) puts it succinctly when he says that "cultural analysis is guessing at meanings, assessing the guesses, and drawing explanatory conclusions from

the better guesses, not discovering the Continent of Meaning and mapping out its bodiless landscape."

This qualitative study of Inuit students' perceptions of connections between their culture and science is a series of vignettes of thoughts and experiences. Therefore, a thematic analysis of the data is appropriate. The themes which emerged from the analysis provided structure for writing (Eisner, 1991).

The Talking Circles were audio-recorded and transcribed for analysis. Upon completion of the Talking Circles, I reviewed and re-examined the data. Findings were shared with each participant for their reactions and feedback.

During the initial analysis, I read through the data carefully in the order of the invitations for participants to share individual thoughts and experiences. During this process, categories were identified and coded. Reflective thinking about the initial analysis, and discussion with my thesis supervisor resulted in my rethinking the initial data analysis. The second analysis resulted in different labels for the coded categories, the integration of three codes into one and the emergence of new categories.

The analysis continued until themes describing patterns and relationships among the categories emerged.

Research Concerns

There are four areas of concern relevant to my study. These are validity, generalizability, subjectivity and ethical considerations.

Validity

I need to ensure that what I describe is as representative as possible of what is occurring. I therefore have used two strategies to check the validity of this study: triangulation method and member checking.

To ensure that my interpretation represented accurately what the students reported, I applied triangulation across the data collection strategies and participants, viz. the audio tape recordings of the Talking Circles, my notes, and the participants' feedback. The information collected by each strategy was checked against the data collected from the others.

Member checking was conducted at the end of each Talking Circle session. The students helped me clarify my interpretation of what went on during the research. Any unclear points were addressed at the final interview by asking questions such as "I'm not sure if I understand X"; "Could you explain Y for me?"; "I'm not sure what you as a group meant by Z."

Subjectivity

Subjectivity was a factor in both the analysis and collection of data. I was aware that my personal experiences, knowledge and beliefs might bias my interpretation.

The following is a list of my beliefs which had the potential to bias my thinking and/or interpretation:

1) As a student, school science totally dominated my understanding of science.

2) Science seemed to me to be a vast compilation of facts, laws, and problems, which I needed to know if I was to make good marks.

3) A good science mark meant I knew science.

4) Science labs were just an external part of what was science. Seldom could I see any connection between the lab and what we were doing in class.

5) I related very little of my school science to my experiences outside of school.

6) As a teacher, I can say that the majority of students I have had contact with have viewed science as a "necessary evil", a required course for graduation. Other students had career aspirations, which necessitated a continuation of science courses.

The above biases were ones I once had but I feel they no longer influence my opinions.

The following statements, 7 through 11, reflect my current biases.

7) Teaching both academic and general science courses in the NWT, I believe that there is far too much attention placed on writing academic departmental examinations. This further exacerbates many students' already strong aversion towards science. The confining academic science curriculum leads to a lack of student initiative and imagination and to rote learning. The provision of very few practical experiments involving key science concepts which students can relate to is also problematic and is

responsible in large part for the negative attitude most students have towards science.

8) I believe that, to shed a new, improved light on science, schools need to make meaningful connections for students with the world around them. For example, community based research projects may help students develop a deeper appreciation of science and its possible contributions to solving societal problems.

9) Despite all the efforts that have been made, I still question the degree of integration of elements of Inuit culture into school subjects in general and into science in particular. I believe there is a real lack of understanding of what constitutes cultural science as well as the relationships between school science and culture.

10) I believe that students need a science curriculum which has been constructed or adapted to reflect their traditional world views, coupled with teachers' deep commitments to the academic and personal growth of their students. Only then may we find the key to "bridging the differences" between student perceptions of cultural connections and school science.

11) I believe that spirituality and social goals need to be connected with nature. School science needs to view the world as one interconnected whole and stop compartmentalizing nature and analyzing it to death.

Generalizability

The aim of this study is to describe young Inuit students' experiences in school science. Specifically the study will represent my perception of a particular group of students' experiences in a particular cultural context. I intend to provide possible meaningful and applicable insights to the NWT Department of Education, to educators interested in the opinions of students and recent graduates, and to those interested in science and culture in general.

Ethical Considerations

This study involved human subjects, so I took the following steps to protect the participants' rights and welfare (SSHRC). I obtained informed and written consent from each participant. As well, verbal permission was audio recorded at the beginning of the initial Talking Circle sessions.

Voluntary participation and the right to opt out of the study at any time without explanation were assured. As well, I agreed not to use any information obtained from the research participants if they decided to opt out of the study. These points were explained verbally to each participant.

To ensure participants of confidentiality and anonymity, each was asked to choose a pseudonym for use in field notes and the thesis. (Kirby & McKenna, 1989; Patton, 1989). Reasonable effort has been made to disguise the location and characteristics of the community, and participants were assured that any information recorded in interviews would not be made accessible to anyone in the community. To ensure accuracy and

preserve anonymity, each participant was given the opportunity to make suggestions and/or corrections to the field notes regarding their experiences.

Tape recordings, field notes and other writings were kept safely out of reach of those not directly involved in the study. All documents will be destroyed within five years from the publication date of the thesis.

As a researcher, I needed to be aware of the possibility of contravening ethical boundaries. Therefore, as stressed by Werner and Schoepfle (1987), it was imperative that I keep my observations separate from the participants' statements so as to prevent compromising the data with researcher bias and ethnocentrism. Werner and Schoepfle also stress maintaining cultural relativism in the field as well as in the preparation and writing of an ethnographic report.

Finally, I took care not to include information from conversations with the participants which went beyond the parameters of this specific study.

APPENDIX C

Talking Circle Protocol

I gave a brief description outlining the sacredness and power of a traditional Talking Circle ceremony as practiced by First Nations people, at the initial meeting of both participant groups. A set of basic rules was articulated and was adhered to by all participants and the researcher throughout the initial and subsequent Talking Circle sessions. These rules were as follows.

- one person speaks at a time
- no one is forced to speak
- no time limit is placed on what the speaker has to say
- everyone in the circle listens respectfully to the words of the speaker
- the person on the speaker's left is the next one to speak
- no one is permitted to criticize or speak negatively of what is shared in the circle

Each Talking Circle began with the researcher stating clearly the intended theme for discussion. This was as an attempt to help participants understand what was expected of them, collect their thoughts and remain focused throughout the Talking Circle session.

APPENDIX D

Sample Talking Circle Transcript

Excerpts from Talking Circle

N: My first day in Kindergarten, I was terrified. I was crying and Mom dragged me to school. The discipline I got from school was very different than at home.

Researcher: In what way?

N: It was foreign to me at school. Discipline like routines and stuff like that. Don't get me wrong, I grew up in a very strict home but there was a big difference. There is Qallunaat discipline and Inuit discipline. They are not the same. I had to get adjusted to the school disciplinary thing and then when I go home I had to readjust to Inuit discipline.

Researcher: What was that like for you?

N: I had a difficult time adjusting to it. I continued to switch back and forth until grade 4 or 5. Then I started going the other way.

Researcher: What way was that?

N: Away from home (the Inuit way). I adopted the Qallunaat way.

Researcher: Can you explain that for me.

N: That's when I started getting into trouble with my parents. I knew that my parents and family respected me but I had different respect from the teachers. If I did a really good job at school, because I really enjoyed school, they (teachers) rewarded me with candy or something like that whereas I never got rewarded at home. Well, I did get rewarded at home but in a different way; not a materialistic award.

Researcher: Can you explain to me in what way you were rewarded at home.

N: Mom would say that (verbally) I was doing a good job and stuff like that. But I began to like the materialistic rewards at school much more. (Everyone is nodding in agreement)

Researcher: How long did this continue?

N: For four years until I was in grade 8 I guess. I had a bad experience with my grade 8 teacher. But you know, my parents, my Mom especially never took sides. I saw a lot of respect (there).

Researcher: Why do you suppose they did not take sides?

N: Because they were respectful people.

Researcher: Did you understand that at the time?

N: No, I didn't. At that time I didn't think they understood what I was going through but being traditional they respected everybody. One thing I hated in school was the textbook we were through every day. Writing stuff off the blackboard all the time. I just hated that. They gave us no concept hands on things, it was just paper stuff. We just sat there all day.

My teacher in grade eight used to get mad at us (students) whenever we would talk in Inuktitut. That really turned me off school. I had no motivation to go to schools but I went anyway. My parents asked me to keep going to school.

In elementary school I had more hands on experiences but once I reached Jr. High school it was all textbook. There was an SRA program. We had to do those everyday for one hour and I hated doing them. I knew our comprehension was not good but we were made to do the same thing over and over, everyday. And I thought I was always behind in my schoolwork. I would go out of the classroom to work in the hallway because it (the class) was always out of control. I used to get pissed off. My previous teachers have a lot of high expectations, for my other classmates and me. Once we reached grade eight and nine we were basically out of control.

Researcher: What was it like for you in high school?

N: I dropped out of high school in grade ten because I had never been away from home, ever. That was the hardest thing for me.

Researcher: Where did you attend grade ten and for how long did you stay?

N: I came to Iqaluit for grade ten and I stayed for only a few months. Then I had no choice when I went home. I had to do either some work or do some upgrading. So I chose to do some upgrading.

Researcher: What type of work do you mean?

N: Working at Northern Stores. (HBC)

Researcher: What was your upgrading like?

N: I had a very good teacher for upgrading. He showed me a lot of respect. He told me that I could still go back to school in Iqaluit, but I never did. He helped me out a lot.

Researcher: Can you tell me in what ways he helped you out?

N: He helped me realize that I can be and do whatever I want. I believe he had faith in me. I remember when I first arrived in Iqaluit for grade ten. I had left my money my parents had given me on my dresser and I wasn't aware that people stole things around here. I lost my money the first day I was here at the residence. I went to the high school where I didn't know anybody and it was that way everyday. I became depressed and I didn't care about my schoolwork. I just wanted to go back home.

Researcher: Can you tell me about your school science experiences.

L: Science is exploration. Exploring all different sorts of things; it's (science) affect on society, people. That's what science is to me.

Researcher: What affect does science have on society?

L: All the good and bad things. Like ah...well it's hard to say what science is. To me it is just the exploration of all sorts of things around the universe and around the world.

Researcher: What was science like for you in high school?

L: I didn't take science in high school in Pond Inlet. I finished it in Arctic Bay. I took Chemistry 10 & 20.

Researcher: OK. So tell me about your Chem 10 & 20

L: Chemistry for me was interesting. Learning about all the molecules and chemicals and all that. If you combine two chemicals and its affect on you. Like if it is dangerous or explosive. That's what we learned in Chem 20

Researcher: you talked about molecules, chemicals, combining chemicals, where does this information come from?

L: From science. Well from scientists. Maybe from research, I don't know. We were using textbooks. Some of the things we did in chemistry were dealing with the chemicals like acids. It was interesting. I didn't complete Chem 30 because it wasn't being offered the next year so I never went back to that (chemistry)

L: My science in school was pretty bad because I couldn't quite understand what the teacher was saying. They (science teachers) had to be really specific in order for me to understand science. I needed examples that I could relate to because every time the teacher started talking about science and tried to explain it on the board without any examples to show it, that was the hardest part for me to understand.

During the time the teacher started talking about molecules and some other stuff, that is where I couldn't understand so I just started daydreaming instead of listening to

the teacher. I was somewhere else instead of listening to the teacher. Whenever I can't understand something in science, I just get bored.

Researcher: Would that be the way science was for you all the way through school?

L: Not really. Back home in Clyde River in junior high school our science teacher used to show us interesting and amazing examples. I was very interested in science at that time. That was science 15 in grades 9 & 10. But when I went to high school to take science 25, I just lost touch. I used to get pretty good marks in science back home in Clyde River but in science 25 in Iqaluit there were so many strangers and people that I felt like I was too dumb to do it. The teacher was just explaining it (science) on the board and just writing it on the board. (Others nod in agreement).

Researcher: So you are saying that you have to feel comfortable with the people you are around before any learning takes place? (M. & B1 nodding and saying uh huh)

L: In a way but it's mostly about the teachers and how they teach. People have different ways of teaching but instead of just writing on the board if they would teach them by their hands, showing them how to do it. I could understand it (science) better if they taught that way. I can remember it more than just writing it in my notebook from the board.

Researcher: Do you think all science could be taught (using hands) that way?

L: In some ways, I think so but not all the time.
Researcher: Can you give me an example of where you couldn't teach by showing the students with your hands?

L: Like back home they don't have the proper equipment to show students the examples. They just make a drawing out of it and they just show it. If I couldn't see how the job was done, I wouldn't be able to understand it.

Researcher: Did the drawings help?

L: Not really. I've got to see it to believe it. (Others in group are all nodding in agreement.) If there is somebody who knows how to teach science and knows about it, I think it would be very interesting to learn; like on the TV shows, they show some pretty amazing things. Like on "Bill Nye the Science Guy". I really like how he teaches science. They show so many examples and sometimes they make it hilarious. The show how most of the examples a week... visual effects. And most of the young people are involved rather than just sitting there doing nothing.

F: I noticed there was a lot of jargon used in science classes.

Researcher: What do you mean by jargon?

F: Like words you have never seen before and will probably never use again. (Lots of laughter) We have to learn too much jargon and I had a terrible problem understanding what it meant. I think all science is like that.

Researcher: Do you think anything can be done about the use of jargon in science?

F: Well, you cant start early by trying to understand what the words are, what they mean. That's one of the biggest things I had problems with in science class was the jargon. It just wouldn't stick to my head. She (the teacher) would try to explain it but... there was absolutely nothing I could relate to in my culture. Absolutely nothing.

Researcher: What B1 talking about chemistry and he mentioned acids, I was thinking if there was anything in Inuit culture in terms of food or food preparation that could be related to acid.

F: You know, I never thought about it. Mainly because it was directed into a Western style of philosophy. We don't have terminology of those things because we never used them before.

Researcher: What do you think of science in terms of then?

F: Now just in terms of Western philosophy, that's for sure. I understand science as trying to explain how things work all around us.

N: We had no science classes from k - grade eight. I have no recollection of having any science classes. So when I came to H.S. it was, wow!

Researcher: That must have been a change for you.

N: It was a big shock. Science, I've never heard of science. The only subject areas we took then were Phys Ed, English, Math, and Social Studies. I remember building igloos, but I never saw it as science.

Researcher: Building igloos was science?

N: Yes, but I didn't realize it back then.

Researcher: When did you believe building igloos was associated with science?

N: There is a lot of science in my culture but I just started making the connection because I recently attended the archeology course in Igloolik. I was amazed at just how

much science they (my ancestors) used. They used a lot of technology. Everything they made was from scratch. Everything was so tiny yet everything worked. They had no ruler to measure with. They had no tools; they had to use their mental abilities. Our ancestors from 3000 to 4000 years ago used science. That's awesome. That's when it really hit me, it's amazing. I discovered artifacts during the dig.

Researcher: But how do you know it was science your ancestors were using?

N: We had lectures and stuff like that. Nobody told me that science was involved, But I started to make connection and then I asked her in private "this is science".

Researcher: But you made the connections yourself?

N: Yes, I made the connections myself. With the tools they used, that was science.

Researcher: So you had some sort of sense in your mind what science was?

N: Yes.

Researcher: So can you tell me what science is to you?

N: You mean right now or in Western science? Well, Western Science means something to me in a modern way, in a Western way to me its finding out things but I can't many any connection to them because like I said I didn't take science until I went to college or upgrading I guess. But I couldn't many any connections with all that terminology, all those words, wow, I had no examples or demonstrations, none, but during hands on experiences. Then in traditional science there is a difference. I can relate to that science, Like science to me is exploration, finding out things and experimenting. That's what my/our ancestors were doing. I can remember stories our grandfather used to tell us and then I started making connections. I realized what they did was part of their survival skills, science.

Researcher: Can you recall a story that your grandparents told you that made sense to you later but not at the time it was told?

N: How to make a qulliq and then trying to make that shape. And then trying to make an uqsuk, that's science. Then things started clicking for me. They made sleds komatiqs with, not out of wood, but out of fish, caribou... they didn't actually use that but their grandfathers used to tell those stories..... that's science. It had to be in a particular shape, for a dog team; its the connection b/w the komatik and the dogs. It was stuff like that I started making connections, woah! It was awesome.

Researcher: How did you make those connections? What was it that enabled you to make those connections?

N: I don't know exactly but the teachers didn't make the connections for me. I was digging the ancestors' house and in the beginning I felt really guilty. I wondered if I should do this; it was like an invasion but then I started to find artifacts and examined them and looking through the book or ask the instructor what it was used for and she would explain. When I found something I would reference it to the instructor because I didn't know what it was used for because it was a small piece and she would say it was a part of that harpoon head or whatever.

Researcher: Can you explain what role the instructor played?

N: She simply identified the pieces of an artifact for me but she did not make the connections for me. It was not until I asked her in private "this is science?" and she said "yes". I had to justify that question I asked her. Our ancestors didn't see what they were doing was science. (all in the group nod in agreement)

B: It was pure intelligence.

M: It was their survival. They made these things, they did these things in order to survive. They didn't say, "Oh! This is science!" (Everyone laughs loudly)

F: Qallunaat categorize everything and Inuit don't.

N: Yes. When you do science as brainstorming learning, we often say science is experimenting and observing. I guess those are categories. I never really thought about it I guess.

F: I don't think Inuit ever used to think in categories. They never used to take things apart and think about the pieces.

B: They do now! (Everyone in group laughs loudly)

Researcher; Why do you think they do that now?

F: The younger generation for sure does it and maybe the older generation. I think it's because of all the new technology in the Arctic nowadays. They have more experienced instructors to teach them now. For example, we should be taught to dissect. Because inside the body parts, it is very interesting and you can learn a lot from it.

N: But didn't our mothers and fathers do that already? I remember as kids we watched our Dad cutting up caribou and seal and say to my older brother, who was becoming a

hunter then, this is what you call this part and this is how you cut it (Yeah from B1) so it has always been there. They know what every part was and the job it did but for sure they didn't call it science. We learned from observation and do you guys remember all the seal parts, what parts to eat and not to eat; the names of the different body parts.
F: We were told this information when we were out hunting with our parents. These things were told to us when we were right there doing it.

N: That's the way we were taught. If you did it on a blackboard, if you draw a seal and say this is the name for this body part or this organ then how are you suppose to make a connection without actually seeing them? ....seeing the seal being cut up. (A number of the group says "yeah") You can't learn like that. In the traditional way, we learn better by observations, by examples and by demonstrations.

B: Every time we went caribou hunting, with my father and grandfather, by climbing the mountains after we shot it, they used to show me how to cut it, where to specifically cut it. How the bone moves so just by moving it you can feel where to cut it so that the parts will come off easily. With seals, they would talk about it when they were cutting it into pieces, how to properly carry it so that it won't keep falling off.

Researcher: How did they learn these things?

B: Yeah, we take everything from the animals. We try to use everything. We don't waste. We respect the animals. One time I can remember my grandfather saying they never left any animal body parts, they used up everything they could. The parts humans couldn't eat, they would feed to the dogs. I can also remember my grandfather saying that when he was a kid every time he caught a seal he had to melt snow in his mouth and then drop the melted snow from his mouth into the seal's throat. He did this because he felt it was like luck or it helped him to catch more seals or animals. (All in the group agree by saying "yeah")

N: It was giving back the soul so that there will be more food for everybody to share. And also there will be more food foe everybody to share. And also there are a lot of taboos and myths about the animals that if we abuse or don't respect the animals they will fight back. (To the others.. "Have you heard about that?" All respond by saying "Yeah")
Or if you make fun of them.

Researcher: Do you believe that?

N: (Adamantly) Yes, I do. In fact I think this sort of thing needs to be talked about in science classes.

Researcher: Why?

N: Because there is a lot of respect there. And I know it would be difficult today, especially today with our generation. I don't think our younger people would believe in it but I think it would be worth trying it so that it can be passed on.

Researcher: You will be finished your teacher training soon. When you go into the classroom to teach science, how are you going to teach science?

N: I'm going to integrate Iuuqatigiit because that is what we will be teaching, those things from Iuuqatigiit.

Researcher: But if we didn't have Inuuqatigiit, what approach would you take?

N: I'm going to have to go through the curriculum, do some research. If the curriculum said to teach Qallunaat science, then I would have to take that road.

Researcher: Would you integrate traditional science?

N: That would be hard for me to do.

Researcher: Why?

N: Like I said, I don't have a lot of experience in science but I have an idea. I don't think that would be right to do in some ways. Trying to integrate modern science with my science. I wouldn't feel comfortable integrating the two of them together. Just the idea of putting the two of them together, I don't know. It's just that it would confuse the kids even more.
Researcher: In what way?

N: If I tried to teach Western science and traditional science at the same time I think there would be some confusion trying to relate one science to the other science. It would be frustrating. I would prefer to teach the traditional science rather than the modern science. I would get someone else to teach the modern science. But I think it is important that students see there are two ways of doing science.

Researcher: Why?

F & N: Because modern science has a lot of text, a lot of terminology whereas traditional science is all hands on, experience and all that.

N: And then I could integrate some part of modern science to explain what that means, or from the elders perspective. I think it is very important to receive science from the Qallunaat and Inuit perspectives. (All in the group agree)

B: I'd like to share a story.

When we were talking about respect for animals, I remember one time when my father told me about Inuumariks; caribou that turns into a human or a human that turns into a caribou. One of my grandfathers was saved by these inuumariks during a period of starvation when they had nothing to eat. Every time you looked at him, you would get scared easily because you might think he is a demon or some kind of a ghost. But if you have respect for them, you are going to have a very successful hunt. My father told me to never worship people like that because if you start believing that they are gods, then they are going to kill you for sure.

Researcher: Is this the same thing as shamans?

B: No, I don't think they were the same things as shamans but they were probably part of the world. Shamans were totally different from what I described.

Researcher: Do you think this information you have shared with us is important to pass on?

B: Yes, I think it is very important to pass on. If they (our ancestors) never had respect for the animals, they would never have survived. They told me to have respect for the caribou and if you do, then you will always have success hunting during the caribou season.

Researcher: To what extent do you think this type of information we have been talking about here tonight is being passed on now in school science classes?

N: I think some traditional science knowledge is being passed on in the lower grades but not in the high school.

Researcher: Why just the lower grades?

N: Because from k-3, instruction is always in Inuktitut so for me it would be easier to pass on that knowledge or read from a book of legends. I know the lower grades are more into that sort of thing but when they reach junior high school or high school, I don't think they really believe in them. I think it is because of a lot of Qallunaat teachers at this level. Did you know there is only one Inuk teacher at the junior high school level here in Iqaluit? That explains why it is so.

Researcher: But if the Qallunaat teachers were informed of this knowledge by other Inuit teachers and Inuit elders, do you think they would pass it on to their students?

N: No! Because I know a lot of Qallunaat people are suspicious, skeptical about our mythology.

Researcher: They don't believe it?

N: Well, they do and they don't. It is the same with the new generation right now, especially at the high school level. Then I don't see the point of telling you the story ...then would you pass it on to your students?

Researcher: You mean me personally?

N: Yeah.

Researcher: Yes, I would.

N: Then what is the percentage of people like you who are Qallunaat teachers, would do this? I don't think very many.

N: My Dad is a pretty good hunter,; I don't want to sound as if I am bragging, but if he goes out to study polar bears or a herd of caribou with a bunch of biologists, then I'm positive his knowledge is much broader and higher than the biologists; in the Inuit way. And I know that he knows something about the animal just by the way it moves. He knows when not to disturb that animal and when to stalk that animal. That is Inuit science!

B: Not just Inuit science.... that's science period!

APPENDIX E

A List of Examples of Connections between Inuit Culture and Science with Detailed Explanations as Provided by the Graduates

The following list is a compilation of specific examples showing connections between Inuit culture and science.

- fermentation - bacterial / fungal activity
- engineering in building traditional shelters
- animal body parts - anatomy
- nutrition - aged meat, cartilage
- used levers to move large rocks to cache meat
- technology to measure nutritional value of aged meat
- archeological digs of traditional sites
- skin preparations
- dog team technology
- insect development
- medicine
- tool design - harpoon, wick of koodliq, koodliq design
- navigation - ice, water

The following excerpts are detailed explanations of specific connections between Inuit culture and science.

T: Inuit are natural scientists. You have to approach it from the perspective of how the mind of a traditional Inuk works and that is you have to look at it from the point of what they invented, how they dealt with the environment. When you observe it from that point of view you realize they did develop ways of utilizing physics, biology and chemistry. Physics in the sense where they used leverage when they cached meat. They used big rocks, boulders, and there are stories of how Inuit used tools that tells the observer that the mind of an Inuk was extremely creative.

I think of my own Dad. He would often be faced with awkward situations and I have seen it with other Inuit too, the older ones. Their approach to a problem was one of using something that was in their hand and they would turn it into something that would benefit them or help them solve their problem, short term or long term. I have seen my Dad use a lever... we couldn't move a rock so he used a stick. He just leaned into the stick and was able to move the rock. And when you are out hunting, just the way you carry the caribou meat. Inuit found a way to balance weight on their body and not just on one part of the body. That's profound when you think about it.

And just different techniques of finding your way back to your community, different techniques of hunting such as using natural things like the wind and landsites. You use the wind and stars to find your way home. Fermenting. How can I forget about fermenting. Now there is a bit of interesting chemistry in fermenting meat. The process enriches the meat in terms of its nutritional value. I have seen fermented food do wonders to a person who has been sick. You saw it on people's faces, the craving for fermented food. It has a nutritional value, maybe even a medicinal value. You can only observe the effect it has and using technology we have now you can measure its exact nutritional value. This tells me that Inuit are very intelligent in terms of the natural sciences.

When an Inuk understands a situation it is bound to be resolved / solved using what resources they have and when you observe that from a scientists point of view, you just sit there in awe. You can't really put a full scientific definition on what exactly science is in terms of Inuit knowledge but you see it in the lifestyle. The lifestyle speaks for itself in terms of scientific accomplishment or the reality of science being applied in our culture. If it wasn't for science, we (Inuit) wouldn't be here. If it wasn't for the harpoon . . . it is a long stick that can be thrown like a javelin but it can still penetrate. There are very interesting ways you can observe that from a physicists point of view. And that is why I think it can be very interesting.

A: Well, if you were out hunting or camping; even the simplest thing like how to pitch a tent so that you don" get wind blown or you don't get wet. Out on the land, knowing

where to go through a certain water route...those are examples of traditional knowledge. How to treat skins, how to butcher caribou, how to make skin clothing...

Traditional knowledge; it can't be owned but the respect has to be there: whoever knows something about a certain species or certain animal behaviour, those are the people who have the knowledge, who have seen it and actually experience it. They know when the species mate, they know when the meat tastes better, they know what parts are good and not good to eat.

We are taught never to own anything. Even if it is my own snowmobile, even if I paid for it, in the olden days, I wouldn't own it. The whole family owns it. It belongs to everybody. Let's say I am out with another family and if they were in need of a snowmobile in order to survive, it would belong to them as well. My grandmother and mother taught us that we don't own stuff, you don't own things or people. A snowmobile can be replaced but a person can't be replaced.

A: By experience. You learn by what you do. You become an expert. Like I can say my father is an expert on building beautiful komatiks which just glide over the snow and ice. This knowledge he gained from other men, his step-father and other hunters.

I want to tell you some other examples of where I believe are a connection between traditional knowledge and science. The shelters and tools we used to have, food preparation, butchering certain animals a certain way because we may be preparing it for clothing or food. That knowledge definitely has some science relevance to it. Take for example the fermented walrus meat. We were taught in school that if we leave meat out it will rot and we could get poisoning from it. But Inuit had also discovered using fermentation, that is using fungus and bacteria to make fermented or "aged" walrus meat is what we call it. It is put under ground, covered with pebbles or small rocks usually on a beach for about 3 months. It is a delicacy, a certain smell or odor to it. It is also used by hunters who go hunting in mid January / February, the coldest months. It gives them a lot more energy and keeps them a lot warmer than other food. It also has medicinal powers. I just can't explain it but you can see the results in people who haven't eaten for some time. Then when they eat it, their face looks full, reddish and healthy. They needed some sort of energizer and this gave it to them.

The great engineering that Inuit did when they built shelters. That effectively utilized their resources; they used the seal blubber as fuel for light, heat and cooking purposes. They also invented or discovered, whatever, the qaamuk. The entrance was low, almost crawling level so that the inside could retain heat and not loose too much especially in the middle of the winter. Actually qaamuks and igloovigas have similar designs. Both have a lot to do with air and how heat rises and those are things taught during science classes but reference is not made to what we were living or how our shelters were built.

I want to talk about dog teams as well because to me that is Inuit technology but using the most of the resources from the environment without any synthetic stuff. For example, the toggles we use for the dog teams. That was a big invention or discovery Inuit made. I have started my own dog team and I have asked why my father would have

the traces, or the pituk, that is the main rope from the komatik to where the dogs fan out from. He said he would have the pituk shorter if he was traveling through dangerous ice like if there were holes or if the ice was breaking up easily, he would have the main toggle called the sanniruaq, on the pituk, closer to the komatik where he could reach it in case one of the dogs went through the ice. He would just release it so that the dog could get free without drowning; he could save it that way. I was not aware of that. It never even entered my mind. I learned of it when I asked him (my father) how long he usually has his pituk. That was when he told me that it depends; he would have it shorter, closer to him so that he could release it when he was traveling on dangerous ice. On land, he would have it further from him.

Researcher: Can you tell me more about this toggle.

A: It can be made out of ivory tusk or caribou antler. But ivory tusk is better because it is much stronger.
* While A. is drawing this for me, she is also saying: You would find this in old archeological sites or old qaamuk dwellings.

There is a lot of science and technology involved here. I was amazed because I grew up when dog teams were no longer used because of the so called epidemics of dogs. But from what my father used to tell me, I was always interested. I consider that to be Inuit technology. It was invented to ensure their survival. I'll give you some examples. All of these ropes (on the dog team) are from the skin of a seal; the meat of the seal was used as food, the blubber was used for fuel. Nothing was wasted. That was respect for the animals, it was giving thanks to the provider of the people. Not only that but it was part of survival; you had to use what you had back then; you didn't waste anything.

Now that you have me thinking of this, last week when I was in Pelly Bay; at lunch time I noticed an Inuk had just arrived from a dog team trip so I went up to him while he was tying up his dogs...releasing his toggle and so forth. The bottom of the runners of his komatik was all made from a combination of earth, moss and frozen water as opposed to the high density white plastic we use today. I had always wanted to see that but I only saw it in the movies. I touched it to see what it was like. It was in good condition after being out all morning and it wasn't broken. I asked him how long it would last if he used it every day. He said between 4-14 days depending on the ice conditions. It was amazing what my ancestors had used or invented. I have been dog teaming for 4 years and I am still learning more things. There are more things that I ask about even though I am not living the way my ancestors did, I have a high interest in how simple technology like the toggle, the trace and the komatik...how it is built for maneuverability and gliding, why it is not nailed together and why it is lashed up.

A: My life growing up and even today, I still live a good part of my culture. I guess my knowledge comes from the fact that I "lived it".... I lived my culture... I lived off the land, surviving, coming from a big family where everyone had a part to do in order to ensure we survived. Everything my mother or father did, I would observe it closely. When my

father would butcher or cut up a seal, he would cut certain joints or certain areas he would avoid cutting because he didn't want sour tasting meat. I was amazed whenever he would cut without hesitation even when the area he was cutting was completely covered with meat, he knew exactly where the joint was. In that sense he was a ...what do you call it?...a doctor of anatomy! It didn't matter if it was a seal, caribou or fish....he knew the anatomy.

I remember my father seal hunting. There are different types of seals: ring, bearded, harp...from a distance my father could tell what type of seal it was. He could only have done this if he was exposed to them on a daily basis. That took me a long time to figure out how he knew the type of seal from a great distance. When we were kids in the boat, we would point out a seal to him and then when it dove under the water and surfaced again in a couple of minutes, we would say, "there it is again" He would say "no it's no the one we are after. It is not the same one you just saw." I was confused over how he knew this. Now that I am older, I am learning more on my own, I am actually doing it rather than just following along. I am starting to realize how he was able to do this.

Let me tell you another story. We would fish all summer. I would help my mother gut fish. She taught me how to cut a certain way. I am doing 30 fish a day. I remember one of them had eggs and she knew, I mean, my mother had never been in school. She had the knowledge and I wondered how she knew. Sometimes my mother would feel hurt that what I was bringing from school, I would show her but she would explain a little bit about what was in our own culture, what we had been living but I remember she was frustrated. I thought she was disappointed with my work but she couldn't relate to me. She knew there was something there that we could use from watching the teachers but what we were learning wasn't something that she had knowledge about. I mean it was the same concept, the same process but different animals or plants or whatever.

Another example I want to talk about is the harpoon. That is a technology Inuit used. The harpoon head is made in a certain way that when it punctures through the animals' skin, it will go vertical, preventing it from coming back out through the puncture hole. I am very pleased that hunters today still use this technology. It is the key to our survival even though we still have all this modern equipment and influences of today , hunters still rely on it for their catch. There is no doubt that if you puncture the skin of a walrus, seal or whale.... you have it....unless it drags you off! (laughter). For the beluga whale, they use the harpoon head, ujuk rope and floats. The floats are a whole seal skin inflated with air. The seal is sewn up where the hind flippers are and around the mouth area there is a plug usually made out of ivory.

Another example is the wick of a koodliq is made from peat moss we get from the tundra and a certain kind of cotton that comes out from an arctic willow tree, just before the fall. This is all very scientific.

Inuit knew a lot about plants. Plants were used for medicinal purposes, for teething, for food, for tea. There are many things about plants that haven't been passed on. (Remind me to tell you the mushroom story and my grandfather) A lot of vitamins our bodies needed came from plants and animals we ate. Let me give you an example. Before we had apples and oranges, the doctors used to wonder how we got so much

vitamin C. I remember taking Health in school. Our teacher used to tell us we had to eat this food and that food to make sure we got the vitamins we lacked. Vitamin C is an example. Most of the sea mammals we eat are very rich in vitamin C. They (health teachers, Drs. & nurses) didn't know that. They were telling us we needed vitamin C but in fact we were getting all kinds of it. Seals have the highest concentrations of vitamin C of the arctic sea mammals. Because the doctors and nurses said we needed vitamin C our parents bought apples and oranges. We were going in between our food and the food we were told to buy. But I need country food; my body craves for it. If I am going to be hunting in February, I would rather have seal broth and seal meat in the morning. That way, I will get quick energy. When I was living in Ottawa, I think I suffered from malnutrition. Let me give you a comparison. I have a high metabolism. Especially in the last week I have felt weak because I have been traveling and eating Qallunaat food in restaurants and hotels. I have been getting the shakes because I need to eat a lot. Just to recuperate myself, I will have boiled seal meat. After that I feel much better, healthier. I become pale when I don't eat my kind of food. Growing up, when we started to eat more and more junk food, like chips and pop, my grandparents noticed we were very hyperactive. My parents and grandparents said they would eat country food, which is good for you. Now that I am grown up I understand what they meant. I used to think they would say those things because they didn't like the taste but it was the energy in the country food.

Another example is the fly, which lays eggs inside the caribou skin. I can remember one summer watching my father carve up a caribou. There were hundreds of larvae under the skin on its back. I asked him what they were. They were well developed, some had tiny eyes, they were white and gooey. He said they were koomuks; parasites of the caribou and they turn into flies at a certain time and come out of the skin and through the nose of the caribou. That is part of insect development in our culture.

OK. One last story. I think I was about 7 years old and I can remember my grandfather had a big cut. He went to see a doctor for ointment. The cut wasn't healing. So my grandfather told me to go out and collect a certain type of mushroom. I can't remember the name of it. He described to me what it looked like and what it felt like and if I opened it, it was powdery and all the powder, all the fungus in it. (When the mushroom is dry, it is powdery and when you pop it, all the powder stuff in it disappears because you have broken it). So after he explained that to me, he said for me to go out on the land and find some of it. So here I am walking around everywhere, looking around, up the hill and so forth and I finally found one. It was only one. And the only way I knew it was the right kind was from the times when I was out on hikes or walks or playing out on the tundra with my friends, I knew what kind of plant he was talking about because I had broken it before. We played with it, we have thrown it at each other. So I brought it back and my grandfather used the skin of the mushroom as a bandage and his cut healed up perfectly.

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