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EDUCATION FOR PLANET EARTH

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Education for Planet Earth

Editorial

On an island in the middle of the St. Lawrence River, at the intersection of Ontario, Québec and New York, sits the Akwesasne Mohawk School. Twenty years ago, the school revamped the Grade 6–8 science curriculum so that their students could more confidently “walk in two worlds” when they left the island to go to public high schools across the river in Ontario. The program stressed the importance of local ecosystem knowledge, and graduating students were expected to recognize 50 local birds, identify the tracks of local mammals, understand the medicinal properties of plants, and be able to map the streams and rivers in their watershed. To facilitate such learning, Native elders accompanied students on numerous field trips during the school year. The new curriculum was so successful that teachers in non-Native schools nearby began asking if their classes could join the field trips. They recognized that the holistic, bioregional view of the environment imparted in Native science provided an essential counterpoint to the objective, analytical view imparted through Western science.

Having published the story of the Akwesasne curriculum project many years ago, we were excited to learn last year about the integrative approach to science education currently being taken by Annamarie Hatcher, Cheryl Bartlett and their colleagues in the Institute for Integrative Science and Health at Cape Breton University in Nova Scotia. Inspired by the concept of “Two-Eyed Seeing” developed by Mi'kmaq Elder Albert Marshall, their science program aims to help students learn “to see from one eye with the strengths of Indigenous ways of knowing, and from the other eye with the strengths of Western ways of knowing, and to use both of these eyes together.” In this issue, we present some of the learning activities that they and others have designed for teaching science in this way, thus enabling students to take the best from both world views, Indigenous and Western.

Regardless of where one teaches, integrating the sciences and world views of local Indigenous peoples into the curriculum can be a fascinating inroad to a more bioregional education, one that enables young people to develop a strong sense of place, a respectful relationship with other species, and an awareness of their responsibilities as stewards of the land and resources they and future generations depend on. We hope you will find much in this issue to inspire your own teaching, and, as always, we welcome your comments.

— Tim Grant and Gail Littlejohn, Editors

Note about terminology in this issue:
Native Americans, First Nations, Aboriginal peoples, Indigenous peoples... depending on where you live, you may be more familiar with one of these terms than with the others, but they are synonymous. All refer to the original peoples of a particular region.
In editing this issue, we have chosen not to strive for consistency, but rather to let the individual authors use the terms of their choice.

MSɫT: Transdisciplinary, cross-cultural science

An Integrative Science unit on birds for high school students


Ray Cromie

by **Annamarie Hatcher** and **Cheryl Bartlett**

THE THEME "BIRDS" is a productive avenue for exploring many questions that can be incorporated into presentations, outdoor activities and laboratory exercises. Birds have a cultural significance and a strong presence in many legends of the Mi'kmaq and other Aboriginal peoples, and serve as a link between the present interests of students and the past interests of their ancestors. In observing birds, students observe their surroundings and arrive at a more holistic understanding of their environment. Birds are also of interest to many parents and grandparents, and this encourages students to share stories and information with family and community members.

Here we outline the basics of a question-based approach to the theme "Birds" for high school students. It is adapted from the MSɫT curriculum in the Community Studies in Integrative Science program at Cape Breton University in Nova Scotia. MSɫT is a Mi'kmaq word meaning "everything together," and the MSɫT curriculum employs the "Two-Eyed Seeing" approach of integrating Western and Aboriginal world views. The classroom mirrors the world outside the window, and practical engagement with that world is an integral part of the curriculum. Indigenous science concepts, such as the interrelatedness of all things, are examined in the context of natural cycles at all time and space scales.

The bird-friendly classroom

Students can begin to gain familiarity with birds by installing birdfeeder "watch stations" in nearby natural areas and sheltered spots outside classroom windows. Choose at least two different habitats, such as the north and south sides of the building, or among trees and out in the open. As students log their observations, they should note spatial and temporal patterns in the numbers, types and behaviour of birds. They can generate hypotheses to explain these patterns, as well as compare them to weather patterns that are easily measured with thermometers, rain gauges and hand-held anemometers. For bird monitoring resources, see Project Feeder Watch <www.birds.cornell.edu/pfw/>.

Left: Brete Griffin; Right: Gail Littlejohn

Transdisciplinary understandings

1. Where do birds fit on the evolutionary tree of Western science? How does this relate to the Aboriginal concept that we are all related?

This topic incorporates aspects of the Western disciplines of genetics, evolutionary theory, biochemistry, geology and astronomy, and the Native understanding of the interrelatedness of all things.

Genetics and biochemistry: Genetics concentrates on living things, whereas the "we" in "we are all related" refers to both living and non-living components of an ecosystem. If we extend our view back to life's basic building blocks, we come to a non-living component: the phosphorus atoms in amino acids, which make up DNA. The molecular building blocks of our DNA may have once been incorporated into the DNA of a bird, a dinosaur or a tree. Atomic components were once part of rocks and, even further back, of a star or of space dust.

Evolutionary theory: The skeletons of humans and birds have many homologous (similar) structures, a reminder of the evolutionary connection between them. Students can compare and contrast skeletons of birds and other animals, beginning at The Biology Corner website, where they can colour homologous skeletal structures. Try cutting out the skeleton pieces and have the students re-assemble them and discuss the degree of similarity. See <www.biologycorner.com/worksheets/comparing_avian_human.html>.

Geology and astronomy: Some natural cycles proceed over very long time scales and change the Earth's surface (such as through plate tectonics and continental drift). Others, having to do with changes in the shape of Earth's orbit (eccentricity), the wobble on its axis (precession) and its axial tilt, result in the Earth being closer to or further from the sun at different times. Because of these cycles, Mother Earth experiences periods of glaciation and warming, so that birds may have evolved in a climate very different from the one we now experience. Many birds now migrate long distances, having adapted strategies in their evolutionary past to avoid solid masses of ice. The cycle of precession caused our ancestors to see a different pole star, and our descendants will see yet another. Students can see a simulation of the precession cycle at <http://cse.ssl.berkeley.edu/lessons/indiv/beth/beth_precess.html>.

2. How is flight in birds related to my environment?

This is a good topic for introducing basic principles of physics and the concepts of adaptation and natural selection.

Physics: The shape of a wing causes air pressure to be higher below it than above it. This creates lift, a positive force that allows birds (and airplanes) to fly. If the wing is shaped differently, airspeed over the wing changes and the amount of lift changes.

Natural selection: Function dictates form in the design of bird wings, a match that has resulted from the pressures of natural selection. Short, stumpy wings (with low aspect ratio) are characteristic of birds that live in the forest and fly among tree trunks. They are capable of rapid takeoff and maneuvering but cannot sustain high speed. Similarly, aircraft manufacturers outfit short-hop aircraft that have to be very maneuverable with low aspect-ratio wings. Soaring seabirds, on the other hand, use long narrow high-aspect-ratio wings to take advantage of updrafts created on windward slopes. The eagle (*Kitpu*) carries prayers to the Creator on its wings, and its "finger-tip" feathers help it to maneuver. Wing and feather adaptations can help to introduce concepts of natural selection. Students might calculate aspect ratios of various birds' wings, matching these with habitat or flight characteristics.

3. What can birds tell us about weather?

Birds are very good weather predictors. In our region of Cape Breton, the local abundance of some short-distance migrators such as the common Redpoll and the White-winged crossbill is a reflection of the food abundance in their habitats farther north. The appearance of large flocks of redpolls in early winter is often a harbinger of a hard winter; in mild winters, they stay in their more northerly habitats. Seagulls often appear in sheltered inland waterways when a marine storm is approaching. (*"When the seagulls fly to land, there is a storm at hand."*) For students living near

Annamarie Hatcher

large water bodies, this can form the basis of a simple exercise of monitoring seagull numbers in certain sheltered sites and correlating the numbers to offshore wind speed.

4. What role do birds play in science and legend?

Birds have a significant presence in Mi'kmaq science because their abundance and distribution are indicators of weather patterns, productivity of various plants, environmental disturbances and of other, related phenomena, such as fish abundance.

Birds also play a significant role in many Aboriginal legends, such as the Mi'kmaq story of "The Bird Whose Wings Made the Wind." In this legend, a large bird called The Storm King causes winds to be so intense that the families on the seashore cannot spear eels. One man tricks the bird into letting him carry him to shore. But the man drops the bird, and his wing is broken. The man binds both wings and brings food to the bird. Because the wings of the bird are bound, the winds cease and the weather becomes calm, allowing the villagers to catch many fish. This seems ideal, but it is too much of a good thing, and a dense scum forms on the ocean because of the lack of water circulation. The scum prohibits eel spearing because the hunters cannot see into the water. The man visits the bird again and frees one of its wings. With the winds now gentle and steady, the water begins to circulate properly and the villagers are able to spear enough eels to feed their families.

This legend conveys a strong message about ecological relationships and the unpredictable consequences of interfering with natural processes. In the oral traditions of Aboriginal people, such legends served to educate and amuse. Students may generate their own stories by reading articles on environmental issues and then writing simple stories to convey environmental messages. The "Native Drums" website has good sections on myths and stories See <http://nativedrums.ca/>.

The connection between our stories and our treatment of the natural world is one that Western storytellers and educators have perhaps failed to realize.

5. What can birds tell us about the health of our environment?

For the Mi'kmaq people, the bald eagle (*Kitpu*) is the messenger to the Creator because it flies high and is respected by all creatures. Kitpu and other birds are also sensitive environmental indicators, as evidenced during the DDT crisis of the mid-20th century. Seabirds follow schools of fish, and many cultures have used them as indicators of fish accumulations. A modern example of birds as environmental indicators is the devastating impact of pesticides in South and Central America on songbirds that migrate back to North America.

Integrative Science is underlain by pattern recognition and an intimate, respectful relationship between the scientist, the natural world and different worldviews. Following the question-based approach outlined above, there should be a natural progression, from observation of spatial and temporal patterns of bird abundance outside of a bird-friendly classroom, to discussions of natural selection and evolution, to the physics of flight, to the dynamic nature of our local environments over long temporal scales due to extra-planetary forces. The Western science meshes elegantly with an exercise on story-telling and the oral tradition, which could lead the class in several directions. With their teacher using birds as a catalyst to make them look at what is outside the school doors, students will leave this theme with a renewed appreciation of their local environment.

Annamarie Hatcher is a Senior Research Associate in the Institute for Integrative Science and Health at Cape Breton University in Sydney, Nova Scotia. **Cheryl Bartlett** is a Tier I Canada Research Chair in Integrative Science and Professor of Biology at Cape Breton University.

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