

MAPLE SYRUPING

Environmental Education Lesson
EDWARDS CAMP AND CONFERENCE CENTER

SUMMARY

Visit the forest to discover how sap is collected from Maple trees and how it is turned into tasty Maple Syrup! Learn about some historical significance of maple products and historical techniques for collecting and producing them.

USAGE

Any age, early spring (variable, mid March to mid April)

OBJECTIVES

Upon completion of this lesson students will be able to...

- summarize the process of collecting sap and how it is turned into syrup
- describe what sap is and how sap is produced and used by trees
- describe the basic process of photosynthesis
- identify maple trees

In addition students may learn to...

- recognize the historical significance of maple syrup
- recognize some historical procedures for sap collection and syrup production
- identify the bark, cambium, sapwood and heartwood of a tree
- describe the basic environmental conditions needed for sap collection

MATERIALS

Food Factory Sheet and vocabulary cards
Tree Factory Sheet
Tree ID graphics
Maple trees
Metal Spiles
Measuring tape
Disinfectant alcohol solution in spray bottle
Brace & bit (7/16 inch)
Various samples of spiles
Taste test bottles

INTRODUCTION

1. **Potawatami:** Teach the students the words “Bozo Nikan.” Pronounced Bozo (like the clown) and Nikan (like the camera). Have them repeat the phrase a couple of times. Ask them what this phrase has to do with maple syruping. The language is Potawatami. The Potawatami were the Native American tribe that settled in this area. The phrase means “Hello Friend.”

2. **How maple syrup was discovered:** This leads into how Native Americans were the first to discover the fact that sap from maple trees could be processed into maple syrup and sugar. From the journals of early explorers we know that the Native American Indians had a process for making maple sugar as early as 1609. While there are no authenticated accounts of how this process was discovered, there are several interesting legends. Share a few from the list below:
- One Iroquois legend tells how Chief Woksis had thrown his tomahawk into a maple tree one late winter evening. After he removed it the following morning, the weather turned sunny and warm. Sap began to flow from the cut in the tree, and drip down into a container which was at the base of the tree. Chief Woksis's squaw used the sap to boil the meat for dinner. As the water in the sap boiled away, a wonderful, sweet maple taste was left with the meat. This was the first maple syrup.
 - Most likely the Native Americans discovered the sweetness of the maple tree by eating "sapsicles," the icicles of frozen maple sap that form from the end of a broken twig. As the ice forms, some of the water evaporates, leaving a sweet treat hanging from the tree. The Native Americans figured out that if this was boiled down, what was left was what we call sugar.

If this is a full day group, this is the time to split the group into their different classes. The first half will continue on with maple syrup and the second group will do maple syrup after lunch.

ACTIVITIES

Food Factory- materials: vocabulary cards

This activity is to help students understand how a tree makes sap. Follow the outline below to have the students act out how a tree produces its sap. The process is called photosynthesis.

1. What is the sap to a tree? (Food for the tree, helps the tree grow and produce leaves)
2. We are going to learn how a tree makes sap. Have the students stand up. As the vocabulary words are introduced have the students come up and hold the cards.
 - a. Plant your roots (feet) firmly in the ground and start pumping (bending your knees up and down).
 - b. What are we pumping through our roots? (**Water**) Put your branches out (extend arms) and start catching something with your leaves (open and close your hands).
 - c. What are you catching with your leaves? (**Sunlight**)
 - d. Now we need to take in something from the air (make a sucking sound). What are we taking in? (**Carbon dioxide**)
 - e. Now you know the ingredients for photosynthesis! What are they? (H₂O, Sunlight, CO₂) Have the kids shout these words a couple of times.
 - f. What is given off or produced through photosynthesis? What are we (as trees) giving off? (**Oxygen**) What are we (as trees) making for food? (**Sugar**) Why do we want that sugar today? (To make maple syrup)

- g. Explain that tree sap is the combination of the water the roots collect and the sugar the leaves make through photosynthesis. The sap is what we collect to make into maple syrup.

Tree Factory (optional, if not enough time)

Maple Tree ID and Tapping Background

Discuss when tapping should take place

The sap “runs” in late winter/early spring, when nights are below 32 degrees and days are in the 40’s. This is part of the trees preparation for the growing season as stored sugars from last year are pumped up from the ground to the buds to produce the new leaves for the coming year. The freezing nights are needed to build pressure in the tree to allow the sap to flow. Ideal temperatures are 20-25 degrees F at night and 45-50 degrees F during the day. The stored sap flows up the sapwood during the day and back down through the phloem at night. Why does the sap need to be stored in the roots at night this time of year? (if the sap freezes in the trees tissue it will expand and could harm the tree)

Why tap only maple trees?

Maple trees have the most sugar in their sap. 2-3% sugar. Most other trees do not have this much sugar in their sap. Sugar, black, and red maples have the highest concentration of sugar. We have mostly sugar maples at Camp Edwards. It takes 40 gallons of sap to get 1 gallon of syrup. The sap is boiled down until it is 67% sugar, then it is considered syrup. Birch, basswood, butternut, hickory can be tapped too. Their sap isn’t as sweet, so you would need a lot more sap to make 1 gallon of syrup.

How do we know if it is a maple tree?

Branches: All Maple trees have opposite branching. Two branches grow opposite each other, like out arms. Only a few other trees have opposite branching, including Ash. Ash trees though have deeply furrowed bark and the twigs are stout. Trees that do not have opposite branching are considered alternately branched, oak for example. Find small branches/twigs on the ground to demonstrate opposite branching. Look up into the branches to determine if a tree is opposite or alternate; some branches may be broken off and not look opposite, but if you find any, then the whole tree is opposite.

Bark: Sugar Maples have medium gray bark with medium grooves. Silver Maples have gray bark which separates into long flakes.

Leaves: Maple leaves are palmate in shape (look like our hand). Pick one off of ground or show picture. Compare it to other leaves around. Oak for example. Show how oaks are deeply lobed and longer. Sometimes maple tree hold onto a few leaves. This can help identify the maple trees.

Mustaches: Sugar Maples have dark gray or black inverted “V’s” on trunk over the branches.

It’s a maple, can we tap it? Here are a few things to check before a maple tree can be tapped.

Size: Tapping trees that are too small is hard on the tree. It would be like collecting blood from a child that is still growing. Trees need to be 10 inches in diameter or 32 inches in circumference. A tree this size is old enough to tap without doing any harm.

Health: Choose trees that are healthy and are not injured, have peeling bark or lots of broken branches. Look for signs of disease.

Tapping Rotation

The group will be divided into 3 groups. Each group will rotate through the 3 activities below. Signal to the groups when you want them to rotate. For safety reasons, remind students that there is no running and give boundaries.

Maple Tapping

Locate taps about 2 – 4 feet off the ground (lower helps to increase the force of gravity acting on the sap).

Multiple taps if tree is big enough. At 4 ½ feet above ground, 10 –14 inch diameter, one tap; 15 – 19 inch diameter, 2 taps; 20 – 24 inch diameter, 3 taps.

Place new taps at least 6 inches from old scars.

Hole should be drilled with 7/16 inch bit. Drill about 3 inches into tree and angled slightly up. Clean shavings out with a stick. Spray with disinfectant. Insert and tap spile into hole.

Hang sap bucket on spile so that sap will drip into bucket.

Discuss various historical procedures/equipment for collecting sap.

Native Americans cut slashes in the bark and collected the sap that ran out. Settlers eventually developed “spiles”, hollow wooden spouts inserted in holes in the trees. Spiles have evolved through a variety of shapes and are now metal or plastic. Some people now connect plastic tubing to spiles of multiple trees so sap can run to a central collection point rather than using a bucket on each tree.

Scavenger Hunt

Each pair of students will try to find all of the objects on their scavenger hunt card. Remind students to not harm any living things in their search.

Maple Count

Students need to find 40 maple leaves and then count how many maple trees they can find. Remind them to use their maple ID skills. Show the sugar maple leaf card to students as a visual cue. Remind the students of opposite branching.

Taste Test

Taste the syrup! Each student receives a drop of pure maple syrup on the back of one hand and a drop of artificial syrup on the other. They then taste each one and try to guess which is which.

Take a trip to the Evaporator

Discuss historical procedures for producing syrup.

Native Americans would collect the sap in wooden troughs and let it partially freeze overnight. Then they would discard the ice and this would concentrate the sugar in the liquid. Next, they would place hot rocks in the liquid to boil it down.

WRAP-UP

BACKGROUND INFORMATION

History of Maple Syrup

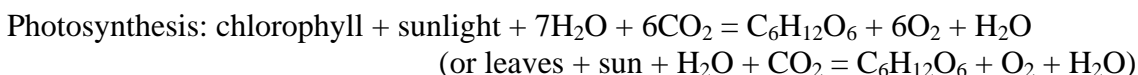
Maple products were an important part of many Native American's diet. They used the sap as a drink, and processed it into syrup, candy, sugar, and food flavoring. They also used maple items to trade with settlers. Eventually, settlers learned to make their own. Once early colonials were able to produce their own sugar, they were able to become less dependent on imported sugar which eventually helped to contribute to the American Revolution. For more information see attached information.

How and why trees produce sap

Sap is an important part of a tree's biology. Sap is what carries nutrients and energy (sugar) for growing from the soil and roots to the spring buds or leaves and all other parts of a tree (similar to our blood). Sap also carries sugars from the leaves to the roots to be stored for the winter.

Yellow-bellied sapsuckers tap small holes in trees in neat rows to eat a little sap. The leaky holes attract insects and the birds come back later to eat the insects.

Photosynthesis is the process by which chlorophyll-containing tissues of a plant (leaves) produce carbohydrates (sugar), water and oxygen from sunlight, water and carbon dioxide.



Parts of a tree

Trees are covered with a protective layer of bark. The cambium is the growing layer and lies directly beneath the bark. The next layer is the sapwood which is the fairly new wood where the sap flows. The heartwood is at the center of the tree, it is older more rigid wood which helps hold the tree up but does not help transfer sap.

How sap is collected and syrup is made

Maple sap is collected from trees by drilling holes into trees, inserting a spile (spout) and letting the sap drip into a bucket. The sap is then filtered to remove debris and heated/boiled to remove excess water through evaporation until syrup is formed.

Maple sap usually contains about 2 – 3% sugar and needs to be boiled down to 65% sugar to produce syrup. It usually takes about 40 gallons of sap to produce 1 gallon of syrup. By further evaporating the sap, other Maple products can be produced such as Maple candy or even Maple sugar. Syrup can also be made from other types of trees such as birch, box elder and hickory, but maples have the highest concentration of sugar, which makes it easier to produce syrup. Of the several species of Maple trees, Sugar Maple has the highest concentration of sugar. Sugar Maple and Black Maple are common at Camp Edwards with some other Maple species present.

Vocabulary

sap: the fluid of the tree (or any plant) which circulates throughout the vascular system and transports water, nutrients and energy throughout the plant, synonymous to our blood.

syrup: a sweet thick liquid used to flavor food.

photosynthesis: process by which plants form sugars
(sunlight + 6 H₂O + CO = C₆H₁₂O₆ + O₂)

bark: tough, outer protective layer of tree

cambium: a layer of living, growing tissue beneath the bark

sapwood: younger, more tender, tan, living wood, active in transport of sap, located between cambium and heartwood

heartwood: dark colored, older, not living, harder wood toward the center of tree xylem

phloem

xylem:

tap: to drill hole in tree for sap collection

spile: spout inserted in tree for sap collection.

evaporator: apparatus for removing excess water from sap to produce syrup; consisting of pan or tray and heat source

sugar bush: a stand or forest of sugar maple trees.

Maple Sugaring Facts and Figures

Maples grow about 4 inches a year; it takes about 45 years for a tree top to grow large enough to tap.

Average Sugar Maple sap is about 2 – 3 % sugar. Some Red Maples can have 10% or more sugar!

Rule of 86: 86 divided by % sugar in sap equals number of gallons of sap required to produce 1 gallon syrup. Example: 86 divided by 2(% sugar) = 43 gallons of sap to produce 1 gallon syrup.

It usually takes about 40 gallons of Maple sap to produce 1 gallon of syrup, but could vary from 30 to 50 gallons sap to 1 gallon syrup.

Finished syrup is about 65% sugar.

One tap produces about 5 – 15 gallons of sap.

One tap hole yields about 8% of a trees sap.

Boiling point of water is 212 degrees F, of syrup is 219 degrees F.

Moisture level is important; sap yield will be lower following a dry fall/winter.

Syrup can also be made from the sap of box elder, birch, butternut, hickory and sycamore. Their sap is not as sweet so it takes more to make syrup.

Wisconsin ranks third in the U.S. in maple syrup production by state.

A Native American Maple Syrup Legend

When Creator made Maple trees, he kindly filled them with rich, sweet syrup that flowed from the bark all year round. One fine day, the impish trickster, Manabozho, decided to visit his friends, the Winnebago people. When he arrived at the village it was strangely quiet. No one was hunting or cooking and gathering nuts, berries and roots. The vegetable garden was empty. No children laughed as they played games. Walking farther into the woods, Manabozho found a group of Maple trees. There were the villagers lazily lying under the trees, eyes closed, content to do nothing more than let the delicious syrup dribble into their open mouths. So Manabozho quickly dipped a birch bark bucket of water from a nearby lake. Using his magical powers he flew to the top of one of the maples and poured it over the tree. Instantly, the rich sweet syrup changed to watery sap in all the maples.

“On your feet, my friends” Manabozho laughed heartily at his own trick. “Now there is only watery sap instead of the syrup the Creator gave you. In a few weeks, all the sap will feed the tree’s new leaves and there will be none for you. You will have to go back to working for your food. When the sap rises again next spring, you will have to work hard to collect and boil it down into syrup and sugar. Then you will truly appreciate the great gift of Maple syrup that Creator gave you!” And that is how it is for all of us to this very day.

Half day Maple Tapping Program outline

Intro Tell story from keepers of the earth

Part A

1. Discussion Basic needs of trees and plants SAWSS
 - Sun needed for leaves to make food
 - Air Trees breath in Carbon Dioxide - breath out Oxygen
 - Water essential for all living things
 - Soil contains the nutrients for the plant
 - Seed baby plant
2. Seasons of the Maple
 - Summer Leaves make food so tree can grow
 - Fall Leaves stop producing food turn colors and fall off
 - Winter Food is stored in the roots
 - Spring stored food (sap) flows from the roots to buds to produce new leaves
3. Build a tree (Go over parts)
 - *heartwood* central core of dense dead wood supports the tree
 - *sapwood or xylem* transports water and nutrients from roots to leaves
 - *cambium* thin layer of growing tissue make cells that become new xylem or phloem
 - *phloem or inner bark* transports sap through-out tree
 - *roots* anchor the tree and absorb water and nutrients from the soil
 - *leaves* make food for the tree through photosynthesis
4. Photosynthesis Tube activity Sunlight + $7\text{H}_2\text{O} + 6\text{CO}_2 = \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 + \text{H}_2\text{O}$ Explain how the tree makes sap & why it runs in early spring.

Part B

5. Tree Identification. (Opposites and gray flakey or medium grooved bark)
6. Tapping a tree.
 - Trees at least 10 inch DBH
 - When does sap run 40° days and freezing nights
 - Where to tap? Preferably on the south side of tree or under large branches
7. Using different sap collecting techniques through history
 - Yellow bellied sap-suckers tap holes in rows to get sap and collect insects
 - Cut on a tree and collect in Birch bark baskets
 - Freeze and remove ice then boil with Hot rocks
 - Spiles and buckets
 - Gravity tubes/pipelines
 - Bags
8. *Make a spile
9. *Collect sap (strain thorough filter and store in buckets or bins)

Part C

10. *Gather Firewood to bring to the evaporator
11. Visit the evaporator. (Discuss sugar concentration and the evaporation process)
12. Grades of syrup
13. Hear a story about maple syrup production.

Part D

14. Taste Test real or artificial?
15. Taste the syrup on a pancake.
16. What can you do to protect trees and forests?
 - Plant a tree
 - Clean up a natural area
 - Recycle
 - Pick up litter

17. Summary / Review

*Optional activities depending on age and time

Things to do to get ready....

- Set up Evaporator
- Gather firewood
- 70 % alcohol solution
- Cross section of tree to show the layers
- Collect buckets & Wash equipment
- Gather spile making supplies (cut sumac)

- Organize with Kitchen
- Get Maple syrup and pickles

- Get permission to tap neighbors trees from Kutch
- School confirmation
- Staffing

- Find Stories
- Another photosynthesis tube
- Blind taste test sample bottles
- Cook down old syrup
- Collect sap
- Make birch bark basket and Hollow log for cooking sap
- Cut more firewood