# Green Teacher

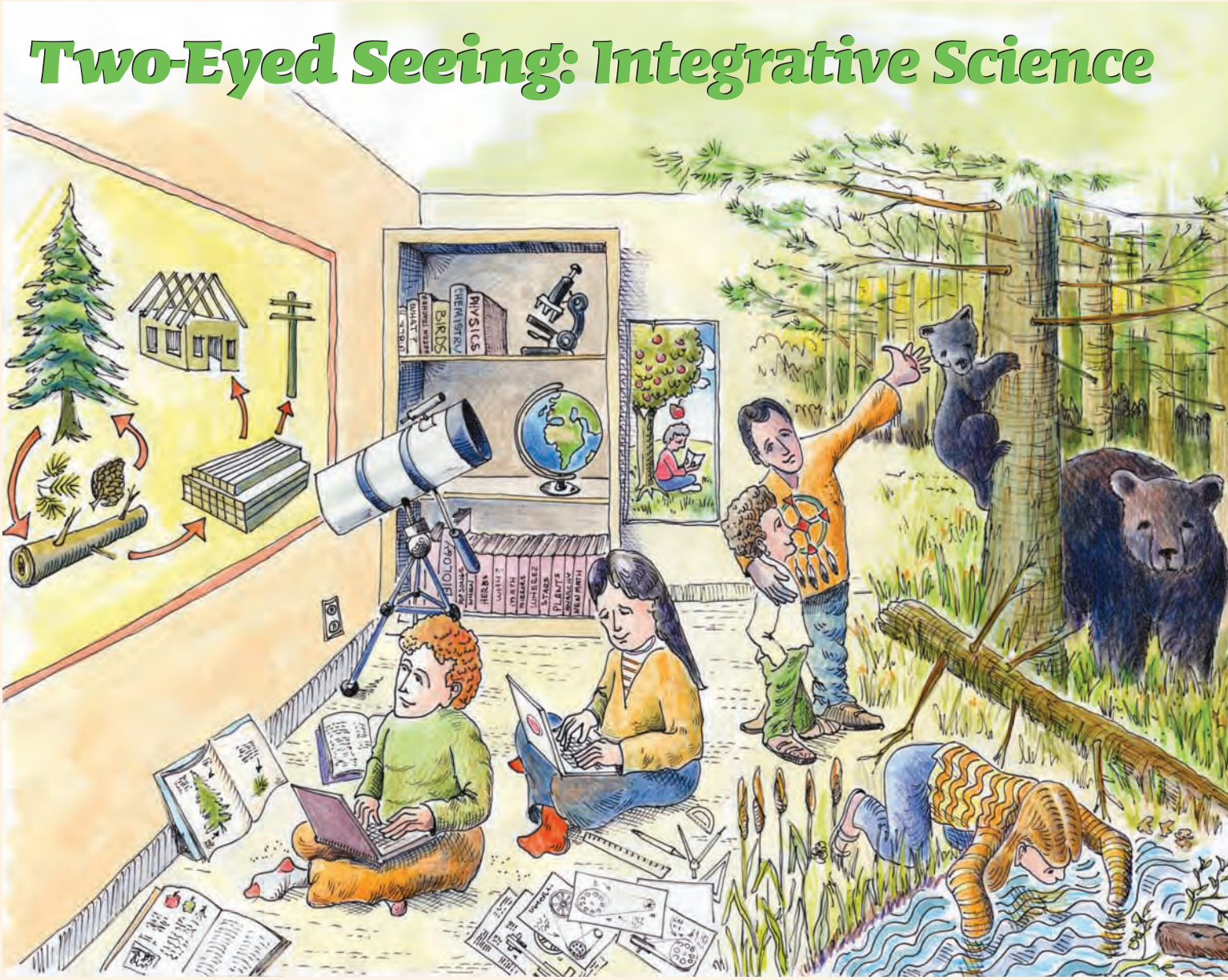
EDUCATION FOR PLANET EARTH

$7.95

*Fall 2009*

*Issue 86*

## Two-Eyed Seeing: Integrative Science

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Green Teacher is published quarterly in September, December, March and June.
Subscriptions: Canada-CAD $30.48 plus $1.52 GST/$3.96 HST; USA-USD $32; all others CAD/USD $42 air mail
ISSN 1192-1285; GST Registration No. 124125337; Canada Post Publications Mail Agreement No. 40069238; PAP Registration No. 08981
US Postmaster: Send address changes to Green Teacher, PO Box 452, Niagara Falls, NY 14304-0452.
Canada Post: Send address changes to Green Teacher, 95 Robert St., Toronto, ON M5S 2K5. Return postage guaranteed.
Printed in Canada.

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**Issue 86, Fall 2009**

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Green Teacher is a nonprofit organization incorporated in Canada.

**Design and Production**
Cover illustration by James Paterson; cover design by Michael Kelley; printing by General Printers, Oshawa, Ontario, on acid-free paper certified by the Forest Stewardship Council and the Rainforest Alliance.

This issue is supported by the Natural Sciences and Engineering Research Council of Canada.

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# Editorial

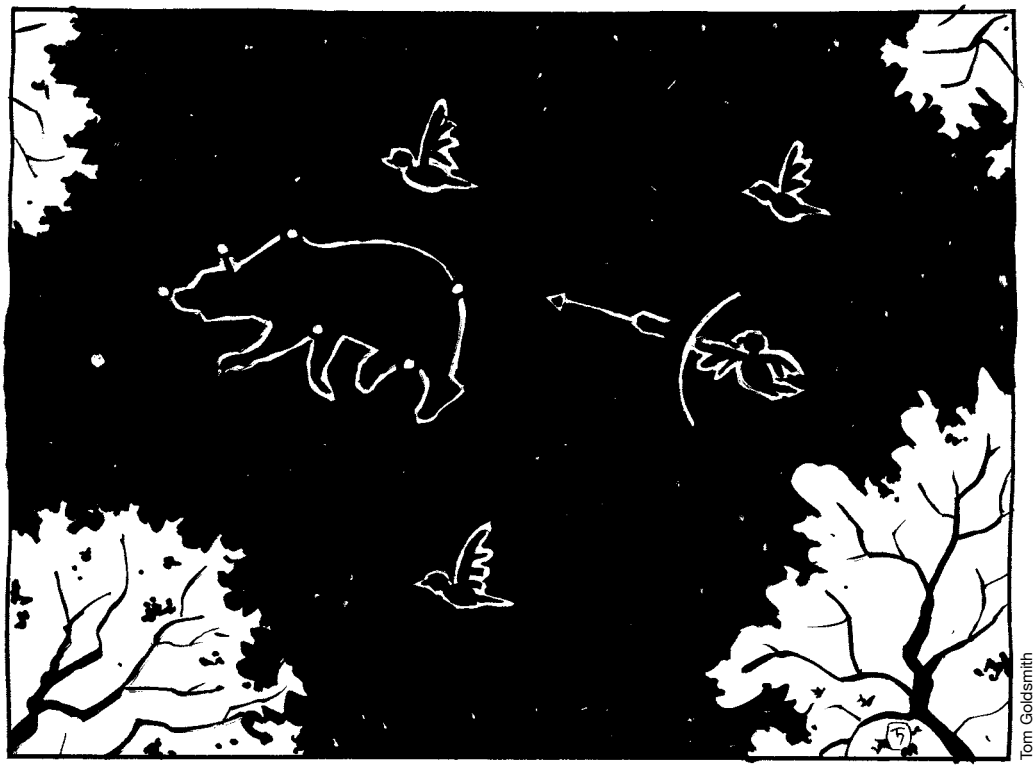
ON AN ISLAND IN THE MIDDLE of the St. Lawrence River, at the intersection of Ontario, Québec and New York, sits the Akwesasne Mohawk School. Twenty years ago, the school revamped the Grade 6–8 science curriculum so that their students could more confidently "walk in two worlds" when they left the island 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.



Tom Goldsmith

# Traditional Legends:
## Meanings on many levels

*A lesson in astronomy and storytelling for high school students*

by **Annamarie Hatcher**, **Sana Kavanagh**, **Cheryl Bartlett** and **Murdena Marshall**

IN ALL CULTURES, traditional legends have meanings on many levels. One such legend is the Mi'kmaq story of the Celestial Bear hunt, which explains changes in the night sky over the course of a full year. In the Indigenous world view, all life follows cycles; and in the Mi'kmaq worldview, that which happens on Earth is mirrored in the sky (see sidebar, "The Legend of the Sky Bear"). The story of the Celestial Bear is a fascinating topic of discussion that can be reinforced by nighttime sky-gazing expeditions. If group sky-gazing is difficult to arrange, teachers can prepare take-home sky-gazing assignments that can be completed under the supervision of parents or guardians.

The constellation commonly known as Ursa Major was recognized as a bear by many ancient peoples, including the Mi'kmaq.[1] In the Mi'kmaq legend, the seven stars "following" the Bear, or *Muin*, were thought to be hunters chasing it across the night sky.[2] This group of seven hunters consists of the three stars that form the handle of the Big Dipper (Robin, or *Jipjawej*; Chickadee, or *Jikjaqoqwej*; Moosebird/Gray Jay or *Nikjaqoqwej*) and four stars in the constellation Bootes (Passenger Pigeon, or *Ples*; Blue Jay, or *Tities*; Owl, or *Kukukwes*; and little Saw-whet Owl, or *Kupkwe'j*). *Muin's* den is what others know as Corona Borealis.

In the spring, *Muin* emerges from the den, and *Jikjaqoqwej* (Chickadee) is visible behind her. The seven hunters chase *Muin* all spring and summer. In the autumn, the hunters in the rear start to lose the trail. First *Kupkwe'j* (Saw-whet) falls back, being too small to keep up. It is said that if you laugh at *Kupkwe'j* for losing the trail, he will descend from the sky and light your clothing with fire from his birch bark torch after you fall asleep.[3] Then *Kukukwes* (Owl) loses the trail because he is too heavy. *Tities* (Blue Jay) and *Ples* (Passenger Pigeon) also lose the trail. Then, as *Nikjaqoqwej* (Moosebird) is about to lose the trail in mid-autumn, *Muin* stands up on her hind legs. This gives *Jipjawej* (Robin) a clear shot, and he kills *Muin* with his bow and arrow. Covered with Bear's blood, *Jipjawej* flies to a maple tree and shakes. The maple tree turns red with *Jipjawej's* blood, and that is why all maples turn red at this time of year and why the *Jipjawej's* (Robin's) breast is red. After *Jipjawej* kills the bear, *Jikjaqoqwej* (Chickadee) arrives with his cooking pot. The two hunters carve off some of the meat and cook it. As they prepare to eat, *Nikjaqoqwej* (Moosebird) shows up for his share. This works so well for him that he continues to show up at the last minute to take food whenever animals

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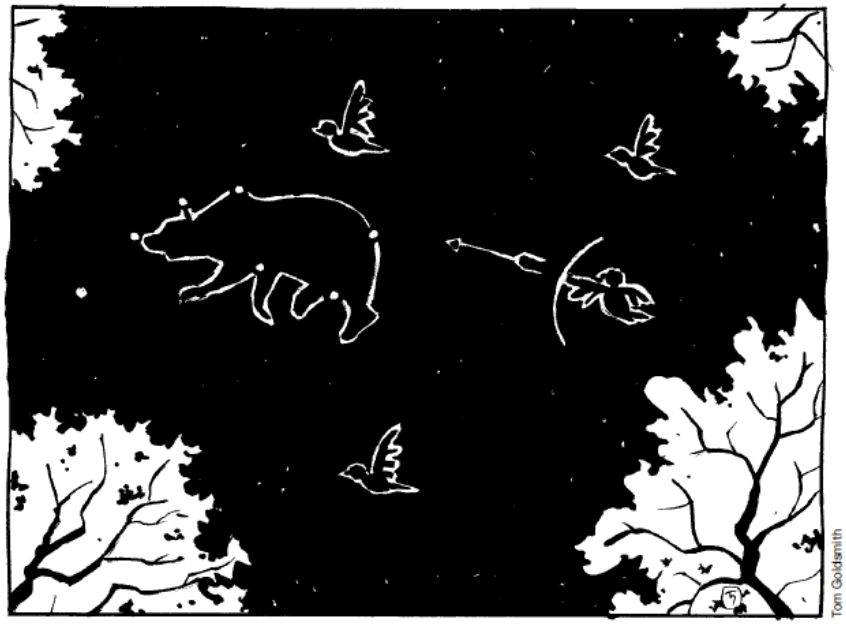


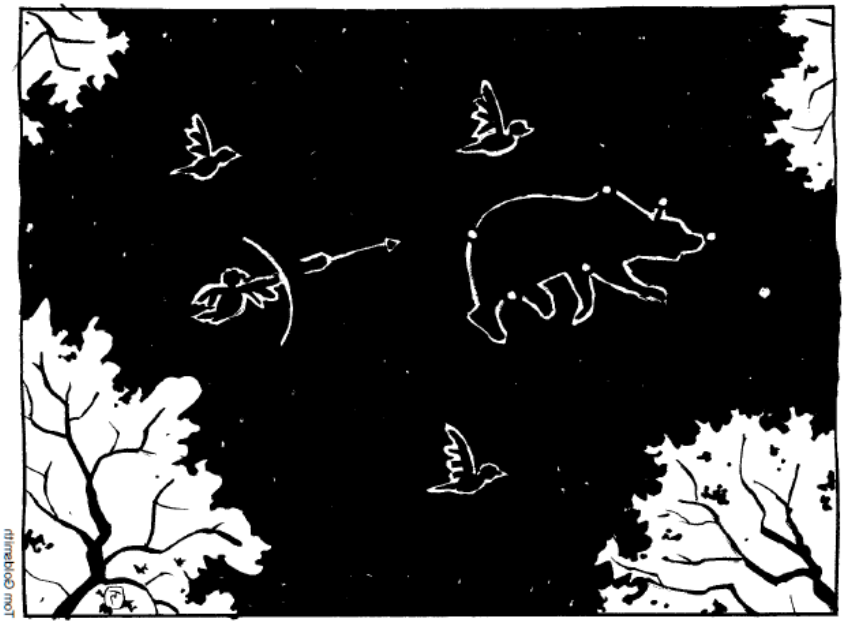


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are hunted. Thus his Mi'kmaq name is *Nikjaqoqwej*, meaning "He-who-comes-at-the-last-minute."[4] During the winter, the skeleton of *Muin* lies on her back, and her spirit stays invisible until the spring when a new *Muin* with the same spirit emerges and the hunt begins again. Thus, organic life begins anew but spirit lives on forever.

## Astronomical explanation

Every motion that the stars appear to make is actually due to the motion of the Earth. Our planet rotates on its axis and revolves around the sun. When we see the stars move in one direction, it is because we are moving in the opposite direction. Our frame of reference is the ground, the horizon, trees, houses and other landmarks. Since they are all moving along with us, we perceive ourselves as stationary and the distant stars as being in motion. This is why we should say that the stars "appear to move," but not that the stars "move."

We think of a day as a 24-hour period, but, astronomically, a day is the time it takes for a location facing the sun to make a full turn as the Earth rotates on its axis and face the sun again. If the Earth stayed in the same place in space while it rotated on its axis (which it doesn't), this would be a movement of 360 degrees, the number of degrees in a full circle. In that case, the stars would appear to move 360 degrees over the course of a day, so that if we looked at the stars from the same location and at the same time every night, they would be in the same place. However, when we observe the stars from night to night we see that they appear to change position each night. Why does this happen?

The stars appear to change position from night to night because in addition to rotating on its axis, the Earth is also revolving around the sun. For every rotation, the Earth also moves along its path around the sun. As a result, in order for a location on Earth facing the sun to make a full turn and face the sun again, the Earth has to turn almost one degree *more* than 360 degrees. Since every movement of the Earth appears to us as motion in the stars, it appears that the stars move over the course of a day. If we check the stars at the same time each night, we see what appears to be a change in position of nearly one degree every night. The story of *Muin* and the Seven Bird hunters describes this pattern over a whole year.

Many students are unaware that the sky presents an ever-changing view of celestial bodies, and the *Muin* story is an appealing and memorable introduction to these changes. Students can better grasp the celestial influences that govern seasons when they see corresponding seasonal changes in the patterns in the sky. The complex interrelationships between Earth and other celestial bodies that are examined in the *Muin* story also ground astronomy concepts strongly in the student's home place. This is because the observed relationships of sky objects are relevant to particular latitudes, illustrating how Indigenous science is grounded in a subjective connectivity between natural patterns and pattern seers that is not emphasized by Western science. The *Muin* story is relevant at mid-northern latitudes, but would not carry the same message at southern latitudes where there are no circumpolar stars and seasonal Earth cycles do not appear to be reflected in the sky.

## Celestial *Muin*-gazing

In the following activities, students locate *Muin* and the Seven Bird Hunters in the sky and learn that their story describes patterns in the location and movement of stars. In the first activity, students learn the location of key stars described in the story. In the second, they observe the stars at the same time for many nights in order to learn about the motion of the stars from season to season.

### The Legend of the Sky Bear

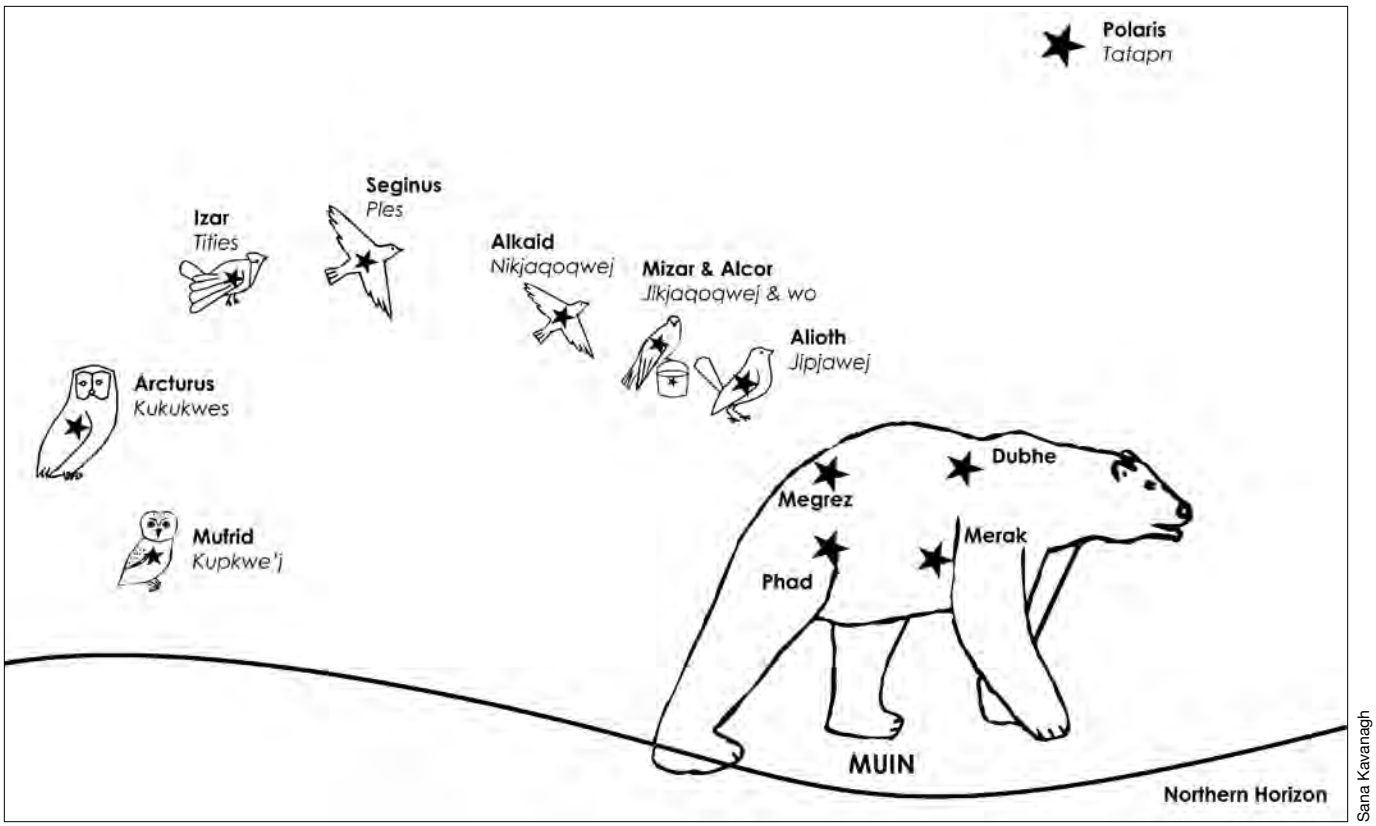
The sky bear comes out of the den
In the spring of each year
To be spotted and chased by seven hunters
The pursuit lasting a time
The chase goes on through the summer
And finally in mid-Autumn
The hunters overtake their prey and kill her
The robin becomes covered with her blood
In the process tries to shake it off
Which he does, with the exception on breast
The gore he trembles
Spattering to the earth below
And there we see Autumn
The red tint on leaves
The reddest on maple
For you see, the trees on Earth
Follow the sight of trees in the sky
The sky maple received the most blood
The sky is the same as the earth
Only older

(by Rita Joe, from *Micmac News*, November 1987, p. 42)

### We Are The Birds of Fire

We are the stars which sing,
We sing with our light;
We are the birds of fire
We fly over the sky.
Our light is a voice;
We make a road for spirits,
For the spirits to pass over.
Among us are three hunter
Who chase a bear;
There never was a time
When they were not hunting.
We look down on the mountains.
This is the song of the stars.

(from C.G. Leland, *The Algonquin Legends of New England; or, Myths and Folklore of the MicMacs, Passamaquoddy, and Penobscot Tribes*, Houghton-Mifflin, 1884, p. 379.)




Sana Kavanagh

### When to stargaze

As we learn from the story, the positions of *Muin* and the Seven Bird Hunters change from season to season. While stargazing can be done at any time of year, these activities focus on the autumn and winter months when early nightfall and long nights make it easier to do stargazing activities with students. This is fitting because the long nights of winter were traditionally a time of storytelling. More stars will be visible on cloudless nights during a new moon, or before the moon has risen, and in a location away from the light pollution of streetlights.

## Finding star patterns

A few easy steps can help students orient themselves to find the Mi'kmaq star patterns in the story. To begin, have students locate North with a compass. The star patterns called Bear and the Seven Bird Hunters will be located above the northern horizon. The four stars that are the bear and the three stars that are the first three bird hunters are very bright. Many people know these seven stars as the Big Dipper. Look for these seven stars first.

The seven bird hunters lie along an imaginary line that arcs from *Jipjawej* (Robin), through *Jikjaqoqwej* (Chickadee) and *Nikjaqoqwej* (Moosebird/Gray Jay), until a very bright star is reached. This is *Kukukwes* (Owl). It is also called Arcturus, so stargazers say "Arc to Arturus" to remember how to find the star from the North Star.

Imagine a line running between the stars Dubhe and Merak in *Muin* and extending five times the distance between them. This points us to *Tatapn*, also known as Polaris and the North Star. *Tatapn* is not a particularly bright star. It will always be due north, and its angle above the horizon is equal to the latitude in any given location. *Tatapn* will be directly overhead only if you live at the North Pole. People of many cultures have used this star to navigate at night.

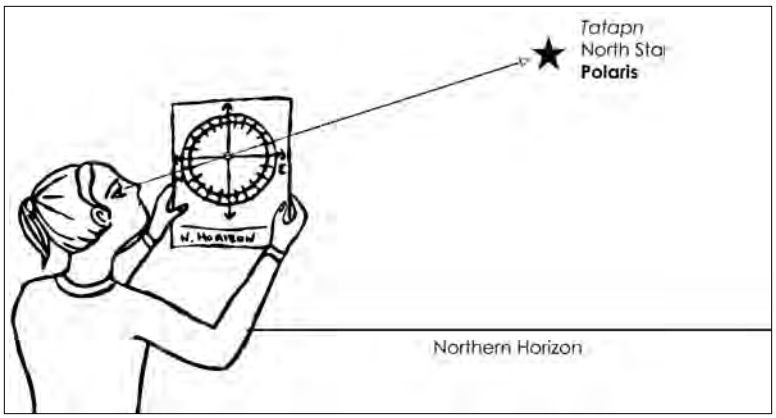
## Seasonal Changes

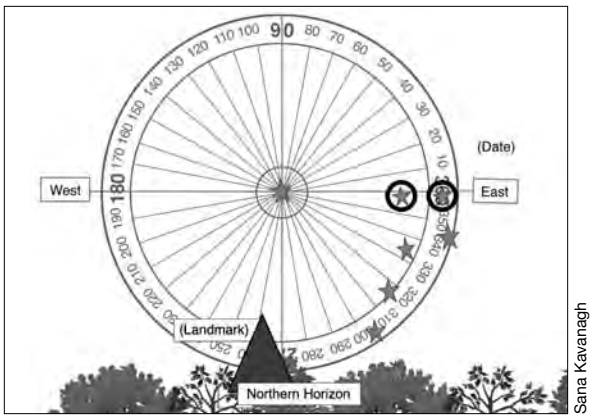
This activity teaches about the seasonal changes of the positions of the stars, which is described in the story of Muin and the Seven Bird Hunters. Students will observe the angle of rotation of the stars at exactly the same time each night.

**Materials:** copies of the protractor (see page 17), enlarged as much as possible and printed onto transparencies. If possible, print in yellow, which is easiest to see at night.

**Procedure:**

1. Hold the transparency up so that *Tatapn* (Polaris) appears in the small circle at the center of the figure. Note a stationary physical landmark on the horizon below *Tatapn*. Sketch the landmark onto the transparency with a marker so that observations can always be made from the same location.
2. Keeping *Tatapn* centered in the small circle, move the transparency forward until at least two stars within the Bear or the Bird Hunters appear to be within the largest circle. Mark the position of two stars on the transparency. Mark the date outside the circle.
3. Repeat the observation at regular intervals from the same location and at the same time of night. Ensure that students select a time for observation that will always be dark. Remember that any time of night that is dark on September 21 will be dark until April 21. This leaves




Sana Kavanagh

plenty of weeks for observation, as this date range bridges the longest nights of the year.

A practical interval for observations is once weekly. Daily changes will be difficult to notice because the stars' positions move by less than one degree a day. Weekly observations will result in a larger angle of rotation being recorded. Each time, ensure that *Tatapn* is centered in the illustration and that the physical landmark lines up with the sketch.

The weekly rotation can be measured in two ways. Students can estimate the angle of rotation directly from the transparency tool. For a more precise measurement, draw lines through each star location and lay a protractor over the transparency. (Remember that this protractor must also be centered on *Tatapn*.) The angle of rotation is the difference in angle between two observations of the same star. Divide the angle of rotation by the number of days between observations to calculate the daily angle of rotation.

After eight to twelve observations, ask students to describe the pattern of the star movements, based on their observations.

**Extensions:** Partner with schools across North America to explore the effect of location on the story of Muin and the Seven Bird Hunters. Select a school at a similar latitude but different longitude to explore how longitude affects the appearance of the night sky. Select a school at a similar longitude but different latitude to explore the effect of latitude on the story in the sky. Students can also research traditional star stories from around the world and learn to connect the patterns in the stars with the stories told in those areas.

**Annamarie Hatcher** is a Senior Research Associate in the Institute for Integrative Science and Health at Cape Breton University in Sydney, Nova Scotia. **Sana Kavanagh** is a Research Associate in Integrative Science at Cape Breton University. **Cheryl Bartlett** is a Tier I Canada Research Chair in Integrative Science and Professor of Biology at Cape Breton University. **Murdena Marshall** is an elder and spiritual leader of the Mi'kmaq Nation in Eskasoni, Nova Scotia, and former Associate Professor of Mi'kmaq Studies at Cape Breton University.

**Acknowledgments:** We thank **Lillian Marshall**, elder of the Mi'kmaq Nation of Potlotek (Chapel Island), Nova Scotia, a keen observer of the stars who patiently worked with us on the story of the Celestial Bear. We also thank **Jane Meader**, Mi'kmaq Nation, Membertou, for many fruitful discussions of legends.

**Notes**

1. Kate Dudding, "The Celestial Bear," 2003, online September 2, 2009, <www.katedudding.com/celestial_bear.shtml>.

2. The story was published by Stansbury Hagar in 1900 from information he had collected from many Mi'kmaq people. An earlier description of the bear story was recounted by Chrétien Le Clercq in 1677, as documented in R.H. Whitehead, *The Old Man Told Us: Excerpts from MicMac History 1500-1950*, Nimbus, 1991.

3. Stansbury Hagar, "The Celestial Bear," *The Journal of American Folklore* 13(49), 1900, pp. 92–103.

4. Hagar, 1900.