Maple syrup: A sweet springtime lesson

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**Maple Syrup: A Sweet Springtime Lesson**

**Stephen G. Saupe & Sarah Gainey**  - College of Saint Benedict | Saint John’s University

**Summary:**

- **Maple Sap Collection**
  - Activity: The students collect sap from the tapped trees in the sugar bush. They use buckets and teamwork to pour the sap from the bag/buckets on the tree into 55 gallon barrels in the woods.
  - Key Points:
    - Sap flow requires fluctuating day/night temperatures (above freezing during the day, below freezing at night).
    - Collect carefully because it requires 40 gals of sap to make one gal of syrup. (Whatever you catch by the drop don’t spill by the pail.)
    - Both bags and buckets are used to collect sap. Bags are easier to store and are disposed at end of year while buckets can be reused but must be washed.
    - It is necessary to filter the sap multiple times to remove debris and other wildlife attracted to the sap.
    - Sap is sterile as it comes out of the tree. Any microbes that grow between collection and cooking are killed by the boiling process.

- **Saint John’s Maple Syrup Operation**
  - The production of sap from the sap of the sugar maple tree (Acer saccharum) is a springtime ritual in many parts of the northeastern United States, including central Minnesota where syrup-makers at Saint John’s have made syrup since 1942.
  - Saint John’s produced syrup ca. every other year until 2000 when the process became an annual affair. In central Minnesota, the trees typically produce sap from mid-March until mid-April. Approximately 1000 taps are installed that yield nearly 10,000 gallons of sap which is boiled down to make about 250 gallons of syrup. The Saint John’s wood-fired evaporator is 4 x 16 feet and uses approximately 12.5 cords of wood per season or roughly 22 gal. of syrup per cord.
  - The operation is run by a core group of staff, university and volunteer syrup-makers and volunteers. In addition, each year we provide an educational experience about the syrup-making process for hundreds of students, from pre-K through college.
  - We also host two maple syrup festivals, open to the public, and have had over 1600 people attend.

- **Saint John Maple Syrup Statistics: Averages**

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- **Rule of 86**
  - By law, maple syrup must contain 66% sugar (wt/wt) or 86% sap per gallon syrup.
  - Maple sap is typically 2.0% sucrose.
  - The sugar concentration of the solution can be measured with a hydrometer or a refractometer.
  - The Rule of 86 estimates the amount of sap needed to make a gallon of syrup.
  - Gallons sap per gallon syrup = 86 / [sap sugar]
  - Example: If sap has a [sugar] of 2.0%, it will take 43 gallons of sap to make one gallon of syrup. (86 / 2 = 43)
  - The rule is derived from the weight of sugar in 1 gal of syrup (7.2115 lbs) compared to weight of sugar in 1% sugar solution (0.0836 lbs)

- **Syrup Scout Patch**
  - Boy and girl scouts have the opportunity to earn a unique Saint John’s Maple Syrup patch by attending one of the maple syrup festivals and completing a series of activities.
  - Scouts learn to tap trees, collect sap, cook syrup, and attend educational talks while writing down things they learned. When they answer a few questions about maple syruping at the end, they earn their patch!

- **College - Physiology of Sap Flow**
  - Activity: The students learn how sap flows through maple trees and why it results in sap flow under the correct temperature conditions.
  - Key Points:
    - Sap flow requires freezing nights and warm days.
    - During the cold night, water freezes inside hollow fiber cells compressing gases and locking them inside ice bubbles.
    - Freezing creates a suction (tension) that draws water/sap from the roots through fluid-filled vessels.
    - Warm days cause the ice to melt and gas to expand.
    - The increased pressure pushes sap out of the tap hole.
    - Sap flow is related to normal water transport (Cohesion-tension hypothesis) which involves a tension in the xylem.
    - Gas-filled fiber cells & fluid-filled vessel elements in the xylem is characteristic of maples and explain why other trees don’t produce sap.

- **Middle School - Rule of 86**
  - Activity: The students determine the [sugar] of the sap using a hydrometer or refractometer. The students then use the Rule of 86 to determine the sap to syrup ratio.
  - Key Points:
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    - Maple sap is typically 2.0% sucrose.
    - The sugar concentration of the solution can be measured with a hydrometer or a refractometer.
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    - The rule is derived from the weight of sugar in 1 gal of syrup (7.2115 lbs) compared to weight of sugar in 1% sugar solution (0.0836 lbs)

- **High School - Sap to Syrup**
  - Activity: The students learn the science and art of cooking maple sap to make maple syrup.
  - Key Points:
    - Native Americans traditionally cooked syrup by heating rocks in a fire, then transferring the hot rocks to a basket of sap.
    - Sap can be cooked using a batch method, i.e., a pot on a stove or over a fire.
    - Large operations use a continuous flow evaporator - sap enters one area and syrup exits another area.
    - A continuous flow evaporator, such as the one at Saint John’s requires: (a) feeding firebox with wood, (b) monitoring level of sap in evaporator; (c) monitoring amount of sap in storage reserve tanks; (d) monitoring progress of the cooking; (e) controlling the temperature of the fire; (f) filtering syrup to remove sugar-sand; (g)removing finished syrup.