

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 (*Larix 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.

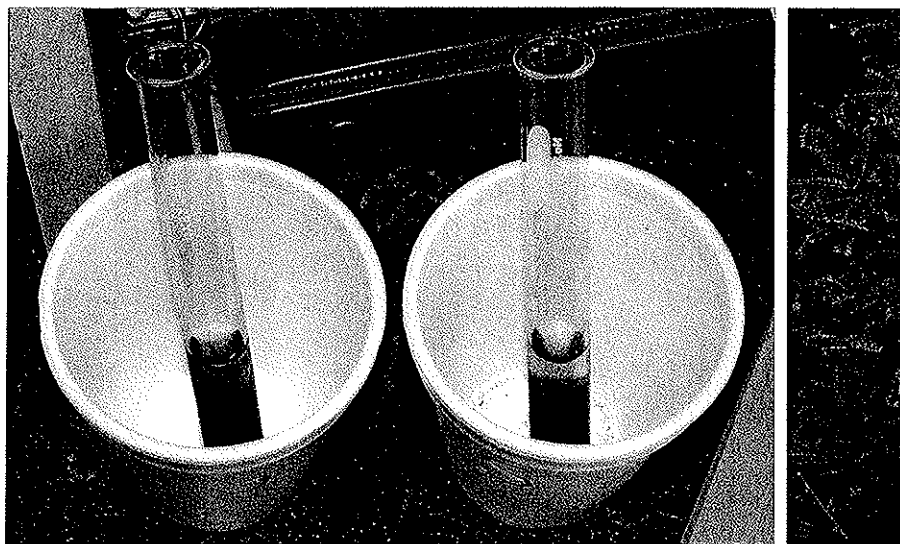
Comparing vitamin C concentration

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



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

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

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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

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