Green Teacher

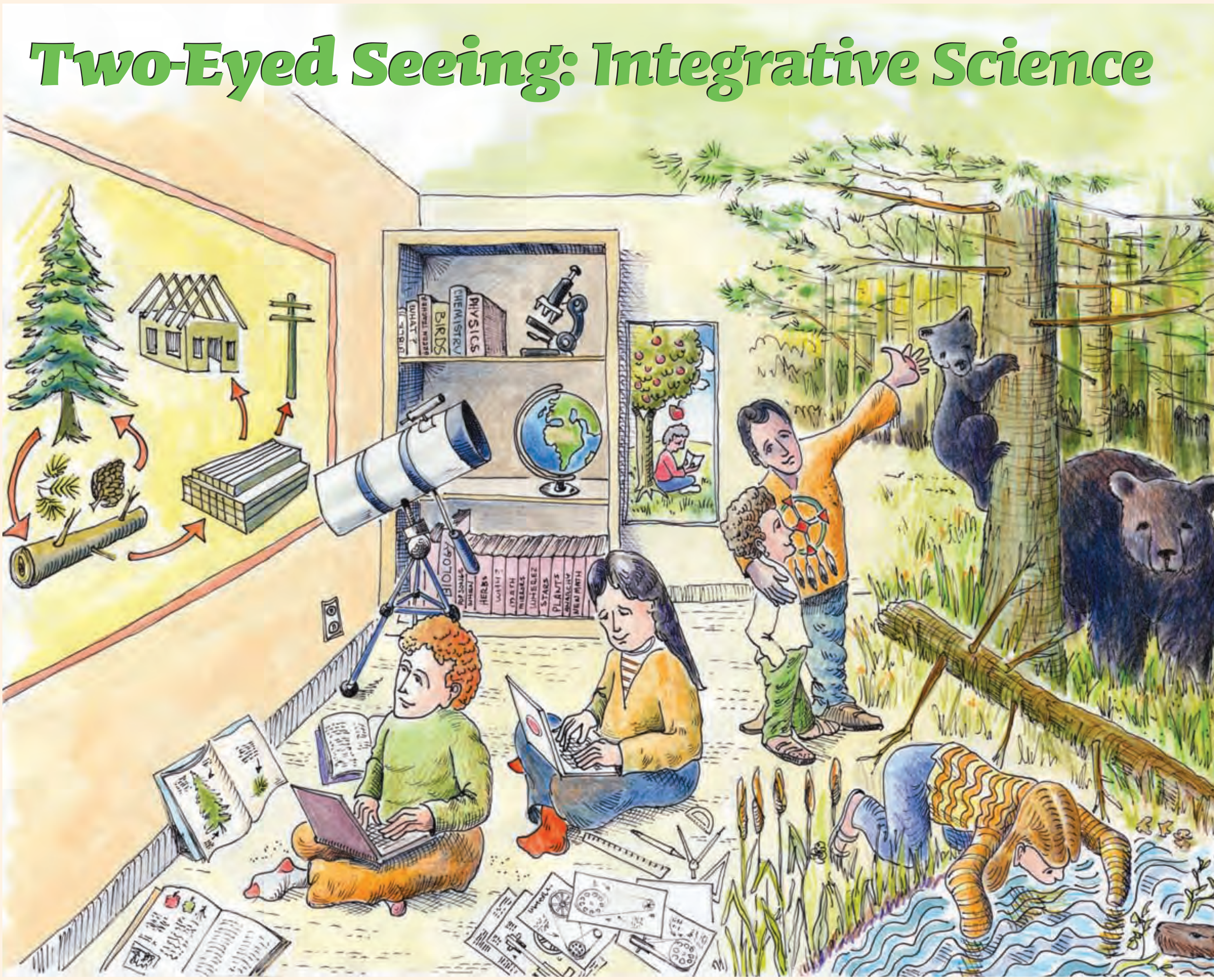
EDUCATION FOR PLANET EARTH

$7.95

Fall 2009

Issue 86

Two-Eyed Seeing: Integrative Science



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

92

7 25274 82478 6

PM40069238

Page 11

Page 25

Page 39

Green Teacher

Issue 86, Fall 2009

Features

Departments

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.

Green Teacher

Issue 86, Fall 2009

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.

Contact Us
95 Robert Street, Toronto, ON M5S 2K5, Canada
Tel: (416) 960-1244 Fax: (416) 925-3474
info@greenteacher.com www.greenteacher.com
U.S. address: PO Box 452, Niagara Falls, NY 14304

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.

Traditional Medicines:
How much is enough?

An integrative science activity for senior elementary and junior high students

Photographs: Shara Johnson

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

BEFORE THE DAYS of pharmacies and vitamin pills, Aboriginal people harvested plants for medicine and used tonics that contained significant quantities of vitamins and minerals. This exercise is an investigation into early methods of measuring dosages of medicinal tonics. It could form the basis of math and chemistry exercises and provide an opportunity to incorporate lessons on nutrition. The topic is well suited to students in upper elementary or junior high school.

Background

In many Aboriginal cultures, teas were both refreshing drinks and medicinal tonics. For example, teas made by steeping the needles from various conifers in boiling water are very high in vitamin C and served as a significant source of this nutrient, particularly in winter. It was tea made from eastern white cedar by Mi'kmaq people that cured Jacques Cartier's crew of scurvy in the winter of 1535–1536.[1] As well as being astringents, conifer needles have antiseptic and stimulant properties due to the monoterpenes in their resins and essential oils. However, conifer needles contain other compounds that are toxic if consumed in large quantities. These are secondary metabolites, such as tannins, produced by plants to discourage herbivores. Because of these secondary metabolites, it is very important to limit consumption of medicinal teas to doses that are appropriate to body size.

Infusions of the needles of tamarack (*Larex laricina*) or red spruce (*Picea rubens*) were used by many Aboriginal people as cough remedies or general tonics.[2] To determine a dose proportional to body size, a branch of the tree was held between the elbow and an outstretched finger.[3] Other units of measure used to determine dosage included the width of the fist, the width of the thumb and the distance from forefinger to pinky in an outstretched hand.

The mathematics of the body

The Aboriginal method of determining medicine doses is the basis of the following exercise exploring allometric relationships among sizes of body parts. This exercise will build understanding of fractions and the use of scatter plots in searching for patterns. It will also lay the basis for understanding correlation and regression in later grades.

Student at Mi'kmawey School in Chapel Island, Nova Scotia, tests the vitamin C content of conifer tea.

Note to teachers: The scatter plots will show a positive linear relationship between forearm length and height. There may be a slight difference between males and females, depending on the number of individuals in the study (i.e., slight differences will show up only in larger sample sizes). Weight differences should introduce significant scatter, meaning that slimmer individuals will obtain a higher dose of vitamin C when measurements are based on forearm length. In fact, dosages of many modern medicines are based on weight for this reason. With modern diets, there is more variability in height/ weight ratios than would have existed when Aboriginal people lived off the land. This should be a topic for class discussion.

Procedure:

1. Make a data table with columns for forearm length, total height, weight, age and gender. Have students measure and record data on a group of classmates or a group of people of different ages.
2. Plot the data on a scatter plot, with height on the x axis and forearm length on the y axis. Make observations about the average heights and forearm lengths, the spread of the data and the slope of the relationship between height and forearm length. Is there a relationship between the length of the forearm and height in humans?
3. Ask students to plot their own height and forearm length on the scatter plot and determine the ratio. Where do they fit with respect to their classmates?
4. Does this ratio change with age or gender? Recreate the scatter plot. Group the data into age categories and plot them using a different symbol for each category. Do the types of symbols group together? Repeat, this time grouping the data into two gender categories. Do the types of symbols group together?
5. How much does the ratio vary with weight? Make a scatter plot of data gathered from people who are approximately the same age. Plot the ratio between forearm length and height against weight. What is the trend? Make an assessment about the amount of scatter.
6. Using the forearm technique to measure a dose of tamarack for making tea, would a thin person obtain more or less vitamin C than a heavier person of the same height? Use data from Step #4 above and group data on the basis of weight categories.

Measuring vitamin C in conifer teas

The diets of the early Aboriginal people who obtained food from the land benefited their bodies in many ways. There was no need for vitamin supplements because their food was rich in vitamins. Modern diets, on the other hand, include many foods that have little nutritional value.

Not many students think of food when shown a coniferous tree. In itself, this is an eye-opener that encourages students to look at their environment in a different way. The following exercise has students compare the nutritional value (vitamin C concentration) of traditional and modern foods containing vitamin C. Topics that can be discussed in conjunction with this exercise include: What is vitamin C? Why do our bodies need it? What happens if we do not have enough? How do modern people obtain vitamin C in the winter? How much vitamin C is in tamarack tea, spruce tea or balsam fir tea compared to a modern source, such as orange juice?

Preparing tea

Prepare teas from several local coniferous species. Needles from various species of conifer, such as tamarack (*Larix laricina*), red spruce (*Picea rubens*) and balsam fir (*Abies balsamea*), were made into teas by Aboriginal people in eastern North America. Teachers and students in other regions should seek out local traditional ecological knowledge to determine which of the coniferous trees in their area may be useful for this exercise.

The amount of the tree used should be a length of a healthy branch equivalent to the distance from elbow to the tip of an outstretched third finger. Break up the measured length of branch and put the needles and small branchlets in a pot of water heated to a rolling boil (the volume of plant material and water should be roughly equivalent). Remove the pot from the heat and steep for approximately five minutes. Strain the liquid through folded cheesecloth into a cup, and sweeten to taste with maple syrup.

The amount of vitamin C in each tea can now be compared to the amount contained in standard fruit juices, fruit drinks and commercial herbal teas.

An iodine indicator solution is used to compare the amount of ascorbic acid in various juices and conifer teas.

Comparing vitamin C concentration

This is a simple comparison of concentrations of vitamin C, based on differences in the intensity of colour resulting from the chemical reaction between ascorbic acid (vitamin C) and iodine.[4] Iodine will turn a solution of cornstarch and water a purple-blue colour, but it reacts with ascorbic acid to produce a colourless product called dehydroascorbic acid. In this test, equal volumes of a purple-blue indicator solution made of starch and iodine are added to equal volumes of the test liquids. If the sample has very little vitamin C, the solution will remain a deep purple-blue; if the sample has a higher concentration of vitamin C, it will become lighter as the purple-blue iodine becomes colourless in reaction with the ascorbic acid. The more vitamin C in the test liquid, the lighter the solution. With this method, you can compare relative vitamin C content and rank foods from highest to lowest.

Materials: cornstarch, 2% iodine solution (available from pharmacies), eyedropper, water, hot plate, heat-proof beaker or small pan, 15-ml test tubes (one per sample), samples of a variety of conifer teas and fruit juices

Procedure:

1. Make a starch solution by mixing 1 tablespoon of cornstarch into enough water to make a paste. Add 250 ml of water and boil for 5 minutes.
2. Using the eyedropper, add 10 drops of the starch solution to 75 ml of water to make a more dilute starch solution.
3. Add enough iodine to the starch solution to produce an indicator solution with a dark purple-blue colour (approximately 1 ml).
4. Put 5 ml (1 teaspoon) of indicator solution into each of several 15 ml test tubes or vials, one tube for each liquid to be tested.
5. To each tube or vial, add 10 drops of test liquid (juice or tea), using a clean eyedropper. Between samples, rinse the eyedropper with water.
6. To judge the intensity of colour, hold the test tubes against a white background. Line up the tubes from lightest to darkest purple. Vitamin C causes the purple indicator solution to lose its colour. Therefore, the samples with the highest concentration of ascorbic acid (vitamin C) will be the lightest colour of purple.

Titration method: For higher grades, a more complex experiment can be performed which includes standardizing the titration and calculating amounts of vitamin C. In the titration method, a cornstarch solution is added to equal volumes of the liquids to be tested, and then iodine is added dropwise to each solution. As the iodine reacts with ascorbic acid (vitamin C) in the solution, the colour remains the same. When all the ascorbic acid is neutralized, the iodine reacts with the starch in the solution and the colour changes. The amount of iodine added is directly related to the amount of vitamin C in solution.[5]

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.

Acknowledgement: The authors thank **Jane Meader** from the Membertou First Nation for her discussion and inspiration, and for suggesting this topic for an activity.

Notes

1. J. Rousseau. *Jacques Cartier et la Grosse Maladie*, Translated by J. L. Launay, Ronald's Printing, 1953.
2. D.E. Moerman, *Native American Ethnobotany*, Timber Press, 1998.
3. Jane Meader, Membertou First Nation, personal communication.
4. The procedure for this experiment was adapted from "Science Projects About Nutrition & Health," Science Made Simple, 2006, online September 9, 2009 at <www.sciencemadesimple.com/nutrition_projects.html>.
5. For instructions, see "Which Orange Juice Has the Most Vitamin C?" in *Science Buddies*, Kenneth Lafferty Hess Family Charitable Foundation, 2002–2009, online September 9, 2009, at <www.sciencebuddies.org/mentoring/project_ideas/Chem_p044.shtml?from=Home>.

Other references

Arnason, T., Hebda, R.J., Johns, T., "Use of Plants for Food and Medicine by Native Peoples of Eastern Canada." *Canadian Journal of Botany,* 59:11, 1981, pp. 2189– 2325.