Teacher Background Information

Maple Syrup Vocabulary:

sap or "sweet water"

water absorbed through the roots of the tree travels through the growing layer of the tree trunk to transport nutrients and wastes. Early in the spring, the sap absorbs stored sugars from the tree wood. It is sweetened by these sugars that were created during the process of photosynthesis.

trough, spout, and spile

If the sap was allowed to drip out of the gash or hole in the bark, it would gather debris from the bark. Initially shavings or carved branches were used as a trough to move the liquid from the hole and allow it drip into a container. To further protect the golden liquid from contaminants, carved branches that were hollowed would be stuck in the hole, and acted as a hose to channel the sap. The carved branch channels were called 'spiles.' Initially the spile was made out of carved wood. Eventually metal and plastic were used to make the spile more durable and easier to clean.

tapping

The act of cutting a hole into the bark of a tree to reach the sapwood (growth layer) so the sap could flow out of the tree. The size of the hole drilled today is 5/16 of an inch or .35 mm in diameter.

evaporator

Large metal pans designed to provide as much surface contact with the heat and the maple sap to hasten the process of evaporation. Later evaporators had 'baffles' or metal 'fins' that would extend into the liquid to further increase the contact area of the sap and hot metal.

sugar shack

A cabin in the woods built with a roof designed to allow all the evaporating sweet steam of the boiling sap to dissipate out into the air.

mokuk:

Traditional birch bark boxes sewn with elm strips. Used to store maple sugar. Tightly packed with the sugar into sugar cakes.

maple belt

The wide strip of land running from southeastern Canada through northeastern US which provides both the necessary soil and climate conditions for the growth of the sugar maple tree.

tree migration

Due to habitat and climate change, trees that once grew in only a specific geographical area begin to grow in different areas and stop growing in traditional areas.

photosynthesis

Light energy is transformed into chemical energy by plants. Sunlight and carbon dioxide are absorbed by the leaves of the tree. Chemical reactions occur inside the leaf. The products of the chemical reactions are carbohydrates (complex sugars) and oxygen. The oxygen is released into the air and the sugars are stored in the outer layer of the tree trunk.

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Maple Syrup History

How and when the sweet properties of the Maple Sugar tree's sap were first discovered is documented best in the telling of legends by the Eastern Woodland tribes. The harvesting and processing of the watery liquid into a thick syrup and sugar was a spring staple for diet and medicine.

> Note: The tribes of the Eastern Woodland were primarily of two language groups. The Iroquois speaking tribes included the Cayuga, Oneida, Onondaga, Mohawk, Seneca, and Tuscarora. The Algonquian speaking tribes included the Ojibwa, Mi'kmaq, Abenaki,Maliseet and many others.

The maple tree's sweet water was both hard to transport and difficult to preserve. Gashes from sharp tools were made in tree trunks to release the liquid. Shavings were used to channel the liquid away from the tree trunk and into the tightly sewn birch basket containers. Sap was allowed to freeze during the late winter/early spring evenings so that thin sheets of ice could be removed in the morning. Sap was collected into hollowed logs to serve as boiling pots to further reduce the sweet liquid through evaporation. White hot rocks were circulated into the liquid to bring the sap to a boil to remove the water content. During the process, the thickened syrup would be dropped on fresh snow to produce a thick taffy. After more cooking the final product was a maple sugar crystal that would last for longer period. The maple crystals were stored in cake format in a container called a mokuk made from the bark of the birch tree. Sugar crystals would be broken off the cakes to sweeten liquid or add to food for additional energy.

The arrival of settlers resulted in an exchange of knowledge. Indigenous knowledge of the land and its bounty was shared with the settlers. Settlers did not have either easy access to nor the funds for the white sugar crystals they knew which came from the East Indies. They needed the knowledge of the maple sugar used by the indigenous people. Settlers introduced different tools for tapping, collecting and processing the sap. Instead of using a tomahawk to cut a slash in the tree, the settlers used their iron tools to cut a smaller hole which the tree could more quickly heal. Instead of birch baskets for carrying small amounts of sap, they used buckets that were larger, and carrying yokes to more easily move multiple and larger containers of fresh sap through the forest and back to the cooking fires.

The ratio of sap to finished syrup is 40:1. An incredible amount of sap must be collected and processed to create maple syrup and sugar. The many hours required impacted and continues to impact the cost of the end product. If a product is too expensive for the market place, and there is not enough profit for the farmer,

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then the product cannot continue to be made. So maple syrup producers look for ways to make the collection of maple syrup easier, and the processing more efficient so that less energy and hours are needed and costs are reduced.

A healthy maple tree is able to have up to three spiles. Some maple bushes or groves contains hundreds or thousands of trees. Early in the 1900s an attempt was made to create a tube system to collect the sap from many trees into one larger container. Unfortunately, in those early days the only material available to make this tubing was metal which conducts, or absorbs, changes in temperature. Metal tubing was a dismal failure for maple syrup collection because cold weather meant frozen plugs of syrup developing in the tubes during the cold nights. A tube system was introduced again in 1959 with the availability of plastic tubing. Tubing has further been refined to add a suction effect to assist in pulling the sap along the tubes and into the collection containers.

Maple sugar sap has a sugar content ranging between 2- 5%. Maple syrup has a sugar content of at least 66%. Heat energy is required to reduce the sap, or remove the excess water. Evaporator pans were developed in the mid 1800s with the intent of reducing the energy and time required to boil the sap. The shape of the evaporator pan was crucial in increasing energy efficiency. Shallower pans with waffled bottoms and baffles or fins evolved to allow the energy produced by the fires to directly heat the liquid faster because much more liquid was in contact with hot metal.

For many years, the maple product that was in highest demand was maple sugar. The two primary reasons were the difficulty in preserving syrup and the growing antislavery movement. There was a reluctance of the early governments of North America to be dependant upon the West Indies slave trade produced white sugar. It was hoped that the availability of maple sugar would provide a viable alternative to white sugar. Maple sugar was in more demand than maple syrup simply because the technology did not exists to store the liquid without molding or break down in flavour and darkening of colour. Maple syrup would only last for a few months if kept cold and in the dark which made it less practical than the very portable maple sugar as a marketable product. Still, even maple sugar had issues in being kept tightly sealed to avoid absorbing moisture. It wasn't until the invention of the metal can during the Civil War that it was possible to store maple syrup for years.

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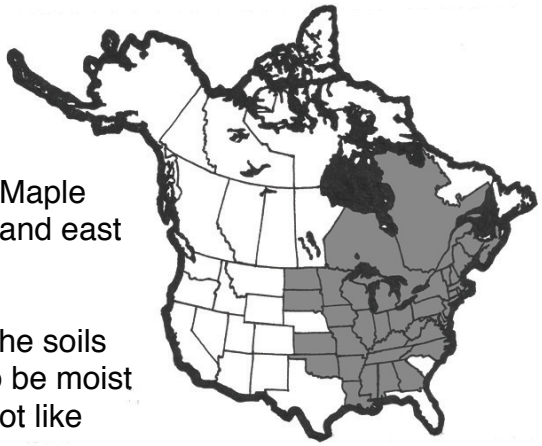
Sugar Maple Habitat



The Maple Belt is the nickname of the swath of land running from the southeast of Canada down through the north east of the US. The Maple Belt includes the Canadian provinces of Nova Scotia, New Brunswick, Quebec, parts of Ontario, and the southeastern corner of Manitoba. In the United States, the Maple Belt extends west through Minnesota, south through Missouri, and east to Tennessee and northern Georgia.

Sugar Maple trees need to grow in soils that are quite deep. The soils need to be quite fine and must be able to hold enough water to be moist but the soils must have good drainage because the trees do not like swampy ground.

The weather must provide warmth in the summer, but not so hot that the broadleaf dries out. The weather must be cold in the winter to provide the optimal -5 C to 5 C nightly temperature difference that permits the saps to rise and flow.

Factors have been identified that directly impact the sugar maple habitat. Warming temperatures are a two pronged issue. Hot weather stresses the tree in the growing season, and lack of freezing temperatures permits more harmful pests and diseases to proliferate. Smog and acid rain change soil acidity which makes results in fewer seedlings growing.

Sugar Maple Tree

The sugar maple is one of almost 150 maple trees found in North America. It is a hardwood tree. A hardwood tree is usually a broadleaf tree, and is a deciduous tree. Hardwood trees usually produce a nut or fruit that contains their seed. They go dormant in the colder season which means that the tree is not growing and the sap is not flowing. The 'sap is rising' is the term used to describe the movement of the sap during the daily warming and cooling cycle of the early spring. When the temperatures remain warmer, then the sap will no longer continue to flow.

Sugar is produced in the sugar maple tree through the process of photosynthesis and stored in the growing wood during the winter months. The freezing and warming temperatures of late winter and early spring impacts the liquid in the tree and around the roots of the tree. The push-pull effect begins as the tree warms during the day and the pressure of the expanding liquid causes liquid to spill from holes or cuts in the bark of the tree. As the night temperatures rapidly cool the tree, the remaining liquid cools and contracts The contraction occurs because of the freezing of the liquid, or because the carbon dioxide trapped in the sap contracts or is dissolved by the sap. Each of the three reasons for the sap contract causes a suction effect in the tree due to the loss of liquid during the warmth of the day. The suction caused by sap contraction and liquid loss through the day pulls water back into the tree through the roots.

The outer layer of the tree is the bark. Beneath the outer lay is a layer called the sapwood. This layer is the growth layer of the tree. This is the layer where the sugars and liquids collect. It is like a collar of straws running vertically up the tree to allow for the movements of nutrients and waste.

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When a hole or gash is made in a tree, some of these tubes in the sapwood are cut and destroyed. Sap escapes through these cuts and leaves the trees through the stile that was inserted into the hole. When the stile is removed from the tree, the tree begins the process of healing the injury.

The Maple Sugar tree can grow as tall as 80 feet and can live as long as 200 years. Healthy maple sugar groves have been harvested for generations by families. The trees grow slowly, and are not usually harvested until they are between 30 - 40 years old. A tree must be at least 10 -12 inches (25-30 cm) in diameter when measured 4.5 feet from the ground before a single tap can be made. It must grow another 5 inches (12.5 cm) before another tap can be made. A maximum of 3 taps can be made on a healthy tree.

Note: Regulations regarding the minimum size of maple sugar trees for tapping vary from province to province, state to state. The data shared in the paragraph above represents a minimum example and should not be considered the standard throughout all maple producing areas.

Each province and state that produces maple sugar products have rules and regulations regarding collection, processing and marketing. Although similar, the regulations are not identical.

COLOUR CLASSES OF "CANADA GRADE A" MAPLE SYRUP

1. The determination of the light transmission of "Canada Grade A" maple syrup shall be made optically by means of

(*a*) a spectrophotometer using matched square optical cells having a 10 mm light path at a wavelength of 560 nm, the colour values being expressed in per cent of light transmission as compared to A.R. Glycerol fixed at 100 per cent transmission; or

(*b*) a visual glass comparator, the optical specifications of which correspond as closely as possible to the method described in paragraph (*a*).

2. "Canada Grade A" maple syrup shall be regarded as in a colour class set out in Column I of the table if its percentage of light transmission is that set out in Column II.

TABLE

	Column I	Column II	
Item	Colour Class	Percentage of Light Transmission	
1	Golden, Delicate Taste (Doré, goût délicat)	not less than	75.0
2	Amber, Rich Taste (Ambré, goût riche)	less than	75.0
		but not less than	50.0
3	Dark, Robust Taste (Foncé, goût robuste)	less than	50.0
		but not less than	25.0
4	Very Dark, Strong Taste (Trés foncé, goût prononcé)	less than	25.0

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source: http://www.gazette.gc.ca/rp-pr/p1/2014/2014-06-28/html/reg1-eng.php

Canada	United States (USDA)	Vermont
No. 1 Extra Light	Grade A Light Amber	Fancy
No. 1 Light Grade A	Grade A Medium Amber	Medium Amber
No. 1 Medium Grade A	Grade A Dark Amber	Dark Amber
No. 2 Amber	Grade B for reprocessing	Grade B
No. 3 Dark		Commercial
	Substandard	Substandard

source: http://maple.dnr.cornell.edu/FAQ.htm

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Sugar Maple Technology

Tapping the Tree

* first nations used sharp tools such as tomahawks to slash the tree trunk to start the flow of sap
* settlers used mechanical drills to create a hole in the trunk
* the size of the hole drilled has become smaller: just big enough for the flow of sap, and small enough that the tree can heal over within months of the spile being removed

Spouts or Spile

* wood shavings or sticks carved into a trough were used by first nations people to channel the syrup away from the tree
* wooden spiles were carved by tunnelling out the inside of a branch and narrowing the end to insert into the hole in the tree. The tunnel rather than channel kept debris from falling into the sap.
* using metal spiles improved the longevity and cleanliness of the spile for use over multiple seasons. Today plastics spiles are in use.

Collecting the Sap

* sewn bark baskets or pottery bowls were placed at the base of the tree to collect sap
* buckets hung on nails below hole
* metal buckets
* metal tubes to connect multiple stiles/trees into one collection tried but ability of metal to absorb temperature changes meant that cold weather froze the liquid in the metal tubes
* plastic buckets
* plastic stiles to connect multiple stiles/trees into one collection system

Processing the Syrup

* first nations people cooked the syrup by adding heated rocks to baskets of syrup
* settlers introduced the metal pot for cooking the syrup over the fire and by the end of the 1700s common practice was use of iron pot or copper kettle
* evaporator was developed for boiling the syrup. The design of the evaporator provides additional contact between the sap/syrup and the metal of the evaporator to hasten the evaporation process

Storing the Maple Products

* first nations people stored maple sugar in birch back baskets (mokuks)
* settlers used a variety of glass, pottery, and metal containers for storage but were unable to provide a seal to prevent moisture from spoiling products
* the invention of the tin can provided an avenue of storing the syrup away from light and air
* today the reservoir of maple syrup is stored in large steel drums
* maple products are sold today in a variety of containers including glass, plastic, metal because of advances in creating air tight vacuum seals.

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New Hampshire Agriculture in the Classroom

WestView Learning

Internet Links & Bibliography

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