Appendix A: Curriculum Connections

Flow Chart of Indigenous Science Curriculum Connections

The following charts provide a brief overview of science concepts and processes that can be explored at suggested grade levels. Although the BC science curriculum was taken into consideration, the concepts and ideas reflect many examples from this book that go beyond the prescribed curriculum, as well as topics for students to research in libraries, by internet searches and by involving Elders and knowledge holders. The ideas are starting points for engaging teachers and students about Indigenous Science knowledge in their local areas. Teachers are encouraged to use their own creative imagination and flexible thinking to weave IS concepts and cases into the science curriculum.

Sample Processes and Skills of Science: observe, compare, describe, question, predict, communicate, infer (give reasons), measure and record, classify, build models, theorize, experiment, and interpret.

GRADES K, 1 AND 2: DAILY AND SEASONAL CHANGES

Concept: the activities of Aboriginal peoples in BC change with each season.

- Give several examples that show how local Aboriginal activities differ according to seasonal cycles and regions (differences between the interior of BC and the coast, north, south, etc.)
- Prepare a detailed list of local Aboriginal activities for each season:
    - spring - prepare fishnets, clean creeks and springs, planting, dry seaweeds, oolichan runs (usually the first fish of the year), spring salmon
    - spring, summer, and fall - gathering abalone, octopuses, shrimp, sea cucumbers, mussels, oysters, red sea urchins, Dungeness crabs, king crabs, red rock crabs, and chitons (sea prunes)
    - summer - salmon runs, gather medicinal plants
    - fall - berry picking, drying berries, clams lightly smoked and preserved in grease, hunting goose, duck, moose, and deer
    - winter - important potlatch/feasts, oolichan grease feast, bring in firewood, sports activities, work indoors carving utensils, sewing clothes, weaving baskets, making moccasins, leggings and boots
    - year round activities - making bannock, medicinal plant gathering.
- Develop a class seasonal wheel illustrating how local Aboriginal peoples harvest plants and animals through the seasons

- Give three ways that modern technology has changed daily and seasonal activities (e.g., electricity, freezer, canning, motorboat, chainsaw, skidoo).

GRADES K, 1 AND 2: ANIMALS GROW AND CHANGE

Concept: Animals are important in the lives of Aboriginal peoples in BC.

- Identify from books, Elders, and historical sources on how animals help to meet the needs of Aboriginal peoples (e.g., bear fur for warmth during the winter, oolichan grease for cooking and preserving berry cakes, bones for tools, seal oil and meat on the west coast, ducks, geese, salmon, herring, beaver, mountain goat, deer, elk, moose, marmot, seals, whales, clams, eagle feather ceremony)
- Identify and illustrate different methods of hunting and fishing (e.g., spear, bow and arrow, dip net, stinging nettle fish net, halibut hook, conical fish trap, weir, reef net, and Dentalium shell broom).

Concept: Knowledge of animal life cycles and migration patterns help Aboriginal peoples to survive.

- Give several examples of Aboriginal knowledge of animal life cycles (e.g., life cycle of oolichan, life cycle and migration routes of salmon, migration routes of caribou and moose, ducks and geese, Dungeness crab)
- Invite an Elder or knowledge holder into the classroom to describe traditional knowledge of migrations and life cycles in relation to hunting and fishing practices
- Describe expectations for respecting Elders, knowledge holders and other guest speakers (e.g., active listening, asking questions, presenting a gift).

GRADES K, 1 AND 2: PLANTS GROW AND CHANGE

Concept: Plants are important in the lives of Aboriginal peoples.

- Identify and illustrate different Aboriginal methods of harvesting plants for food in BC (e.g., root vegetables, crab apples, huckleberries, blueberries, salmonberries, cranberries, thimbleberries, soapberries, salal berries, currents, seaweed, camas bulbs)
- Research how Aboriginal peoples of BC gathered the available plant materials (e.g., cedar bark, birch bark, cottonwood, spruce roots, wild cherry bark, stinging nettle) to make berry-picking,

cooking, or storage baskets, as well as rope, twine, clothing, mats, blankets, diapers, and paint brushes
- Identify different plants used by Aboriginal peoples for medicines in BC (e.g., willow bark tea for colds)
- Identify and illustrate different harvesting tools (e.g., yew digging stick)
- Identify ways that Aboriginal peoples maintain the health and wellbeing of plants (e.g., not over-picking, stripping bark from only one side of the cedar tree, taking only one cedar plank from a tree, leaving the tree alive and healthy)
- Research and illustrate different fruits and vegetables in Meso-America that Indigenous peoples harvest (e.g., corn, pumpkins, yams, potatoes, beans, tomatoes, avocados, sunflowers, papayas, pineapples, cocoa/chocolate, coffee).

GRADES 3 AND 4: CLASSIFICATION OF LIVING AND NON-LIVING THINGS

Concept: Different peoples around the world sort living and non-living things in their own way and use different classification systems.

- Share personal perspectives on "living" and "non-living"
- Compare Aboriginal and Western Science perspectives on "living" and "non-living"
- Share perspectives on the Western Science concept of hierarchical classification of plants and animals
- Press five (5) wild native plants. Label each plant with its Aboriginal name and its scientific name. What do the names tell you about the plant?
- Describe a Kwawa̲ka̲'wakw perspective of classification
- The Nuu-chah-nulth people classify coho salmon depending on whether it lives in the sea or in fresh water. Explore the usefulness of this classification system
- Explore how the way people classify organisms reflects the way they see the world—their worldview.

GRADES 3 AND 4: LIGHT AND SOUNDS

Concept: Aboriginal peoples in British Columbia make a variety of ceremonial instruments for singing and dancing, and producing dramatic sound effects.

- Identify and illustrate ceremonial instruments that Aboriginal peoples in BC make (e.g., rawhide drum, hollow cedar tree drum, wooden whistles, flute, deer or mountain goat hoof rattle, bear claw rattle, puffin beak rattle)
- Using whistles of various lengths, explore pitch and volume
- Using traditional one, two, or three tone whistles, explore pitch and volume
- Explore drumming, chanting, and singing for telling stories
- If possible, invite an Elder into the classroom to demonstrate the sounds and songs of ceremonial instruments
- Make a whistle, drum, or rattle from traditional materials. Explore pitch and volume
- Research how some Aboriginal peoples use light and sound for dramatic effect during ceremonies (e.g., the Nisga'a and Kwakwaka'waka achieve a bright flash of light by throwing oolichan oil on the longhouse fire at the climax of a dramatic performance of a legend or family crest story).

Concept: Research how some Aboriginal peoples have traditions regarding the respectful use of ceremonial instruments. Some groups allow only designated Elders to handle and use ceremonial instruments.

- Interview an Elder to learn about the traditions of the local Aboriginal community
- Identify proper etiquette for using (or not using) local ceremonial instruments.

Concept: Indigenous peoples of the Americas make ceremonial instruments for singing and dancing

- Research how Indigenous peoples of the Americas make ceremonial instruments for singing and dancing, such as mouth bows (ancient stringed instrument), Apache violins, Aztec drums, flutes, whistles, and ocarinas.

GRADES 4 AND 5: STARS AND PLANETS

Concept: Knowledge of celestial events influenced Aboriginal culture.

- The Aboriginal concept of time draws heavily upon natural cycles and does not include precise measurements (month, week, hour, second). Explain how the Aboriginal concept of time differs from the western one
- Research how Meso-American astronomers and mathematicians calculated calendars more accurately than calendars used by Europeans at the time of conquest
- Research Yup'ik terminology of constellations and understanding of seasonal positioning of constellations
- Research traditional stories about the sun, moon, and stars (e.g., *How Raven Stole the Light)*
- Generate specific questions in response to traditional stories focusing on celestial objects

- Write stories, complete with illustrations, on a celestial object (e.g., how the moon came to be, how stars came to be)
- Infer how the Nisga'a predicted the arrival of important migrating fish by observing changes in the location of the sun rising over mountainsides
- Research and describe Nuu-cha-nulth moon phases
- Research and describe Kwawaka'wakw moon phases
- Identify three ways that knowledge of stars and planets influenced Indigenous culture in the Americas (e.g., community location, migration, ceremony, agricultural cycles)
- Research Navajo and Pawnee star maps and their knowledge of equinox, summer solstice, and sky constellations.

GRADE 4 AND 5: HABITATS AND HOME-PLACE COMMUNITIES

Concept: Aboriginal peoples developed a deep connection and knowledge of their home-place.

- On a map of the local region, identify Aboriginal place names
- Research place names and their meanings in relation to a local Aboriginal group
- Students as researchers - use audio and visual technologies to interview and document traditional knowledge of home-place
- Discuss the quote "ownership is a marriage between the chief and the land"
- Interview an Elder or knowledge holder to find out how the harvest of fish, clams, seaweeds, etc., was shared with all members of the community
- Read stories that demonstrate the relationship Aboriginal peoples have with the land, water, animals, plants, and the sky
- Select a relationship with any three—land, water, animal, plant, and sky—then write and/or tell how they personally show respect for each of their choices
- Indicate how their behaviour is similar to or different from the Aboriginal stories they read and wrote about.

Concept: Aboriginal technologies have contributed to the settlement of communities in home-places.

- Build a model of a cedar dugout canoe for long distance ocean journeying; whaling canoe or interior birch bark canoe for streams and lakes; or Inuit kayak for icy waters. Explain how their choice of canoe is designed for a specific purpose and environment
- Build a model of a west coast big house made of cedar planks, or an interior tepee made of rawhide, or an igloo made from blocks of ice. Explain how their choice of shelter is designed for a specific environment

- Research the traditional lifestyle of the local Aboriginal community. How did they get their needs met for food, transportation, shelter and housing? How has their lifestyle changed?

Concept: Aboriginal peoples developed deep respect for the home-place environment.

- Give several examples that illustrate how traditional Aboriginal peoples respected plants and animals (e.g., prayer to the salmon, prayer to the cedar tree, prayer to halibut, thanks to deer, clan names)
- Describe how traditional Aboriginal peoples did not waste edible parts of fish, including the head, bones, cheeks, eyes, edible internal organs, and eggs
- Describe traditional ways of being responsible for the care and preservation of the environment
- Illustrate traditional stories that demonstrate the relationship Aboriginal peoples have with the land, water, animals, plants, and sky
- Engage in an action project that demonstrates respect for home-place environment (recycle, clean up stream bed, engage in a salmon restoration project). Reflect on the outcomes
- Plan a feast that celebrates the foods harvested by local or regional Aboriginal peoples.

GRADES 5 AND 6: FORCES, TOOLS AND SIMPLE MACHINES

Concept: Simple and compound machines were used in daily life by Aboriginal peoples in BC and by Indigenous engineers in the Americas.

- Describe the various ways in which Aboriginal peoples in BC have used tools and simple machines to meet basic and artistic needs in their lives (wedge, lever, maul and cross-bar for splitting timber; inclined plane, lever and fulcrum for raising cedar logs for big houses; fish wheel for catching and storing live salmon, raising totem poles)
- Explore effects of pushes and pulls on movements of objects (building blocks, pulleys, rocks, ropes)
- Observe, predict, and explain the effect of size, shape, and material on movement of objects
- Role play how to move large objects (canoes, cedar beams, totem poles)
- Create a diorama or build a model and explain how massive cedar beams were traditionally lifted onto big houses
- Create a diorama or build a model and explain how totem poles are raised using wedges, blocks, ropes and manpower. Explain how force and energy is transferred
- With the help of a knowledge holder, try splitting cedar planks (take safety into account—e.g., eye goggles)
- Research Inca engineering of roads and bridges (culverts, road tunnels, rope suspension bridges, pulley-operated gondola bridges)

GRADES 6 AND 7: RENEWABLE RESOURCES AND SUSTAINABILITY

Concept: Aboriginal peoples in British Columbia have increased the production of food by developing renewable and sustainable resources.

- Research how Aboriginal peoples have designed tools and technologies to ensure sustainability of resources
- Describe in detail how Aboriginal peoples (past and present) practiced fish enhancement (re-stocking rivers and lakes with salmon, trout, and herring)
- Describe and illustrate how traditional Aboriginal forestry practices show respect for trees, shrubs and plants (stripping cedar bark from one side of the tree, leaving the tree alive and healthy)
- Research how to (or with a knowledge holder) weave a cedar bark bracelet, headband, or basket
- Describe, using examples, how traditional Aboriginal fishing practices show understanding of sustainability practices (seine nets with big holes could catch very big fish while letting juveniles pass through, weirs trapped a designated number of fish while letting large number of fish pass upstream)
- Build a model of a weir or reef net, allowing an escape route for fish to continue the population
- Research how Aboriginal peoples in BC used controlled burning to add nutrients to the soil, control insects and enhance wild food crops (e.g., harvesting blue camas bulbs)
- Research and create a diorama and/or mural demonstrating how coastal Aboriginal peoples built sustainable clam gardens
- Research and create a diorama or mural demonstrating how coastal Aboriginal peoples engineered tidal flats and developed root vegetable gardens
- Research how Aboriginal gardeners tending tidal flats gathered larger root vegetables for eating and put smaller plants back into the ground to ensure future harvests
- Invite an Aboriginal scientist to speak to the class (e.g., biologist, geologist, fisheries biologist, environmentalist, engineer).

Concept: Aboriginal peoples understood the concept of the interconnectedness and interdependence of the environment.

- In groups, explain the traditional Aboriginal concepts of "circle of life," "everything is one," and "everything is one and becomes another"
- Explain, citing examples, how and why traditional Aboriginal peoples' relationship with the environment demonstrates responsibility for the land and resources (never take more fish than you can eat, use every part of the fish, seal, moose or deer, wasting nothing)
- Infer how the practice of sharing the fish or clams or berries with all members of the family and/or community contributes to an understanding of interconnections and interdependence
- Discuss why the Nisga'a often refer to the bear as "a teacher"

- Discuss the common belief among traditional Aboriginal peoples that one should observe nature closely because the plants, animals, forests, and all entities are our teachers
- The Seven Generations principle implies that the actions we take should honour the ancestors seven generations into the past, and have repercussion for the present, as well as seven generations into the future. Explain the Seven Generations Principle in relation to Aboriginal values (worldview).

Concept: Aboriginal peoples past and present engage in monitoring and restoring renewable resources.

- Research how Tsartlip First Nations students helped to monitor eelgrass meadows and restore eelgrass beds (restoring fish habitat) at SNITȻEŁ (place of the blue grouse)
- Research how the T'Sou-ke First Nation uses solar panels and wind for energy, decreasing fossil fuel demand
- Research how the Nuu-chah-nulth First Nations are working with Oceans Network Canada and the University of Victoria to monitor changes in ocean temperature and water quality
- Identify a local resource issue and explore ways Indigenous Science and Western Science can be used to resolve the problem.

GRADES 6 AND 7: WEATHER AND CLIMATIC ZONES

Concept: Aboriginal peoples use a variety of ways to forecast the weather.

- Research how Inuit women and girls forecast the weather using traditional knowledge (i.e. animal behaviours)
- Research how Inuit peoples observe changes in land and weather, and how changes are having an impact on their lifestyles
- Interview an Elder to explore how to forecast the weather
- Observe and record the weather over a five-day period, paying attention to traditional knowledge
- Predict tomorrow's weather.

Concept: Aboriginal peoples developed specific technologies to meet their needs in different climatic zones.

- Explain how Aboriginal peoples made use of the different climatic zones in each season (mountain, valley, river/lake, coastal, muskeg, and tundra)
- Illustrate with accurate, detailed drawings a range of Aboriginal technologies for life in cold snow and icy weather conditions (Haida ocean canoe, Cree snowshoes, Inuit eye goggles, igloo, kayak, sled, and Algonquin toboggan)
- Research how Aboriginal peoples living in a rainforest developed technologies for life in extremely

rainy weather conditions: e.g., wove warm waterproof clothing from shredded cedar bark. Explore, using different materials, how multiple layers of fibre give good insulation
- Illustrate with accurate drawings how rain coast peoples shaped roof planks to allow runoff of rain.

GRADES 6 AND 7: HEAT AND TEMPERATURE

Concept: Aboriginal peoples (past and present) use heat and temperature in a variety of ways to meet their needs.

- Describe and illustrate how Aboriginal peoples preserve food using heat and temperature (sun-dried seaweeds, wind-dried and sun-dried fish, smoked fish and clams, salted fish, preserving using oolichan oil)
- In collaboration with knowledge holders, use heat to dry seaweeds or fish
- Research how Aboriginal and Inuit peoples deal with issues of heating in traditional housing (igloo, tepee, and big house)
- Explain how heat is used in a variety of ways for meeting the needs of Aboriginal peoples and for artistic purposes (steaming bent cedar box and rendering oolichan oil)
- North American Indigenous peoples make pemmican from bison, deer, or elk by pounding the lean meat with hot fat and dried berries. Make some pemmican using beef, deer, or elk
- Aboriginal peoples preserve different runs of salmon in different ways depending on the fat content of the fish (high fat content is not as good for drying as low fat content fish): early runs of sockeye salmon are not as good for drying as later runs of sockeye salmon. Chum salmon are less oily. Predict, observe, infer and compare drying early sockeye salmon with later sockeye salmon
- With a partner, research a traditional Aboriginal method of using heat for the preparation of food or clothing or making dyes. Does the process involve a physical change, chemical change or both?
- Infer how Indigenous peoples might have experimented to develop a process for tanning hides by boiling a broth using deer or elk brains. Does the process involve a physical change, chemical change or both?
- Research how the Aztecs made rubber balls, water-proofing, and gumboots prior to the arrival of the first Europeans
- Research how Indigenous peoples from Meso-America processed freeze-dried potatoes. Does the process involve a physical change, chemical change or both?
- Give examples of Indigenous theorizing and experimenting.

GRADES 7 TO 9: SUSTAINABLE ECOSYSTEMS

Concept: An ecosystem is made up of all the interacting organisms (plants and animals), rocks, water, soil, sun, as well as the interactions between organisms and their environment.

- Identify examples of ecosystems: e.g., forest, wetlands, Garry oak meadow

Concept: Humans impact ecosystems.

- Research examples of how human activity during the 20th century has impacted ecosystems in BC (clear-cut logging, logging over stream beds, damming rivers, filling in and polluting wetlands and estuaries, and oil and gas pipelines)
- Research examples of how human activity has impacted Aboriginal resources in BC over the past century (decline of oolichans, salmon, halibut, herring, cranberry bogs, and crab apple orchards)
- Research how a huge hydro electric dam in BC created Williston Lake—flooding the traditional lands of the Tsay keh Dene peoples and affecting the ecosystem and way of life
- Interview an Elder or knowledge holder to explore how loss of lands and resources have affected the local Aboriginal culture.

Concept: Aboriginal peoples showed respect and understanding of the inter-connectedness of ecosystems.

- Describe, using examples, how traditional Aboriginal fishing practices (past and present) show an understanding of the preservation of fish habitat (walking stream beds in spring to remove debris from spawning channels allowing salmon to return to spawning grounds)
- Describe, using examples, how traditional Aboriginal forestry practices affect forest ecosystems (controlled burning adds nutrients to the soil, reduces understory and decreases wildfire intensity and insect infestation)
- Research how Haida Elders and knowledge holders (with their knowledge of land and sea), work with scientists on conservation and cultural projects in the National Parks Reserve on Gwaii Haanas
- Research how Nisga'a fish wheel technology and modern satellite technology is being used to monitor salmon migrations and maintain the population.

GRADES 7 TO 9: CLIMATE CHANGE

Concept: The earth and its climate has changed over geological time.

- Research and describe, using examples, how Aboriginal and Inuit Elders and knowledge holders

are often first identifiers of climate change (changes to seasons, changes to snow, ice, glaciers, permafrost, and available clean water)
- Research and describe, using examples, how Aboriginal and Inuit Elders and knowledge holders are often first identifiers of changes in animal, bird and plant migration (e.g., killer whales arrive in Arctic region for the first time, first sighting of killer whales hunting narwhales, unusual polar bear migrations)
- Research ways that Aboriginal/Inuit knowledge holders and scientists are working together to study climate change issues.

GRADES 5 TO 12: GEOLOGY, ROCKS AND MINERALS

Concept: Aboriginal peoples (past and present) use rocks and minerals in a variety of ways.

- Illustrate how Aboriginal peoples in BC shaped stones to meet their needs (e.g., arrow heads, knives, spears, hand mauls, wedges, beads and pendants, stone bowls, scrapers for tanning hides, stone anchors for fish nets and dugout canoes)
- Research how traditional peoples were keenly aware of the different properties of rocks and minerals: sandstone for grinding; slate for splitting into slabs; basalt for scrapers, arrow points, knives and spears; glass-like obsidian for fine arrow heads, knives, and pendants)
- Research or invite a knowledge holder into the classroom to explain how Aboriginal peoples in BC worked copper to make knives and to show the wealth of the family
- With the guidance of the teacher and an Aboriginal knowledge holder, explore the properties of rocks and minerals. Try making an arrow head (use face goggles)
- Visit an Aboriginal artist to observe how he or she works with silver, gold, argillite, jade and/or other precious stones to make jewellery, decorate masks and other products
- Research how Mayan, Aztec and Incan artists worked with gold and silver to make jewellery, face masks and animal figures
- Research Aboriginal artists from BC who are famous for their beautiful works with gold, silver, jade, or argillite (e.g., Charles Edenshaw, Bill Reid, Robert Davidson, Roy Vickers).

GRADE 9: FORMS OF REPRODUCTION

Concept: Indigenous peoples developed in-depth knowledge of plant propagation (asexual reproduction) and care for harvesting food sources.

- Research how Aboriginal peoples in BC developed knowledge of plant propagation and genetic variability (pruning, budding, grafting, coning, weeding, selective harvesting, transplanting roots)
- Research Indigenous peoples of Meso-America's knowledge of plant propagation and genetic variability (varieties of potatoes, beans)
- Research how ancient Indigenous peoples of southern Mexico developed corn from grass plants using a process we now call "selective breeding."

GRADE 9: MEDICINE AND MEDICINAL HERBS

Concept: Aboriginal peoples (past and present) harvest plants and animals for medicinal purposes.

- Infer why Aboriginal peoples often use the phrase "the forest is our drugstore"
- Invite a knowledge holder into the classroom to discuss medicinal uses of plants
- Go on a plant walk with a knowledge holder to identify medicinal plants
- Identify and illustrate Aboriginal medicines in BC (e.g., willow bark for headaches, yarrow tea for colds, devil's club for diabetes, seaweed/sea wrack for burns)
- Infer how Indigenous peoples might have discovered that tea made from willow bark cures headaches
- Research the Aboriginal and scientific uses of yew wood for medicinal purposes (taxol for curing cancer)
- Research Indigenous medicines from the Americas (quinine, Ipecac, Aloe vera, Echinacea)
- Research the uses of neem oil in India and North Africa (medicinal, biodegradable insecticide)
- Research how pharmaceutical companies develop and patent medicines from Indigenous peoples' knowledge worldwide
- Research how companies gain access to Indigenous knowledge
- Research and discuss the ethics of obtaining knowledge and not returning a direct benefit back to the community
- Research the terms epidemic and pandemic, and how measles and the smallpox pandemic affected Aboriginal peoples and culture after the arrival of the first Europeans
- Invite an Aboriginal health practitioner into the classroom to discuss health issues in Aboriginal communities.

Appendix B: Selected Curriculum Websites

See Chapter 5 for a more descriptive overview of projects and curriculum resources.

Canadian Web Sites

Aikenhead, G. S. (2000). *Rekindling traditions: Grades 6 to 10 cross-cultural science and technology units*. University of Saskatchewan. Retrieved from http://www.usask.ca/education/ccstu/

Arntzen, H. *Artist response team*. Teacher Handbooks and Videos. Specializes in eco-music and education activities that promote understanding ecology, Aboriginal knowledge of nature, and sustainability. To order: http://www.artistresponseteam.com/music-2/

Gaxsoo Canoes: A Cross-curriculum unit for grade 5. First Nations Education Services, SD 52, Prince Rupert, BC. To order: http://sd52.bc.ca/abed/wp-content/uploads/2009/04/orderlist1.pdf

Menzies, C. R. (2003). *Forests and oceans for the future. Curriculum units on traditional plant knowledge, geography, ecology, and resource management*. Vancouver, Canada: Department of Anthropology, University of British Columbia. Retrieved from http://www.ecoknow.ca

Aboriginal access to engineering. Award-winning site for kids, parents and teachers supporting Aboriginal youth to become engineers. Queen's University. Retrieved from http://www.aboriginalaccess.ca

Oceans Network Canada. Embraces diversity of ocean sciences, place-based knowledge, and cross-cultural learning. University of Victoria. Retrieved from http://www.oceannetworks.ca/learning/get-involved/educators

Saint Marie, Buffy. *The Cradleboard Project. Science: Through Native eyes*. Nihewan Foundation, CD Rom Series. To order: http://www.cradleboard.org/cd.html

Sila Alangotok: Inuit observations of climate change. (2000). Teacher's guide and 60-minute DVD, University of Manitoba, IISD Productions. Chronicles observations by the Inuvialuit that support the Western Science prediction that climate change would be first felt in the Polar Regions.

Summary DVD. Retrieved from http://www.iisd.org/library/inuit-observations-climate-change-full-length-version-dvd

Teacher's guide for the video. Retrieved from http://www.edu.gov.mb.ca/k12/docs/support/sila_video

Strong Nations Publishing. One of the largest selections of Indigenous books on-line, including recent K-1, 2 curriculum resources. Nanaimo, BC. To order: http://www.strongnations.com

Alaska Web Sites

The Alaska materials are highly recommended for BC teachers as much of the content is relevant to west coast and northern Canadian climatic conditions, wildlife, hunting and fishing, and food gathering technologies.

Alaska Native Knowledge Network: ANKN. A rich database of science lessons searchable by content, cultural region, and grade level. Retrieved from http://www.ankn.uaf.edu/curriculum/units/

Alaska Science Fairs, Camps and Equipment. Promotes local and culturally relevant curriculum in science and mathematics. Retrieved from http://www.ankn.uaf.edu/publications/alaska_science/Fairs.html

Stephens, S. (2000). *Handbook for culturally responsive science curriculum*. Alaska Science Consortium and the Alaska Rural Systemic Initiative. Alaska Native Knowledge Network. Cross-cultural science units. Retrieved from http://www.ankn.uaf.edu/publications/handbook/handbook.pdf

Appendix C: Selected Indigenous Science Books

Indigenous Science Education Books

Aikenhead, G., & Michell, H. (2011). *Bridging cultures: Indigenous and scientific ways of knowing nature.* Toronto, ON: Pearson Canada.

Cajete, G. (1994). *Look to the Mountain: An ecology of Indigenous education.* Skyland, NC: Kivaki Press.

Cajete, G. A. (1999). *Igniting the sparkle: An Indigenous science education model.* Skyland, NC: Kivaki Press.

Indigenous Science, Worldview and Philosophy

Berkes, F. (2012). *Sacred ecology (3rd edition).* New York: Routledge Taylor and Francis Group.

Cajete, G. (2000). *Native science: Natural laws of interdependence.* Santa Fe, NM: Clear Light Publishers.

Kirk, R. (1986). *Wisdom of the elders: Native traditions on the Northwest Coast.* Vancouver, BC: Douglas & McIntyre.

Knudtson, P., & Suzuki, D. (1992). *Wisdom of the elders.* Toronto, ON: Stoddart Publishing Company.

Peat, F. D. (1994). *Lighting the seventh fire: The spiritual ways, healing, and science of the Native American.* New York: Birch Lane Press.

Indigenous Science of Northwestern North America

Arima, E., & Hoover, A. (2011). *The whaling people of the west coast of Vancouver Island and Cape Flattery.* Victoria, BC: Royal BC Museum.

Deur, D. E., & Turner, N. J. (Eds.). (2005). *Keeping it living: Traditions of plant use and cultivation on the northwest coast of North America.* Seattle, WA: University of Washington Press.

Stewart, H. (1973). *Artifacts of the Northwest Coast Indian.* Saanichton, BC: Hancock House Publishers.

Stewart, H. (1977). *Indian fishing: Early methods on the northwest coast.* Vancouver, BC: J.J. Douglas Ltd.

Stewart, H. (1984). *Cedar: Tree of life to the northwest coast Indians.* Vancouver, BC: Douglas & McIntyre.

Turner, N. J. (1995). *Food plants of coastal First Peoples.* Royal British Columbia Museum Handbook. Vancouver, BC: UBC Press.

Turner, N. J. (1998). *Plant technology of First Peoples in British Columbia.* Royal British Columbia Museum Handbook. Vancouver, BC: UBC Press.

Turner, N. J. (2005). *The earth's blanket: Traditional teachings for sustainable living.* Vancouver, BC: Douglas & McIntyre.

Turner, N. J. (1997). *Food plants of interior First Peoples.* Royal British Columbia Museum Handbook series. Vancouver, BC: UBC Press.

Turner, N. J. (2010). *Plants of Haida Gwaii.* Winlaw, BC: Sono Nis Press.

Turner, N. J., & R. J. Hebda. (2012). *Saanich ethnobotany: Culturally important plants of the WSÁNEĆ people.* Victoria, BC: Royal BC Museum Publishing.

Turner, N. J. (2014). *Ancient pathways, ancestral knowledge: Ethnobotany and ecological wisdom of Indigenous peoples of northwestern North America, Volume 1: The history and practice of Indigenous plant knowledge.* Montreal, QC: McGill-Queen's University Press.

Turner, N. J. (2014). *Ancient pathways, ancestral knowledge: Ethnobotany and ecological wisdom of Indigenous peoples of northwestern North America, Volume 2: The place and meaning of plants in Indigenous cultures and worldviews.* Montreal, QC: McGill-Queens University Press.

Pasco, J., & Compton, B. (1998). *The Living World: Plants and animals of the Kwakwaka'wakw.* Alert Bay, BC: U'mista Cultural Society.

Williams, J. (2006). *Clam gardens: Aboriginal mariculture on Canada's west coast*. Vancouver, BC: New Star Books.

Indigenous Science of the Americas

Anderson, R., & Bone, R. (2003). *Natural resources and Aboriginal people in Canada: Readings, Cases and Commentary.* Concord, ON: Captus Press Inc.

Inglis, J. Ed. (1993). *Traditional ecological knowledge: Concepts and cases.* Ottawa, ON: International Development Research Centre (IRDC) Books.

Johnson, M. (1992). *Lore: Capturing traditional environmental knowledge.* Ottawa, ON: Dene Cultural Institute and the International Development Research Centre.

Menzies, C. (2006). *Traditional ecological knowledge and natural resource management.* Lincoln, NE: University of Nebraska Press.

Warren, D. M., Slikkerveer, L. J., & Brokensha, D. (Eds.) (1995). *The cultural dimension of development: Indigenous knowledge systems.* London, UK: Intermediate Technology Publications.

Weatherford, J. (1988). *Indian givers: How the Indians of the Americas transformed the world.* Toronto, ON: Random House.

Weatherford, J. (1991). *Native roots: How the Indians enriched America.* Toronto, ON: Random House.

Wright, R. (1992). *Stolen continents: The new world through Indian eyes since 1492*. Toronto, ON: Viking Press.

Appendix D: Research Project and Graduate Program

The Research Team

The project was initiated by Dr. Wanosts'a7 Lorna Williams in September 2003 when she was Director of the Aboriginal Education Enhancements Branch of the Ministry of Education in British Columbia. Dr. Gloria Snively, science and environmental educator and Director of the Graduate Program in Environmental Education at the University of Victoria accepted an invitation to serve as principal investigator for the project. In July 2004, Dr. Williams began a tenure track position at the University of Victoria and became Director of Aboriginal Teacher Education.

The Vision

In January 2003, a group of invited University of Victoria faculty, graduate students, Ministry officials, non-Aboriginal resource persons, and Aboriginal leaders and Elders from around the province met at Dunsmuir Lodge, Victoria to generate a vision statement and to identify possible research directions. The following vision statement reflects the ideas, concerns, and vision of those in attendance.

Programs and curricula need to be developed that:

- Teach Aboriginal children that their culture has contributed to scientific knowledge and will continue to do so.
- Links science instruction to local Indigenous Science and Traditional Ecological Knowledge and Wisdom.
- Recognizes and engages the expertise of local Aboriginal people and links their current observations and understandings to a vast historical and cultural database gained from observation and experience.
- Enables Aboriginal students to understand the importance of science in their daily lives and its relationship to themselves, their community, and the world in which they live.
- Celebrates equity and diversity and recognizes equity and diversity as essential.
- Instills concepts such as giving back to the earth, prayer, offerings, and stream restoration.
- Where possible locating science concepts and practices in First Nations languages to provide a better understanding from a First Nations perspective.
- Enables Aboriginal students to be successful in school and not lose their cultural identify. (Snively & Williams, 2006, p. 232)

These essential points are reflected throughout the context, framework, research methods and expressions of Aboriginal education presented in this project. The research project drew upon the wisdom, knowledge and experience of Elders and community leaders in order to identify both science content elements of Indigenous Knowledge and TEK, as well as identify culturally appropriate and effective ways of teaching and learning science. The intent was to strengthen the connection of Aboriginal children to the land through their Elders, and to develop a new expression of science education for Aboriginal children in the 21st century.

Building a Community of Researchers

By working with Aboriginal graduate students, rather than with practiced researchers, this project was unique in that it was designed to promote capacity building amongst Aboriginal peoples. Although this was an important key element of the research project, it had the difficulties of attempting to work with a cadre of inexperienced graduate students, many of whom were at the beginning stages of taking graduate level research courses.

The Graduate Program in Environmental and First Nations Education

During the summer of 2004, an off-campus Graduate Program in Environmental and First Nations Education was offered to both Aboriginal and non-Aboriginal students in ‘Yalis (Alert Bay), British Columbia, home of the Kwakwaka’wakw people. The aim of this graduate program was “to bring together Aboriginal and non-Aboriginal persons to work together in learning about the forest and ocean environments, respecting the cultures of Aboriginal people, and educating future citizens to make wise decisions regarding long-term sustainable communities and environments” (Snively, 2006). Because the majority of graduate students were full-time teachers, the program was developed to take place in three summer sessions.

The graduate program explored a range of research methods deemed culturally appropriate for the research phase of the project: participant observation, informal interviews with Elders and resource persons, participatory action research (PAR), metaphorical interviews, student drawings, students as researchers creating videos of their choice and archival research. In these studies, cultural validity was assured by having Aboriginal teachers as researchers, Aboriginal Elders and groups participating in identifying the content and teaching strategies of the local science curriculum, participating in the teachings, and identifying culturally appropriate assessment practices.

The first summer session combined a variety of experiences with the natural environment with primary historical documents on BC First Nations’ history and culture, including input from First Nations’ Elders and other resource persons. Courses focused largely on topics dealing with the TEK of several First Nations of BC; current educational issues relevant to Aboriginal peoples; the knowledge and skills of WS; community-environment relationships; and the contributions of both WS and TEK to environmental knowledge, and the resolution of environmental and resource problems.

Although much of the program was team taught, the combined program of courses included Community, Culture and Environment taught by historical researcher John Corsiglia; Ethnobiology of British Columbia First Nations taught by ethnobiologist Dr. Brian Compton; Mythology, Stories and Science, taught by Yup’ik science educator Dr. Oscar Kwagley; and Environmental Education taught by Dr. Gloria Snively. “A key tenant was that environment and culture could not be considered separately, there could be no course on Kwagu’ł culture that was not also about the Kwagu’ł environment. Culture and environment are inextricably linked and must be

treated holistically" (Snively, 2006, p. 203). Common experiences included direct experience with the Elders, and conducting archival and museum research associated with historical events related to colonization and decolonization.

Experiences with Elders and community leaders were coordinated by Gloria Snively and Gwi'molas Vera Newman, a Kwakwaka'wakw language and culture teacher; and included informative and inspiring presentations by Chief Kwaxalanukwa'me' 'Namugwis Bill Cranmer, Chief Nulis Edwin Newman, 93 year old 'Mam'xu'yugwa Auntie Ethel Alfred, Ga'axstalas Flora Cook and 'Waxawidi William Wasden, Jr.; and day hikes and extended boat trips led by Wadzidalaga Wata Christine Joseph, Gwi'molas Vera Newman and Tłalilawikw Pauline Alfred. Topics included the use of Kwakwaka'wakw traditional herbs, traditional medicines, the ethnobiology of marine forest resources, principles associated with language and culture, and historical cultural events. Western Science specialists gave presentations, including whale researcher Dr. Paul Spong, marine biologist Michael Berry, ethnobiologist Brian Compton, and anthropologist Dr. David Garrick.

By bringing together Elders and acknowledged specialists in the key inter-related disciplines, and by providing both Aboriginal and non-Aboriginal students with a total emersion experience in a dynamic Aboriginal community, the program provided a unique interdisciplinary starting point for designing research projects and developing educational programs and curriculum materials.

During the winter of 2004/5, the students took Field Based Research Methods taught by Gloria Snively that was designed to help the students begin to think about their research proposals. During the summer of 2005, they took two courses that were designed to provide additional research skills and focus on concepts associated with the current project: Aboriginal Ways of Knowing taught by Dr. Wanosts'a7 Lorna Williams and Interpretive Inquiry taught by Dr. Ted Riecken. Finally, during the summer of 2006 the students took Marine Biology for Teachers from Dr. Rick Kool at the Bamfield Marine Science Centre, a world-class teaching and research facility located on the outer west coast of Vancouver Island.

Although we consciously avoided teaching science and environmental courses in an assimilative way, the students were expected nevertheless to understand the world through the eyes of the Western scientist, just as they were expected to understand the world through the eyes of Aboriginal peoples.