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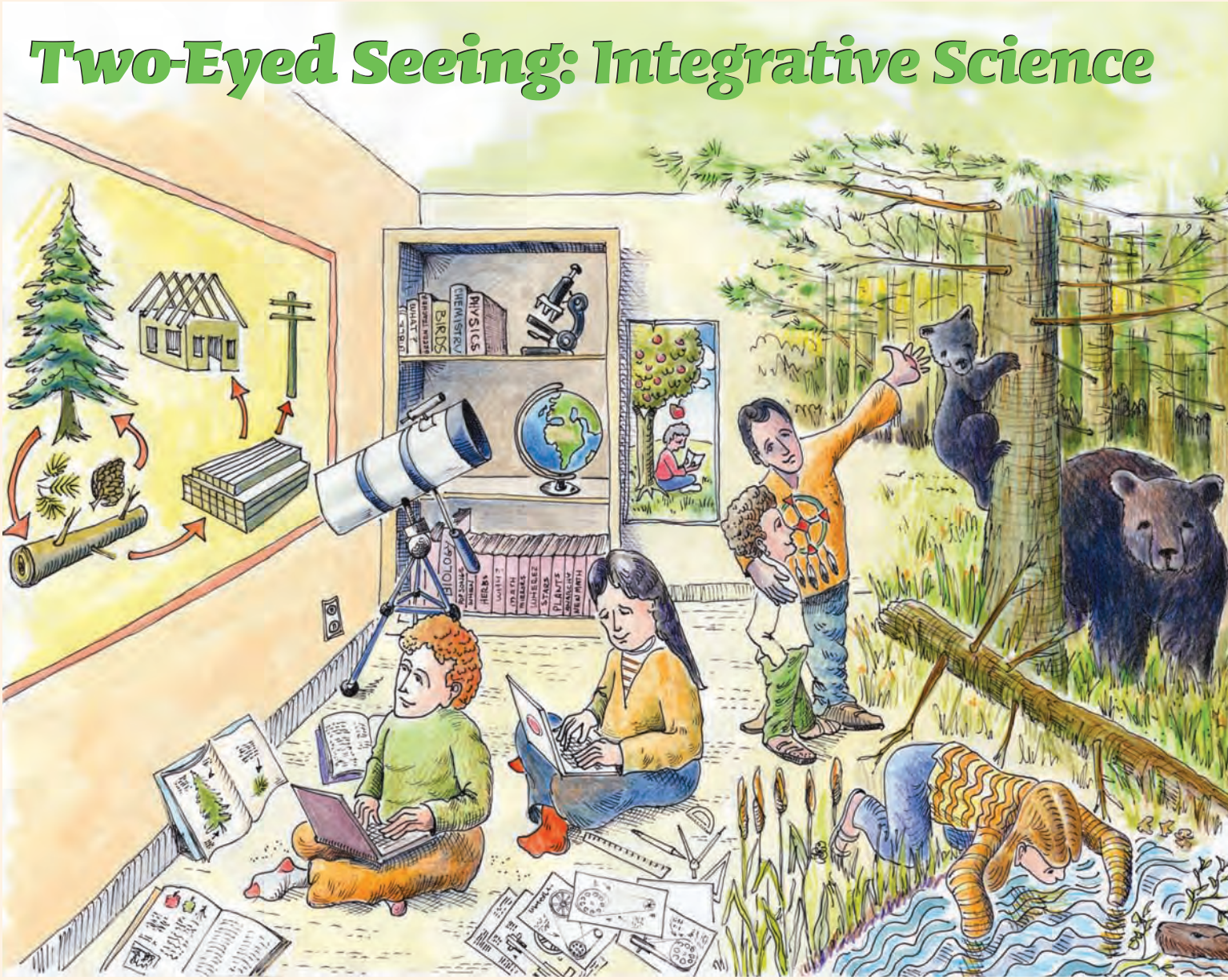
Two-Eyed Seeing: Integrative Science



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Vitamin C Trees: Traditional Medicine

Integrative Science with Native Elders

Earth Alive! Ecosystem Deities

Linking Astronomy and Legend

Resanctifying Nature through Story

Teaching Solstices and Equinoxes

Page 11

Page 25

Page 39

Green Teacher

Issue 86, Fall 2009

Features

Departments

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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.

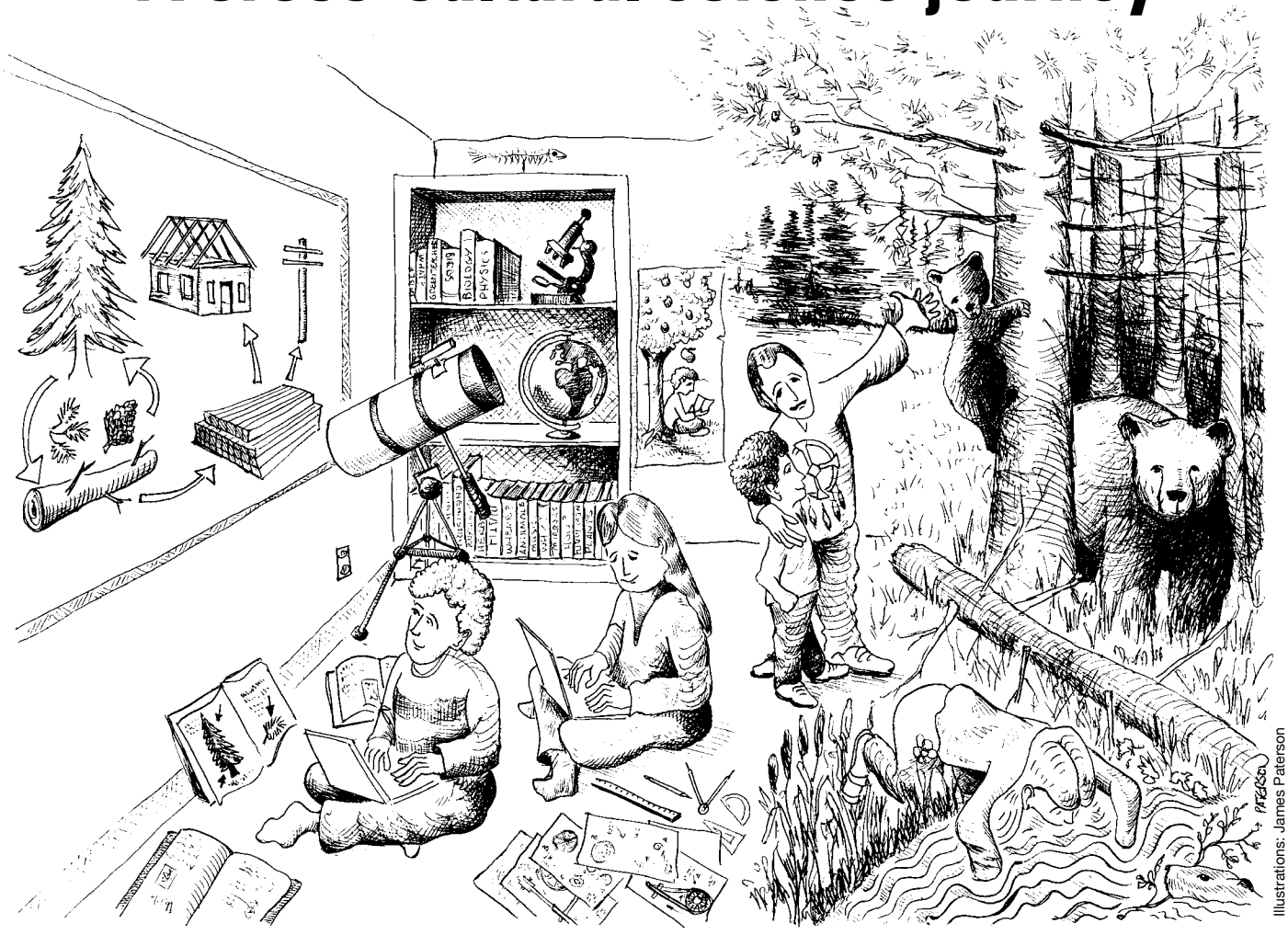
Having published the story of the Akwesasne curriculum project many years ago, we were excited to learn last year about the integrative approach to science education currently being taken by Annamarie Hatcher, Cheryl Bartlett and their colleagues in the Institute for Integrative Science and Health at 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.

Two-Eyed Seeing:
A cross-cultural science journey



Illustrations: James Paterson

by **Annamarie Hatcher**, **Cheryl Bartlett**, **Murdena Marshall** and **Albert Marshall**

THE SCIENCE FAMILIAR TO most of us from school is often referred to as "Western" because of its origins in Western Europe. Yet with its objective approach and mechanistic view of the world, Western science can seem like a foreign culture to many students. According to the Canadian Council for Learning, "the acquisition of science knowledge is often symbolic, abstract and counter-intuitive, unlike the acquisition of everyday knowledge, which is usually pragmatic, personal and based on experience."[1] There are many different ways of knowing, and one of the challenges for teachers is building bridges among them with their students. This challenge is being faced in the Integrative Science program at Cape Breton University as a small group of educators, academics and Mi'kmaq elders build bridges between Western sciences and Indigenous[2] sciences. Guided by the Mi'kmaq culture, Integrative Science represents the coming together of Indigenous and Western sciences in a type of co-existence, a functioning of both systems side by side, as recommended by Battiste.[3] This bridge building began as a way to address the serious under-representation of Aboriginal students in scientific fields. However, the approach is beneficial to all students because it adds an engaging cultural dimension to science studies, provides context for learning about other nations, and demonstrates that all knowledge has a cultural context.

In the Mi'kmaq language, *Toqwa'tu'kl Kjijitaqnn* (Integrative Science) means bringing together Indigenous and Western knowledge using the guiding principles of "Two-Eyed Seeing,"that is, 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. By concentrating on common ground and respecting differences, we have begun to build a bridge between these two ways of knowing. In this and several companion articles, we present concepts and lessons that lie in the common ground between the two.

Science sub-cultures

It is important to reflect on the evolution of the word "science." Today's scientists embrace fundamental worldviews that are shaped by the origin and evolution of science in the social transformations in Europe in the 1600s. The empirical approach of Western science arose in opposition to the authority of church and monarchy, and its emphasis on quantitative objectivity involves a disconnection between the observer and the observation. With the birth of the British Association for the Advancement of Science in 1831, the word "science" became applied to the Western (i.e., Eurocentric) approach that is commonly practiced today. Before this, "science," derived from the Latin *scientia*, simply meant knowledge.[4]

In verb-based Indigenous languages, knowing is more about the journey than about the destination. Indigenous worldviews do not subscribe to the anthropocentric hierarchy of the Western worldview, but rather to a more natural balance of all creation. Indigenous sciences encompass a large range of "coming to know" processes that result from human experiences in the natural world. Knowledge is gained from the interaction of "body, mind, soul and spirit with all aspects of nature."[5] Battiste and Henderson summarize the structure of Indigenous ways of knowing as follows: 1) knowledge of unseen powers; 2) knowledge of the interconnectedness of all things; 3) a perception of reality based on linguistic structure or ways of communicating; 4) knowledge that personal relationships bond people, communities and ecosystems; 5) knowledge that traditions teach specialized knowledge related to morals and ethics; and 6) knowledge that extended kinship facilitates the passing on of social traditions and practices from one generation to the next.[6]

In verb-based Indigenous languages, knowing is more about the journey than about the destination.

Indigenous sciences are underlain by the perception of multiple realities, of which the reality perceived by our five senses is but one.[7] Thus Indigenous knowledge is more than the opposite of Western knowledge and should be seen with eyes unbiased by the dominant Eurocentric outlook. This is a formidable challenge for teachers in the current education system. The basic premise of Western sciences is that nature is "knowable,"[8] and thus Western scientists seek to know how the universe works. The Indigenous view of nature comes from deeper within the human psyche than intellectual curiosity.[9] The basic premise of Indigenous sciences is seeking to know what nature is, not how it works.[10]

Why two sciences for students?

Multi-science perspectives about nature expose students to a rich array of knowledge and ways of living, and open up opportunities to link science with other disciplines such as history and English. For example, Integrative Science provides fertile ground for development of multidisciplinary theme-based units for all grades. For all students, and especially those who plan a future in resource management, science or engineering, Integrative Science helps to develop a multifaceted understanding of nature and problem solving and the personal role of the scientist in the conduct of the science.

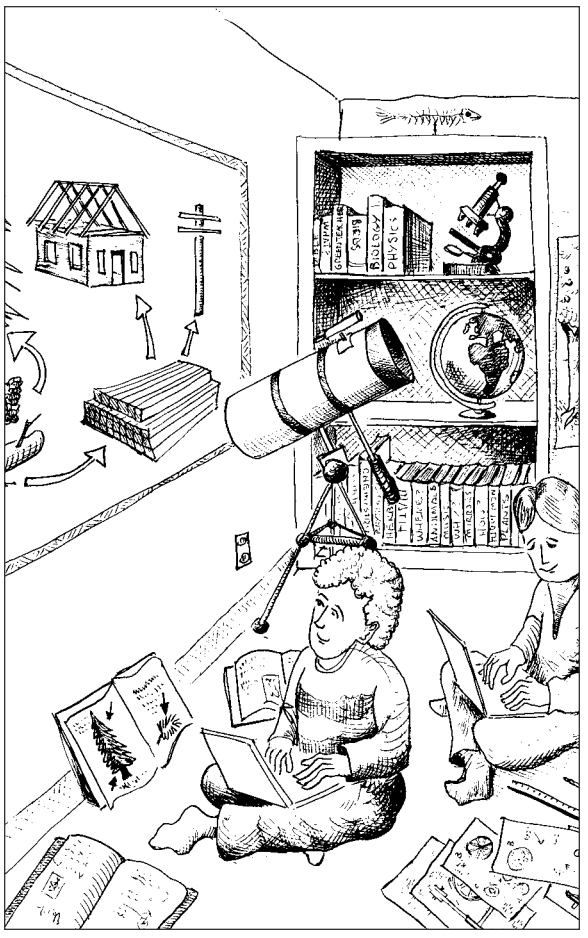
At the World Conference on Science in 1999, UNESCO and the International Council for Science urged governments to promote understanding of Indigenous knowledge systems. They recommended that "scientific and traditional knowledge" be integrated into interdisciplinary projects with links between culture, environment and development.[11] In this and companion articles we will outline some ways to follow this recommendation with respect to teaching science in schools.

Two-Eyed Seeing

It was Mi'kmaq Elder Albert Marshall who brought the concept of Two-Eyed Seeing to Integrative Science. Marshall's experience in residential school led him on a lifelong quest to connect with and understand both the culture he was removed from and the culture he was forced into, and to help these cultures live in mutual respect of each other's strengths and ways. Two-Eyed Seeing recognizes that in a particular set of circumstances we may choose to call upon the strengths of Indigenous sciences, and in another set of circumstances we may choose to call upon those of Western sciences. For example, when we need to compare plant abundance in two habitats and communicate the results to others, we rely heavily on standardized data acquisition, analysis and summarization from Western sciences. But when we wish to teach our children how to catch trout, we teach about the trout, their life cycle and their habitat by experience and by example.

This teaching is holistic, in that the child becomes familiar with cues from several of her senses, drawing on some of the strengths of Indigenous sciences. She will learn the smells of cool freshwater, the sounds of swiftly flowing streams and the visual patterns of insect abundance, and relate these to the movements of the trout. This knowledge is easily passed from those with experience and reinforced by the child's interaction with nature. This interactive aspect of learning is imbedded in Indigenous sciences.

In weaving back and forth between knowledges, Two-Eyed Seeing avoids a clash or "domination and assimilation" of knowledges.[12] As the child grows and learns more Western sciences, she will realize that the smells associated with good catches of brook trout (*Salvelinus fontinalis*) are related to the animals' physiological requirement for highly oxygenated water at temperatures less than 20 degrees Celsius. These environmental conditions provide habitat for diatoms, which have a very identifiable smell. The shallower rapidly-flowing waters where brook trout feed have gravel and rocky bottoms that produce an identifiable sound as water rushes by. The waxing and waning patterns of insect abundance provide clues to the position of the feeding trout and to the type of bait that may be most effective. This can be related to the large body of Western scientific knowledge of preferred prey items of trout, largely catalogued from analyses of gut samples. For Two-Eyed Seeing, we can take the best from our two worlds, Indigenous and Western.



Lying at the juxtaposition of two worldviews, Integrative Science involves a practical engagement with the real world.

Western sciences emphasize objectivity and de-emphasize the subjective human element, yet we depend heavily upon them and their technologies in our modern lives. In the Indigenous worldview, emphasis is placed on the concept of "all my relations." This includes not just our human families, but animals, plants, rocks and other parts of the ecosystem, which are all included in Mother Earth and Father Sky. Components of nature are viewed as spiritual beings, not in order to explain natural phenomena but because human beings experience a spiritual resonance in nature. "Two-Eyed Seeing teaches you to awaken the spirit within you," explains Albert Marshall. "You become a student of life, observant of the natural world. Two-Eyed Seeing teaches that everything is physical and spiritual."

Pattern-based knowledge and the multiple intelligences

Patterns are abstract, culturally-influenced ways of creating order out of apparent disorder through space and time. In the context of Integrative Science, scientific knowledge is considered to be dynamic, pattern-based knowledge shared through stories about our interactions within nature. Different cultures shape and share stories about natural patterns in different ways by using few or many of our multiple human intelligences. The educational theory of multiple intelligences, first developed by Howard Gardner in 1983,[13] describes seven kinds of intelligence: linguistic, logical-mathematical, spatial, bodily-kinesthetic, musical, interpersonal and intrapersonal. In 1998, Gardner added "naturalistic" intelligence.[14] He proposed that individuals manifest varying levels of these different intelligences.

Of the eight intelligences recognized by Gardner, Western sciences tend to draw most on the logical-mathematical (enumerating) and linguistic (reading, writing). For example, scientific names of plants may describe their morphology, but they may also describe a plant's ecology or geography, or honour a person. Wintergreen (or teaberry), a common forest understorey plant of northeastern North America, has the scientific name *Gaultheria procumbens L.* The common name, wintergreen, provides descriptive information about the plant, and "teaberry" describes one of its uses. The genus name, "Gaultheria," honours the J.F. Gaultier, king's physician and naturalist of New France (1708–1756); and "procumbens" means "prostrate or lying down," a reference to the plant's ground-hugging habit. The connection between the plant and the physician Gaultier is the product of a predominantly linguistic intelligence.

Indigenous sciences tend to draw upon the interpersonal, intrapersonal, musical, bodily-kinesthetic, spatial and naturalistic intelligences, as well as the spiritual (considered but not definitively proposed by Gardner). The Mi'kmaq word for the wintergreen plant, *Kaqawejumanaqsi'l*, relies on a naturalistic intelligence that relates the plant to its ecological role in the forest. The word is derived from *Kaqawej*, which means "crow," and *uman* + *aqsi'l*, which means "berries + plant." Similarly, musical intelligence

plays a significant role in naming other creatures in the Mi'kmaq language. *Ti'am*, the Mi'kmaq word for moose, is said to mimic the sound that the animal makes.

Integrative Science in the classroom

Two-Eyed Seeing recognizes that in a particular set of circumstances we may choose to call upon the strengths of Indigenous sciences, and in another set of circumstances we may choose to call upon those of Western sciences.

Whereas Western science education is heavily book-based, often relying on the observations of others, Indigenous sciences represent knowledge that is based on personal experience in the natural world. Within any classroom, there is a wide range of such experience among students, and investigating these multiple relationships is the first of the four key challenges in presenting Integrative Science in the classroom.

Emphasis in the Indigenous sciences is on "change, wholeness and balance," whereas Western sciences focus on parts and emphasize practitioner specialization. The second key challenge in bringing Integrative Science to the classroom is that classroom resources are heavily biased in favour of particular science disciplines. Resources based on more holistic understandings are scarce.

The third key challenge in teaching Integrative Science in the classroom is that today's students are very familiar with computer-mediated entertainment and communication, but tend to have an impoverished personal understanding of nature, regardless of their worldview. The focus on computer resources tends to nurture a pattern of learning that is one-dimensional (i.e., verbal information processing) rather than multi-dimensional (i.e., information processed through all of the senses and integrated).

The fourth key challenge of Integrative Science in the classroom is to guide students to their own spiritual connection with nature, a challenge shared with all environmental educators. Spirituality is a difficult concept to present in a standard classroom.

To meet these four key challenges, teachers can employ the principles of Two-Eyed Seeing, emphasizing Aboriginal concepts such as *MSłT No'kmaq* (we are all related), and using Aboriginal pedagogical resources, such as the medicine wheel, an ancient symbol used by almost all the Native people of North and South America to teach concepts related to change and balance.[15] Teachers must frame multidisciplinary science within contexts of interest to the students using an inquiry-based learning approach. This includes guided outdoor experiences that reinforce concepts learned in the classroom, learning opportunities in the community, and sessions with elders and other local knowledge holders.

Science is a way of knowing that involves observation, analysis and the construction of a complex understanding of nature. The currently devastating impact of humans on the natural environment is in part a manifestation of the anthropocentric Western worldview and of the objective, non-personal approach to nature that characterizes Western sciences. Lying at the juxtaposition of two worldviews, Integrative Science involves a practical engagement with the real world. More important, it involves a realization of a spiritual resonance in nature that is integral to the Aboriginal world view and may be the key to restoring a healthy relationship with Mother Earth. It is an approach to science that should be familiar to all environmental educators.

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Notes

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