



TAPPING INTO MAPLE TRADITION

Lesson Title: Jones Rule of 86

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Grade Level: (check all that apply)

- Early Elementary (K – 2nd)
- Upper Elementary (3rd – 5th)
- Middle School (6th – 8th)
- High School (9th – 12th)

What National Agriculture Literacy Outcomes does your lesson address?

<http://www.agclassroom.org/get/doc/NALObooklet.pdf>

T4.6-8a

What Common Core Standards does your lesson address?

CCSS.MATH.CONTENT.8.F.A.1

CCSS.MATH.CONTENT.8.F.B.5

Brief description of your lesson plan:

In this activity, students will analyze graphs of the different versions Jones Rule of 86 to see that the higher the Brix score, the less amount of sap needed to produce a gallon of syrup.

Time: 1 hour

Materials:

- Colored Pencils
- Graph Paper
- Notebook Paper
- Calculator

Vocabulary: Click or tap here to enter text.

Background:

The Jones "Rule of 86" was devised in 1946 by C.H. Jones, a scientist and educator at the University of Vermont. The rule tells us that if we divide 86 by the sugar content of sap, you can estimate the amount of sap required to produce a gallon of syrup.

$$S = 86/X \text{ and } W = S - 1$$

Where: S = the initial volume of sap (or concentrate) required to produce 1 gallon of syrup

X = the starting sap (or concentrate) sugar concentration in °Brix.

W = the amount of water to be boiled off to produce 1 gallon of syrup

This rule was helpful for producers before the onset of calculators and smartphones as it was easy to remember. However, this is just an approximation. The rule does not really make sense as the concentration rises, as you get to a point where the S rises above one.

An important aspect of the equation is the X, which represents the sugar concentration in degrees Brix. One degree Brix is 1 gram of sucrose in 100 grams of solution and represents the strength of the solution as percentage by mass. The higher the degree, the higher concentration of sugar molecules in the solution. Maple syrup can be made from all maple species (sugar maple, black maple, red maple, silver maple and boxelder) but they are not created equally. Sugar and black maple sap has higher sugar concentrations, (2-3%), than silver maple (1.5-1.75%), and box elder (1%).¹

Interest Approach – Engagement:

Show students a container of maple syrup and ask them how much maple sap they think is needed to produce that syrup. How do they think maple producers work this out?

Procedures:

1. Warm up students by asking them to make a table and graph $y=1/x$ and $y=x+1$.
2. Give students two pieces of graph paper.
3. On one side, have students draw a coordinate plane, only using the first quadrant. Label the x-axis X-sugar concentration and the y-axis S-Gallons of raw sap.
4. On the other side, have students draw a coordinate plane, only using the first quadrant. Label the x-axis S-gallons of raw sap and the y-axis W-gallons of water.
5. On a piece of notebook paper, have students make a table with column headings X, S1, S2, S3. On the opposite side of the paper, have students make a table with column headings, S and W.
6. Give the students each of the Jones Rule of 86 equations, one at a time to fill in their table and then draw a graph. Each graph should be drawn in a different color.
 - a. $S1=(86/x)$
 - b. $S2=(87.1/x)-0.32$
 - c. $S3=(88.2/x)-0.32$
7. On the back side of the paper, students may choose any of the equations from the front of the sheet to fill in the table. Then draw the graph. ($W=S-1$)
8. When all graphs have been drawn asks students what they see. Have a class discussion about the Jones Rule and what they think the graphs mean. (The higher the sugar concentration, the less sap is needed to produce syrup.)

Did you know? (Ag Facts):

It takes nearly 40 gallons of sap to produce one gallon of syrup.²

Enriching Activities:

For homework, have students draw a graph for something they do in their daily life. Making a sandwich, walking to school, etc. Ensure that students can make a table as well. Bonus: Can they write an equation for this task?

Sources/Credits:

1. The Jones Rule of 86 Revisited <http://www.uvm.edu/~pmrc/jones.pdf>
2. <http://www.nysmaple.com/maple-facts/How-Much-Sap-Can-One-Tree-Produce-/3/2>