BIRCH SAP/SYRUP

ACTIVITY & LESSON PLAN

Lesson Profile

This lesson is divided into two activities. Teachers may choose to simply harvest birch sap **(activity 1)** or harvest and condense the sap to make birch sap syrup **(activity 2).** Birch background information and further reading suggestions follow descriptions of and material requirements for main activities 1 and 2.

Heart of the Matter

Birch sap harvesting is a traditional, aboriginal technology. Students will learn how to harvest and use birch sap during the spring run. This is a culturally relevant, activity-based application of chemistry, biology, social studies, mathematics and aboriginal language/culture. See table below for curriculum links.

Birch Backgrounder

Teachers should be familiar with the information contained in the backgrounder –Birch Basics – found below. They may choose to present this, and information contained in some of the additional links found below, to students in conjunction with the core activities 1 & 2.

Time Required

<u>Activity 1</u> requires at least three 40-minute periods to tap, collect and consume the sap.

<u>Activity 2</u> will demand substantially more time and planning; from a minimum 5 classes (with much extra-curricular 'boiling time') - to tap, collect, boil, finish and eat the syrup - to a three-week, cross-curricular, integrated unit. *See suggested curriculum links below.*

Grade Levels

These activities have near universal application and are appropriate for students from K-12. However, the suggested curriculum links are drawn primarily from Elementary and Junior High curriculum documents; teachers may be required to adapt the lesson according to the specificities of their classes (and shoulder more of the work themselves).

Activity 1 - Preparation – Teachers should locate a stand of birch trees approximately 20cm (8”) in diameter (be generous with your measurements, especially in northerly latitudes). Look for trees with healthy crowns (i.e. buds to the top, without rot or ice/wind damage at the crowns), healthy bark (i.e. not girdled or stripped) and lots of exposure to the southern sun. Drill a test hole in one or two trees in and continue to monitor until sap begins to visibly flow from the holes. Sap season has begun! (Birch sap begins to flow in late April/early May in the south of the NWT – more northerly communities can expect a later spring run.)

1. Have students identify birch trees appropriate for tapping. Visually examine the trees and measure their Chest Height Diameter (CHD is a standard forestry measurement). You may wish to have students tap their own trees in pairs or individually, depending on number of trees, buckets, spigots etc..

2. Clean a smooth part of the tree’s trunk, roughly chest height from the ground, with an alcohol-based disinfectant. Select an area on the north or shaded side of the tree to prevent exposing the sap to the sun. Disinfect the drill bit and proceed to bore a hole about 3.5 to 5 cm (1 ½ to 2”) deep on a slight upwards angle. Pull out the drill and clear the hole of any wood chips that may clog the spigot when the sap begins to flow.

4.a) Gently tap in the spigot, tightly enough that it won’t easily be dislodged, but not so tightly that it splits the wood or cracks the spigot. Hang the bucket or jug either by tying it around the tree with rope or hanging it from the spigot; ensure the container is covered.

b) An alternate technique involves cutting a wound through the bark, into the sapwood with an axe. Beneath this, a ‘V’ is cut into the bark and peeling it up to create a lip over which the sap will drip. Secure a bucket beneath the ‘V’ to collect the sap.

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5. Check your sap buckets daily. Pour the sap through a sieve or screen (the sap will harbour bugs, leaves and bark, despite your lid) into a large container to be transported back to the school. Naturally occurring yeasts can easily cause the sap to spoil so care must be taken to refrigerate or freeze the sap if you choose not to immediately drink or boil it.

6. Drink the sap cold, straight from the tree. Aboriginal peoples of the NWT have traditionally consumed raw birch sap as a spring tonic. You might also choose to make tea with the water, using commercially prepared teas, or naturally harvested plants. For example, try infusing birch twigs in boiled sap.

7. Birch sap season lasts from 2-3 weeks. As birch leaves emerge and temperatures rise, sap spoils more easily and a distinctive pink fungus will be visible around the spigot, on the tree. Sap, too, turns cloudy and begins to smell like rotten feet. It’s time to pull the taps!

8. Insert appropriately-sized disinfected cork or dowel plugs into the tap holes with a mallet or hammer. A 7/16” hole should be filled with a 1/2” plug, for example. A scar will ultimately heal over the hole.

Activity 2 – Teachers who choose to make birch syrup should proceed from step 5 (above) and follow these instructions:

1. Refrigerate or freeze sap until you have sufficient quantities to boil; sap spoils quite easily. Using a large-volume pot, or evaporator (see picture, right) concentrate sap on a rolling-boil until it darkens in colour- when it begins to look like very strong tea. Transfer the liquid to a temperature-controlled stove or burner. Be vigilant: over-heating the concentrated sap risks burning the sugar, causing the syrup to taste unpleasantly bitter.

2. Slowly evaporate the concentrate, keeping an eye on a thermometer suspended in the liquid. The syrup should not be heated above 93^0C. You might choose to filter the sap, using filter paper, before it reaches its desired thickness, to remove suspended ash, dust or bark.

3. If using a hydrometer or refractometer, measure the density of the cooled syrup to ensure that it achieves a hydrometer reading of roughly 1.32 or 67 Brix. Note that this will result in syrup that is thinner than maple. Though birch syrup at this concentration shouldn't need to be refrigerated, it would be advisable to distill to 70 Brix to be certain of its shelf life. Without a hydrometer, you can concentrate according to taste; keep in mind that sufficiently concentrated birch syrup is about half as viscous as maple syrup at a similar concentration.

4. Heat birch syrup to about 82^0 C and pour into pre-boiled or otherwise sterile jars. Screw on the pre-boiled/sterilized lids and invert to avoid contaminating the syrup.

5. Enjoy the syrup with bannock, with fish, meat, in salad dressing, in marinades, on ice cream, waffles, pancakes and french toast. It's also really good all by itself.

Materials, and Equipment Required

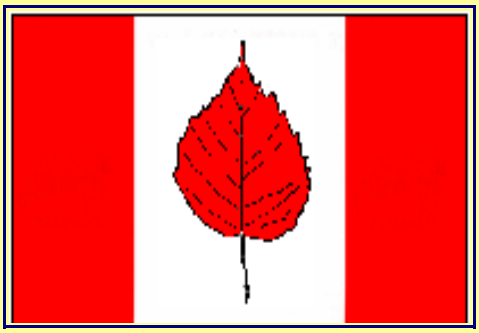
Activity 1 – birch sap harvesting	
Proximate birch trees	Ensure that your trees are close enough to permit frequent visits and easy collection and transportation of sap
drill and 7/16" bit	drill bits must be sufficiently long to penetrate approx. 5cm (2") deep into the tree's sapwood
spile/spigot and hammer	spiles or spigots are tubes through which the sap flows. Modest quantities of spiles can be procured from maple syrup retailers (see a suggested link, below); improvised spiles can be made from ½" pvc pipe.
Disinfectant and cloth	To avoid introducing infectious material into the tree, be sure to disinfect drill bit, spiles and plugs using an alcohol-based disinfectant
buckets or jugs and rope	commercial buckets can hold 10-12 litres of sap which is a realistic volume per hole per day for a healthy birch. Smaller containers may be used, but must be emptied more frequently. Be sure to cover your container to deter insects and avoid rain/snow diluting the sap
sieve and large volume container	Ideal are 25-30 liter camp jugs for transporting sap; sieve is for filtering the sap
stove and pot	Birch sap is delicious straight out of the tree. You may also wish to boil the sap to make a tea with commercial tea bags, or infuse birch twigs to make a natural birch tea (infuse, do not boil, birch twigs to avoid bitterly flavouring the tea)
cork or dowel plug (7/16-1/2")	similar diameter plugs are used to fill the tap-holes to reduce exposing the tree to pathogenic infection

Activity 2 – birch syrup distillation	
large volume pot or metal container	Sap is boiled to eliminate about 80-90% water; syrup is simply concentrated sap. To make even a modest amount of syrup you must boil a lot of sap!
outdoor fire pit or woodstove	It is advisable to evaporate birch sap outdoors. Indoor boiling can peel wallpaper, discolour walls and permeate rooms with sweet, sickly odours. Of course, you'll need wood and an axe.
heat-regulating stove and thermometer	Birch sugars burn at about 70^0 C at high concentrations. Syrup evaporation must be finished on a low, regulated heat, paying attention to the liquid temperature
Hydrometer/re-fractometer (equipment not necessary)	Syrup viscosity is measured according to specific gravity, or density. While this equipment may not be necessary, un-refrigerated syrup must achieve a minimum concentration of sugar to avoid spoiling. Hydrometers and refractometers are used to measure the syrup's density, often according to a 'Brix' scale. 67-70 Brix is an optimum concentration.
filter paper	Filter syrup to remove suspended particles (ash, wood, dust) before jarring.
jars and lids	Small-volume jars are most appropriate for low syrup yields.

Curriculum Links

Math	**Measurement** • circumference, diameter, radius of trees • temperature (air, soil, sap, syrup) • volume/capacity • tree stand density /m^2 • scale to estimate tree height **Number Concepts** • adding, subtracting, multiplying and dividing decimals • rounding/estimation • decimal/SI conversions	• fractions **Data Analysis**- • data collection and analysis (predictions, graphing) • ratio, proportion and percent (yield: sap to syrup) • mean, median, mode (average yield/tree) • range, quartiles • collecting, displaying and analysing data • rate of flow (& variance with temperature, diameter, exposure to the sun)
Social Studies	• First Nations' relationships with the land- traditional importance of birch trees (medicine, food, wood) and traditional harvesting of sap and syrup-making. • Circumpolar distribution of birch within the boreal and taiga forests – importance and uses of birch in other regions and cultures.	• Changes in circumpolar communities: traditional vs. modern uses of birch, how climate change affects harvesting • Birch sap, syrup, baskets etc. as Non-Timber Forest Products (NTFP); renewable and non-renewable resources
Science	**Life Systems/Ecosystems** • tree species identification • needs and uses of plants – tree physiology and life cycle (propagation, reproduction) • producer/consumer/decomposer • plant cell biology, dedrochronology • food webs, energy pyramids **Matter and Materials** • mixtures, solutions, concentrations	• solubility and saturation • properties of liquids:, capillary action, viscosity and density (hydrometer) **Energy** • heat transmission, heat capacity, boiling point • photosynthesis, chemical potential energy **Earth and Space** • earth's rotations - daily and seasonal cycles • identify birch habitat by soil type
Dene Lang./ Culture	• vocabulary building – tree species, parts of a tree, uses of birch, bird species, seasons..**viz. SSDEC Dene Language Series' *k'i tu* (see reference below)**	• harvest sap and deliver to elders • make birch tea • try eating birch inner-bark
CTS	• Outdoor Experiences 1& 2 • Planning a Venture	• Canadian Heritage Foods • Forestry 1 & 2

Birch Basics



Paper birch (betula papyrifera spp.) is arguably the most important tree in the boreal forest. It is a prolific, resilient tree whose range extends from the Pacific to Atlantic to near the Arctic tree line. Whereas Sugar Maples (*acer saccarum*) grow only in eastern regions, Canadians from coast, to coast to almost coast co-habitate with Paper Birch trees. Perhaps a new national flag is in order?

Humans have countless uses for birch, from fuelwood, to furniture to food. Indeed, birch sap harvesting is a traditional Aboriginal technology practiced by many First Nations, including those in the Northwest Territories. As a seasonal activity, birch sap harvesting represents one of Dene Kede's **key cultural experiences inasmuch as it grounds the concepts, skills and attitudes of a classroom in a practical, traditionally-relevant, outdoor activity.**

Some critical facts about birch trees and sap production may prove useful in the execution of these activities:

- Sap flow is in the spring of the year, when day time temperatures are consistently above freezing and the ground begins to thaw. While there is still much debate about the mechanisms of sap transport, it is a sure bet that sugars photosynthesized during the previous summer and fall are stored in the trees roots, are carried, along with minerals such as calcium, magnesium and potassium, in watery sap up the trunk and towards the crown when conditions become favourable (i.e. warm). These sugars help fuel the growth of the new season's leaves.

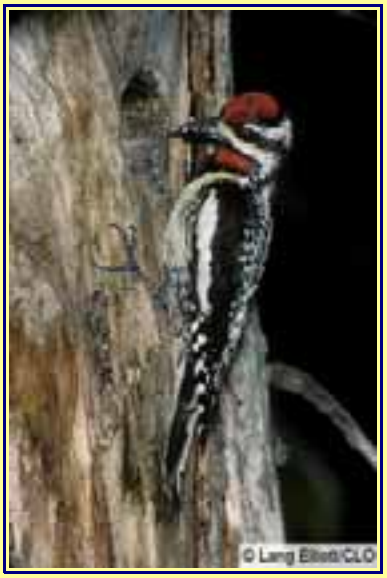
- There are a variety of birch species in Canada. In Western Canada, indigenous birch trees (as opposed to indigenous shrubs – Dwarf Birch, Bog Birch) are known as Paper Birch, White Birch, Canoe Birch or Alaska Birch. There is some debate whether Alaska Birch is a sub-species of Paper Birch or a species in its own right. For our purpose all **trees** can be harvested for sap.

- Birch sap contains, on average, 1 % sugar. The sugars are principally fructose and glucose, as opposed to maples' high concentration sucrose. Fructose tends to burn at lower temperatures than sucrose, meaning that care must be taken not to scorch birch sap during evaporation. Moreover, fructose has a lower tendency to crystallize, resulting in a thinner syrup than maple.

- Birch sap is reportedly more acidic than Maple sap. For this reason, The Alaska Birch Syrupmakers' Association recommends avoiding metal equipment, whenever possible (i.e. plastic spigots and buckets and glass jars) in the harvesting and production of birch syrup, to avoid imparting metallic flavours.

- Invariably, question arise whether sap harvesting harms the tree. Seemingly, exposure to infection poses a great risk to the health of birch than sap taking. For this reason care must be taken when tapping and plugging holes. Only sterilized drill bits, spigots and cork plugs should be used.

- Humans aren't the only species to tap birch trees in the spring. Yellow-bellied sap suckers can often been seen boring holes in birch trunks and eating the insects that are attracted to the sweet, dripping, liquid. Look for sap-sucker perforations on birch trunks in the southerly regions of the NWT, and keep your eyes peeled for this boreal bird during the spring run.



Additional Resources

http://www.uaf.edu/snras/afes/pubs/misc/MP_04_02.pdf - ***White gold in the boreal forest*** – this PDF document is an invaluable reference for debutant birch harvesters. While the information relates specifically to Alaska, the site contains recipes, best practice guidelines and suggestions for further reading/research.

www.birchboy.com – A comprehensive site providing information on birch syrup production, history, commercial standards and recipes. Also a retail source of birch syrup products and other NTFPs.

http://www.akborealforest.org/tapping/index.php - ***Tapping into Spring*** is a school birch syrup program run under the auspices of the Alaska Boreal Forest Council. Though seemingly defunct, the site still hosts pictures of and stories by participating classes.

http://pick4.pick.uga.edu/mp/20q?search=Betula – A University of Georgia-hosted site that provides detailed pictures of many of the world's birch species, their leaves, bark and reproductive structures.

http://www.atkinsonmaple.com/ This Ontario-based maple syrup equipment supplier is a source for all enthusiasts, from backyard hobbyists to full-scale commercial outfits. Plastic maple equipment is appropriate for birch syrup production.

Books

Kaulback, Brent & students of Chief Sunrise Education Centre. ***K'i tu/Birch Water***. South Slave District Education Authority. - Intended as an Aboriginal Language resource in the South Slave, *Birch Water* will be available in South Slavey, Chipewyan and Cree in March, 2007. It may be possible to translate into other dialects. Contact the author at: brent_kaulback@southslave.learnnet.nt.ca

Mann, Rink. ***Backyard Sugarin'***. Woodstock Vermont: Countryman Press. 1976. – A bible for hobbyist syrupmakers. Rink's book details economical plans for sugar shacks and evaporators. I found it through www.chapters.ca.

About the author... Mike Mitchell is an outdoor educator and student of life who has been tapping birch trees for personal pleasure and with school groups for a number of years. Don't hesitate to contact him at (867)-874-2595 (mitchemma@yahoo.com) if you want to talk shop about birch!