# TAPPING INTO MAPLE TRADITION

**Lesson Title:** **Tubing Layout Design**

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**Grade Level**:
- ☐ 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?**
Theme 4: Science, Technology, Engineering & Mathematics

**What Common Core Standards does your lesson address?**
Science **Standard 2 technological design**

**Brief description of your lesson plan:**

**Proper sap collection systems start with an efficient tubing design. This lesson will go over how to effectively design a tubing system that not only works great but also is easy to maintain. Using natural slope and valleys of a hill can help aid a design. Vacuum pressure is also very important to a maple sugar maker. This will also be touched on in the lesson.**

**Time:** 2 week lesson from guest speakers, field work and class work.

**Materials:**
1. Topographic Maps (http://www.wildlife.state.nh.us/maps/topo.html) Google Earth
2. Ruler
3. Pencil (Different Colors to identify different main lines)

**Vocabulary**

Main Line: Large food grade tubing that carries maple sap to the collection point
Topographical Map: Type of map characterized with large-scale detail. Usually using contour line.
Lateral Line: Smaller food grade maple tubing the is strung from tree to tree
Releaser: A device used to separate maple sap and air. There are mechanical and electrical styles.

Sight Level: A tool that uses sight to determine is line is level.
Gravity: The force that attracts towards the center of the Earth
Vacuum: Space in which the air has been removed.

**Background**:

Not every site is created equal. A determination should be made whether a site will be profitable to tap or not. This should be done before any tubing design takes place. Meet with a forester on your property or make a map yourself of where your concentration of maple trees are. Many types of maple tree can be tapped (ie. Sugar, Red, Silver etc.). Once these are mapped you can then start your layout. Once the number of maple trees is determined the next selection to be made is whether to use vacuum or gravity system. The design of these systems is drastically different. A vacuum system should have no more than five taps per lateral line. A gravity system can be as high as ten taps. A relatively new technology utilizes 3/16$^{th}$ tubing and this will allow up to 20 taps per lateral line. This new technology creates lots of natural vacuum therefore increasing yield.

To identify the number of taps per trees you need to consider the diameter of the tree. A maple tree should not be tapped if less than ten inches in diameter. Once a tree reaches eighteen inches in diameter it can now receive up to two taps. No tree should exceed two taps to maintain tree health.

The health of your sugar bush can vary your sap flow rates. You can expect up to a gallon per tap on average flow days and up to two gallons per tap on high flow days.

**Interest Approach – Engagement**:

Once you have completed your mapping layout of your sugar bush the next task is to bring your work out into the field/woods. The mapping layout work will support the tubing layout design you have created. The drawn plan will also help guide how your tubing system should be easily laid out. Once tubing installation is completed your mapping plan should be similar, if in the field you identify areas changes are needed you can easily update your mapping go have a record of your sugar bush layout.

**Procedures:**

**Engage**: Identify students interested in both classroom and field work. Should have some basic knowledge in map reading.

**Explore:** Explore with your students and Forester an area you have identified as a sugar bush, locate topographical map of the area. Identify tubing system you wish to use, gravity or vacuum.

Distinguish the different types of sugar trees, quantities, and age of each in your stand area. Cite evidence, including but not limited to bark, crown, topography, diameter, and age.

**Explain:** Explain the process of getting the sap from the trees through the tubing layout, determine how many mainlines? Identify where your storage tank is to be located, which should be an easily accessed low point in the sugar bush, will be for the sap collection so you can begin layout design. The next step is to get the mainline to your trees always-select natural valley and areas that have natural sunlight if at all possible. Tubing size has some rough guidelines ¾”250 taps 1” up to 500 taps and 1.25” up to 1000 taps. Identify tap capacity; this needs to be considered to determine mainline sizing. Select the smallest size needed to access the amount of taps you have. This will help keep costs at a minimum.

Defend the selection of your tubing design size and layout based on the area you were assigned to tap. What facts can you use to support your decision?

**Elaborate/Demonstrate:** Begin layout of tubing design, use maps of the area and any previous site notes you may have to determine central location for sap collection. Using different colors for the various main lines will help to identify the location and mainline sizing. Once tubing layout is designed you can begin set up of tubing in the woods based on your tubing plan.

Describe how the maple syrup collection design process could be related to another content area, like installing power lines in a rural area, or plumbing in a home. Cite examples, similarities, and draw conclusions on how the process could be adopted to this new theme. Include this in your presentation.

Project Options:

1. Compare and contrast 2 different design plans using data and evidence. (Trunk and crown size, distance from tree to tree, land grade and layout, tubing or bucket, storage tank location, tap height, vacuum vs. gravity feed, expected vs. actual flow rate) Create a decision matrix to determine the best approach based on the evidence gathered. Rank each category from most important (5) to least (1) and select the best approach. Defend your matrix decisions.
2. Create a project proposal to present to the class. Use and show reasoning, planning and evidence. Areas to consider include:
   a. When would be the best time to tap?
   b. How will you get the maple syrup from field to boiler house?
   c. Bill of materials needed including cost.
   d. Time frame allowed to tap and expected yield
   e. Topographical map outlining area of taps, collection lines, storage area, etc
   f. Tree types, expected output, collection time frame
   g. Include data, graphs, pictures and site sources APA style
3. Grades 6 -8 can create a design competition using hand sketches
   High School classes can create CAD designs where feasible.

**Did you know? (Ag Facts):**

Maple trees with large crowns tend to have higher sugar content. This means you make more maple syrup with less sap. Many trees with large crowns also can produce a lot of sap sometimes even as much as 6 gallons per tap. Leave some areas where your mainline is higher than five feet this will allow areas where animals can cross underneath.

**Enriching Activities**:

Visit a local sugar bush or have a local sugar maker come speak to the class.

**Sources/Credits**: n/a