MAPLE SYRUPING with SARE

at

Straight Creek Valley Farm

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Straight Creek

The Sugar Bush at Straight Creek

Maple Sugaring in Southern Ohio

Our first year sugaring at Straight Creek, simple but effective!!!!!!

Range of Sugar Maples

- The northern limit of sugar maple extends eastward from the extreme southeast corner of Manitoba, through central Ontario, the southern third of Quebec and all of New Brunswick and Nova Scotia.
- Within the United States sugar maples are found throughout New England, New York, Pennsylvania, and the middle Atlantic States, extending southwestward through central New Jersey to the Appalachian Mountains, then southward through the western edge of North Carolina to the southern border of Tennessee.
- The western limit extends through Missouri into a small area of Kansas, the eastern one-third of Iowa, and the eastern two-thirds of Minnesota. A few outlier communities are found in northern Kansas, Georgia, and the Carolinas.

Ohio Sugar Maples

- The trees are found throughout the state
- Sugar maples grow on sands, sandy loams, loams, and silt loams but they do best on well-drained loams.
- *They* do not grow well on dry, shallow soils and are rarely, if ever, found in swamps.
- Sugar maples are associated with sites that have abundant organic matter and often in areas with high oak populations.

Soil and Elevation

- Sugar maples grow in soils ranging from strongly acid (pH 3.7) to slightly alkaline (pH 7.3), but it most commonly grows on soils with a pH of from 5.5 to 7. *Our Creek Valley soils average a ph of 6.5.*
- The heavy leaf litter typical of sugar maple tends to modify the pH and nutrient status of the soil. The leaves contain about 1.81 percent calcium, 0.24 percent magnesium, 0.75 percent potassium, 0.11 percent phosphorus, 0.67 percent nitrogen, and 11.85 percent ash, based on dry weight
- Along the Great Lakes, sugar maples are found at elevations up to 1,600 ft, most commonly on ridges on soil with at least 3 to 5 ft to the water table.
- In the southern part of the State, along the Ohio River, sugar maples more typically grow on moist flats and along ravines at intermediate elevations in the rolling topography.

Why Does Maple Sap Flow?

- The flow is triggered by wounding the tree during the late winter and then harvesting the sap that flows from the wound. any time during the late winter season when the temperatures fluctuate above and below freezing. Flows are usually the largest during the late winter and early spring months of February, March and April when above freezing daytime temperatures are often followed by below freezing nights.
- The freeze/thaw cycle actually results in an increased pressure inside the tree's sap wood, and it is this increased pressure that forcefully pushes the sap out of any wounds in the wood, resulting in the sap flow.

The Pressure Theory

- The pressure inside the tree, can be well above the atmospheric pressure outside the tree.
- When the temperatures fall below freezing, the sap in the tree's sapwood (the youngest wood closest to the bark) freezes.
- Gasses in the sapwood are contracted with the below freezing temperatures, and this contraction creates a negative pressure in the wood that results in a suction.

Pressure and Volume

- This suction, down in the roots, then draws water from the surrounding soil into the tree, thus maples like to be close to the water table.
- It is this added water that increases the sap's volume and increases the pressure inside the tree.
- When the temperature then rises above freezing, the frozen sap thaws, increasing the sap volume even more and creating an even greater positive pressure inside the tree.
- Thus, good sap flow weather is below freezing nights followed by sunny above freezing, warm days.

Length of Flow

- A single period of sap flow can last anywhere from one to two hours to or even up to twenty hours in length and the whole sap flow season usually lasts no more than two weeks.

Why is Maple Sap Sweet

- The sugar in maple sap is produced by photosynthesis that took place during the preceding year's growing season.
- Photosynthesis, or the tree's ability to absorb sunlight and turn it into usable tree energy, produces carbohydrates, that the tree stores as starch, although some carbohydrates may be stored as sucrose.
- During the winter, maple trees, convert some of this starch into sucrose which is dissolved in the sap.
- The amount of sugar in the sap depends on many factors, such as the genetics of the individual tree, the quality of the site on which the tree is growing, the tree's health, local environmental conditions, the weather conditions of the previous growing season, and the weather conditions of the current tapping season.

Sugar Content Varies

- Generally, sap sugar content is lower at the beginning of the sugar season, rises rapidly towards the middle of the season, and then slowly declines until the sap stops running.

ANY ONE CAN DO IT!
Maple Sugaring Equipment

- There is not much equipment required for sugaring. You probably have almost everything you need in your kitchen and basement right now.
- For collecting the sap, you need a drill, a 7/16 drill bit, a tap (more technically called a spile), a small mallet, and a clean jug or bucket with which to collect the sap.
- For the boil down process all you need is a source of heat, a large pan, a filter, and glass jars.

The First Year … Hard At Work!

Second Year … Still Hard at Work!

How Many Taps Per Tree?

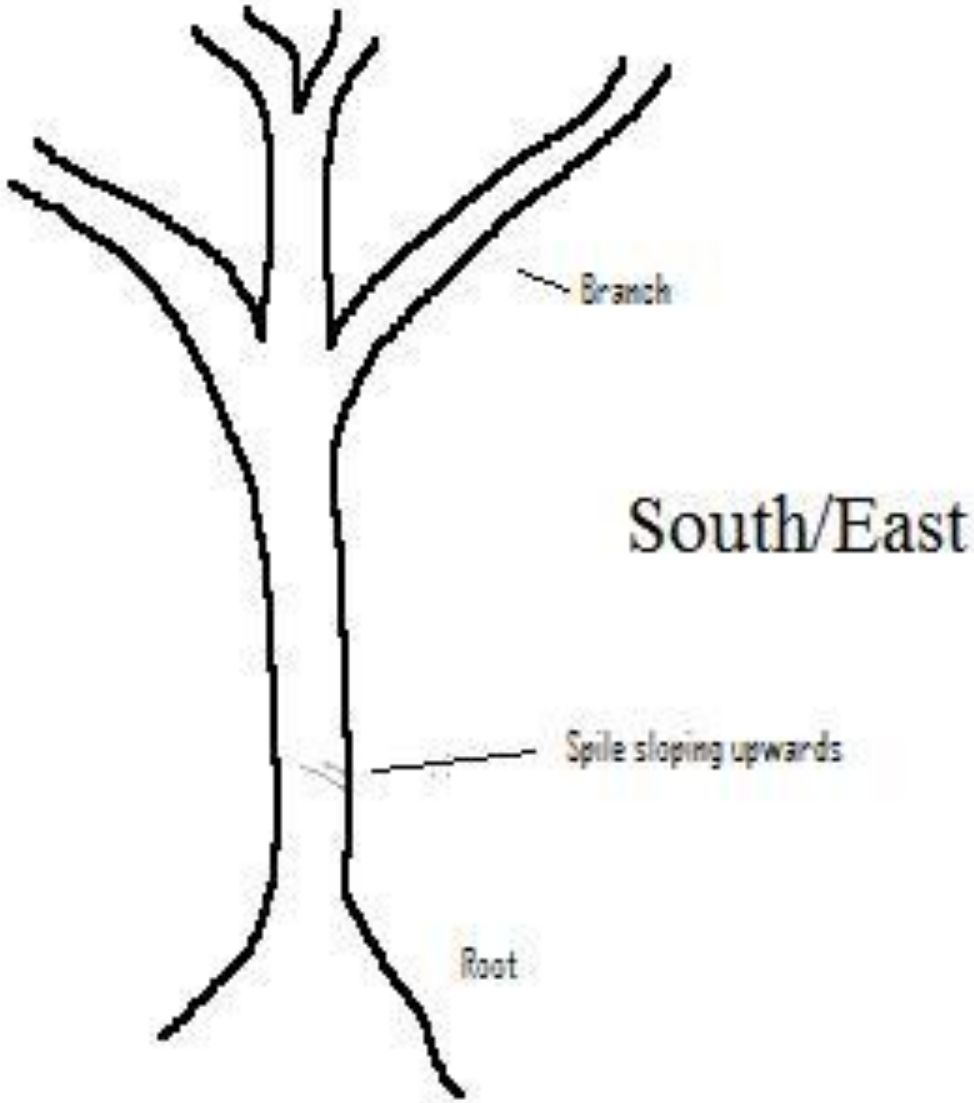
- Historically, maple sugarers believed that healthy, maple trees could support four or more taps.
- Modern maple trees are not in the best of health, and suffer from a variety of stressing factors, including wounds from fence row clearing, insects, diseases, drought, soil compaction, and air pollution.
- Maple trees throughout much of the northeastern United States now suffer from severe stress from an infestation of gypsy moths.
- Pollution has also taken a toll on maple tree health.
- The effect of these stressing factors is easily measured by the thickness of the tree growth rings.

No More Than Two Taps Per Tree

- Tapping guidelines have accordingly become more conservative. It is now recommended that you never tap a maple tree that is less than twelve inches in diameter, and no more than 2 taps should ever be set in any one tree, no matter how large the tree.
- Maple sugarers have recently realized that the volume of sap produced at each tap hole increases substantially when fewer tap holes per tree are used.

Drilling The Tap Hole

- Use a clean, sharp 7/16 inch diameter drill bit.
- Drill tap holes about two feet above the ground, over a large root and under a large overhead branch.
- Angled each tap hole up into the tree, so that gravity would assist the sap in flowing out of the hole and to prevent any sap from pooling inside the hole and freezing. Such sap would be more likely to freeze and expand and widen the tap hole allowing sap to flow around the tap's seal and leak down the side of the tree, uncollected.



Where to Place a Maple Spile

The Drill Bit

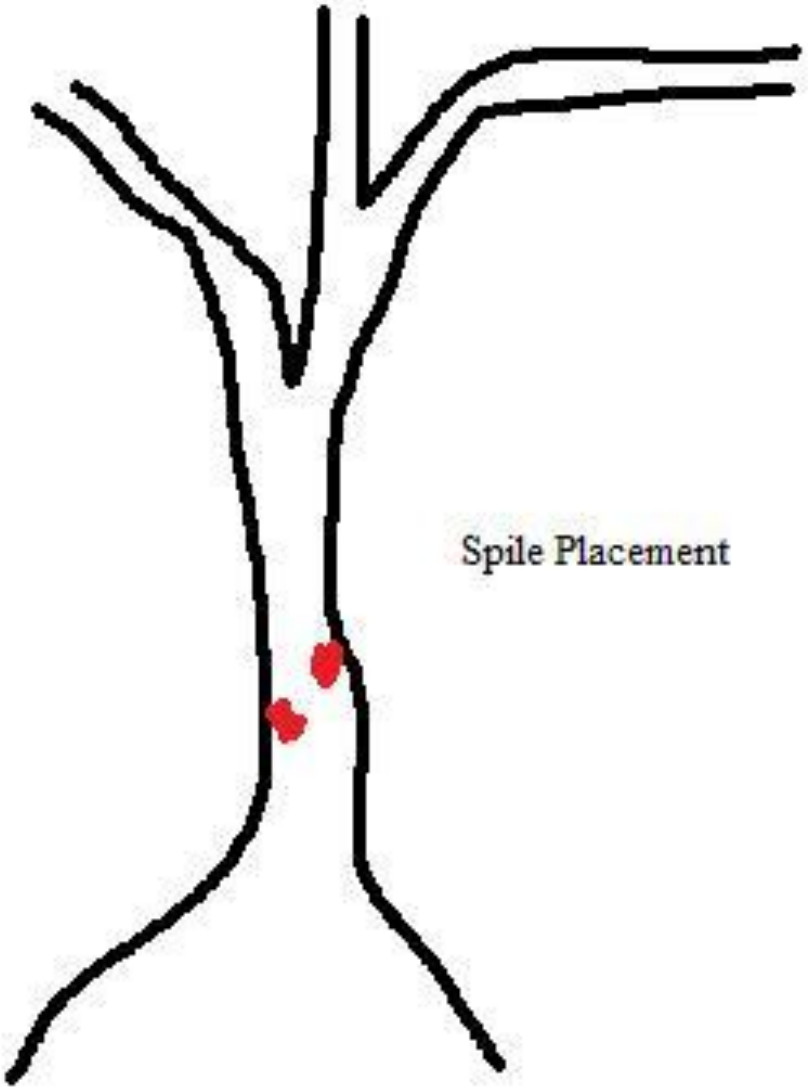
- Use a sharp bit, for a dull bit would tend to create a ragged tap hole which would not only impede sap flow, but would provide additional surface within the hole that would encourage the growth of micro organisms.
- Dull bits are also more likely to produce oval holes which will again allow the sap to leak around the sides of the tap.
- It also seems that sharp bits not only cut clean round holes, but that these clean round holes are easier for the tree to later close or cure, when the tap is removed after sugaring is done for the season.

Drill and Bit

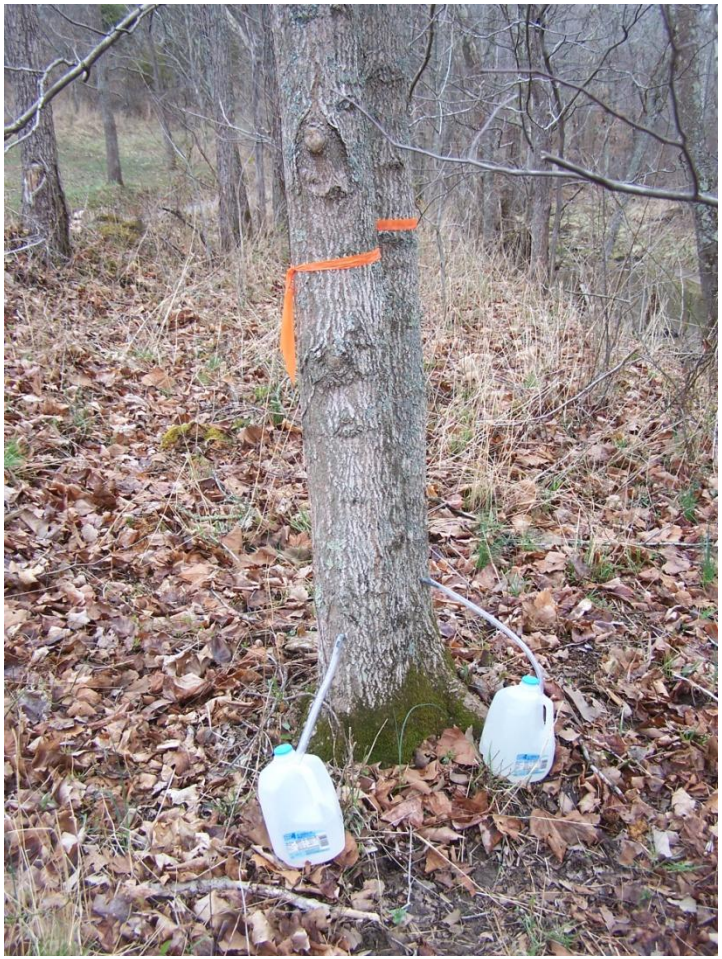
Tap Placement

- If the tree has been tapped before, any new tap holes should be at least 6 inches to the side of the old ones.
- Tap holes drilled in successive years should not be placed in a straight line around the tree. I learned that a useful pattern is to drill each new tap hole at least 6 inches to the side and slightly above or below the old tap holes. This results in a spiral pattern of tapping around the tree, and over progressive years, utilizes the entire tapping surface of the trunk.
- Similarly, tap holes should be at least 6 inches from old branch scars or other wounds, even if they have healed over. Tap holes should also only be made into sound, healthy, light colored sapwood.
- Decayed or discolored wood should not be tapped.
- Tap holes should also extend no deeper than two inches into the sap wood and should never go as far as to reach the tree's darker heartwood.

No More Than Two Taps Per Tree



Twin Tree Tapping



Spile Purpose

- Taps, also called spouts or spiles, have three functions.
- They first work to transfer the sap from the tap hole into a container.
- Their next function is to provide support for either a hanging collection container or tubing.
- Finally, the tap spouts provide a seal around the tap hole that prevents leaking and minimizes contamination by micro organisms.

Spiles

- Spiles have evolved from the early days when hollowed out reeds or wooden dowels were used, to the metal or even plastic spouts used today.
- All modern spiles are tapered to form a tight seal against the bark or outer sapwood when they are seated firmly in the tap hole. Spouts, as noted above, must be clean and rust free.
- At the end of each season, they should be cleaned with detergent or bleach, rinsed, and then dried and stored in a clean, dry place.

Old Fashioned Spiles

Modern Spile

Tapping

- After the tap hole is drilled, use a small mallet, with a wooden or rubber head, is used to gently tap the spile into the drilled hole.
- We actually use a hammer, but is very important not to use too much force for you do not want to split the sapwood allowing the sap to leak around the tap.
- Passersby would then see a dark stain running underneath the tap and know that you had split the sapwood.
- There is a greater danger of splitting the sapwood in colder weather when the wood is frozen.

Collecting the Sap

- I use gallon milk jugs!
- There is one wonderful advantage with using plastic milk jugs for sap collection. The jugs are fairly transparent and with a simple glance, you can tell if it is time to collect the jug or let it sit for a while longer.
- Another milk jug advantage is that the gallon sized jugs can be used for both collection and storage of the sap, as I did in my refrigerator as well as my neighbors.
- Finally, I should not forget to mention that milk jug collection devices are a free perk of drinking lots of healthy milk!

Milk Jug With Spile Hole

Milk Jug Ready for a Few Days Storage

Milk Jug At Work

Milk Jug Collection System

Love Those Jugs!

HOW MUCH SAP MAKES HOW MUCH SYRUP?

- Because the conversion of sap to syrup is essentially a concentration process, the initial sugar content of the sap determines the amount of sap that will be required to produce a gallon of syrup.
- There is a formula called the Rule of 86 that is used to estimate the number of gallons of sap of a specific density that will be required to produce one gallon of maple syrup.
- You just need to figure out the sugar content of your sap with a hydrometer and then multiply that number by 86 to come up with the number of gallons of sap needed to produce one gallon of syrup.
- Typically between twenty to forty five gallons of sap, produce one gallon of syrup. A lot of water needs to be evaporated out of the sap in order to produce maple syrup!

Evaporation!

Boiling Down the Sap

- The basic premise of sap evaporation is to keep the sap at a constant rolling boil, adding more sap as the water evaporates.
- The process simply involves adding new sap to the boiling sap until the sap's two to three percent sugar content increases to sixty eight percent, at which time the sap is no longer sap, but is maple syrup.
- As the water evaporates, the sugar content increases. Syrup is produced as the sugars concentrate and the water content is reduced.
- During the course of this evaporation process, the characteristic flavor and color associated with pure maple syrup are produced, but it is not only a concentration of the sugar content that produces maple syrup, for the compounds present in the sap also increase in concentration, and it is these concentrated compounds that add to the color and flavor of pure maple syrup with which we are all so familiar.

Skimming The Scum

So Easy Anyone Can Do It

Evaporation

- The larger the evaporation pan's surface, the quicker the water will evaporate and the sap will concentrate.
- Using a pot would take longer than a larger pan, for there would be less surface area for the evaporation to occur.
- The sap tends to boil over as it's sugar content increases. A boil over is imminent when the sap's surface starts to get small white bubbles all the way across it and the bubbles start to rise up in the pan.
- A tried and true way to stop a boil over is to drop a few drops of vegetable oil into the pan or else touch the surface of the frothing sap with a stick of butter.

Evaporating!

Pre-Heaters

- Because the evaporation process involves constantly adding new sap to the boiling sap, it is important to figure out a way to add the new sap without breaking the boil.
- If the boil is broken by adding cold sap, more time will be required to reach the final syrup, as more time will be required to bring the sap back up to that rolling boil.
- Maple sugarers have thus developed the concept of preheating the sap before it is added to the evaporator pan.
- There are many forms of preheaters, but all involve the same basic principle of heating up cold sap before adding it to the boiling sap so that the boil is not broken.

First Year Coffee Can Pre-Warmer

Second Year Pre-Warmer

How Long to Cook?

- You could test the syrup with a hydrometer, after it cools down to 60 degrees Fahrenheit, and when it reaches that magic sixty eight percent sugar content, you know that you have syrup.
- The better process is to test the temperature of the sap with a candy thermometer.
- When the temperature of the boiling sap reaches a temperature of 7.2 degrees Fahrenheit above the boiling point of water on that particular day at that particular location, then you have maple syrup.

Sometimes for a Long Time!

Temperature?

- To be precise, you should boil a pot of water and test the temperature at which it reaches a rolling boil. The boiling point on any given day depends on barometric pressure, thus weather and topographic elevation are the two factors that determine an exact boiling point.
- The approximate average boiling point of water is 112 degrees Fahrenheit.
- But rather than boil water and measure the temperature at which it reaches a rolling boil, I will simply boil my sap until it reaches a temperature of 220 degrees Fahrenheit.

Too Hot And Crystals Will Form!

Finishing Off Inside

Almost Syrup!

Filtering

- When maple syrup finally reaches it's syrup stage, it contains some solid particles, that look like dark specs floating in the syrup. These specs are technically called niter but are commonly called sugar sand.
- Sugar sand is the product of boiling down the calcium and magnesium salts found in the sap's malic acid, one of the organic acids present in maple sap.
- The amount of sugar sand varies from batch to batch and year to year and will even vary from one sugar bush to another within the same season.
- The reasons behind this variation are not really known, but likely depend on the amount of mineral compounds found in the maple sap.
- To get the sugar sand out of the syrup requires filtering. I found a variety of commercial filters on the internet, but for my first batch of syrup I simply used coffee filters.
- For my second sugar season I ordered felt filter cones that are specifically intended for syrup filtering. They have worked great and after use can be washed out and used again.

Bottling

- To prevent the contamination of finished syrup by yeast or mold growth, it should always be bottled while hot.
- If the temperature of the syrup after filtering is 180F or higher it can be bottled immediately.
- If the syrup has cooled and the temperature has fallen below 180F, it should be reheated to 180F or slightly higher.
- I learned, however, that the syrup should not be reheated to temperatures of 200, because this higher heat will cause the syrup to darken and loose flavor or crystallize!
- It is important to bottle the syrup at temperatures over 180F, because those temperatures will kill any yeast or mold spores present in the bottle.
- It is also important for the entire inside of the bottle to be exposed to this 180F temperature. This is done by simply turning the bottle over and letting the syrup coat the entire inside of the bottle, cap and all, before it is set aside.

SHARE with SARE

So we decided to apply for a grant for a more fuel efficient evaporator and share what we had learned with local families and perhaps learn in the process

SARE GRANT

The project addressed the question of whether Southern Ohio's family farms can utilize an indigenous natural resource to sustainably produce income.

The project's goal was to evaluate the feasibility of maple syrup production at the southern edge of the sugar maple's range, measuring sap out-put and sugar content throughout Brown County, Ohio.

SARE Grant Budget

PERSONNEL COSTS	***Grant Funds Request***
Christine D. Tailer, 6489 Straight Creek Road, Georgetown, Ohio 45121 (513) 205-0054 christine@straightcreekvalleyfarm.com Farmer/attorney/educator, will prepare and present project details to 4-H chapter leaders (6 hrs), will prepare and present how to participate in the project to 40 individual 4-H chapter meetings (40 hrs), will prepare for, supervise, monitor and answer questions at two Open House sap boil down days (24 hrs) Total time 70 hrs @ $15.00/hr = 1,050.00	$1,050.00
Gregory W. Cole, 6489 Straight Creek Road, Georgetown, Ohio 45121 (513) 324-8244 greg@straightcreekvalleyfarm.com Greg as Mechanical Designer, will design exhaust system and install efficient wood fired evaporator into outdoor sugar shed (20 hrs) @$15.00/hr = $300.00 Greg as Farmer, will cut and split one cord of standing dead trees into wood to fire evaporator on two open house days (8 hrs), will run evaporator at two open house days (20 hrs), will gather sap from each of forty trees throughout the sap flow season, recording daily volume of sap and high and low temperatures (90 hrs). total farmer time 118 hrs @ $10.00/hr = $1,180	$ 300.00 $1,180.00
Christine Kuhr, 3436 Traskwood Circle, Cincinnati, Ohio 45208 (513) 333-2128 Artist, will assist with preparation and design of 4-H handout (5 hrs) and will photograph and supervise two 4-H Open Houses (20 hrs). total time donated 25 hrs	
Bessie Kibbey, 101C Fencerail Way, Milford, Ohio 45150 (513) 248-4262 Retired, will assist with set up and supervision at two 4-H Open Houses (20 hrs) time donated 20 hrs.	
SUBTOTAL Matching Funds	$2,530.00

Actual Proposed Costs

- **OTHER COSTS**
- **Grant Funds Request**
- 1000 one page handouts for prospective 4-H participants @ $0.10 per page
  $100.00
- Driving 800 miles to 40 individual 4-H chapter meetings at an average of 20 miles per meeting in order to describe maple syrup history and project participation @ $0.55 per mile
  $440.00
- Ingredients for 1,000 maple sugar cookies and cider to hand out at two Open Houses
  $ 150.00
- Rental of two port-a-pottys
  $150.00

- **Grant Funds Request for Actual Equipment** (Must be 50% or less of total cost of each item.)
- 500 spiles @ $2.00 each $ 500.00
- 2 x 4 Leader Maple Syrup Evaporator $2,000.00
- 200 feet of food grade plastic tubing@ $1.00 a foot $ 100.00
- **Subtotal from above**

$3,440.00

Total Budget

- Soft Money for our time $2,530.00
- Plus Money for equipment $3,440.00
- *(Grant request total cannot exceed $6,000 for individual grants or $18,000 for group grants.)*

- **TOTAL** Grant request of **$5,970.00**

The SARE Evaporator

Sap Waiting to Boil

Straining the Sap

The New Pre-warmer

2x4’ evaporator pan
baffled rear pan
shallow front pan

Once at a rolling boil we produced about a gallon of syrup an hour!!!!!

4-H There are approximately one thousand 4-H members in Brown County, Ohio spread out among forty individual groups. I contacted the group leaders, and then was invited to six individual groups where I gave a presentation and recruited interested families.

I explained the science behind the maple flow and presented a printed handout to each 4-H member detailing how to identify and tap a maple tree, and to those who wish to participate in the project I loaned a spile (tap). The hand out explained in detail how to tap a maple tree with nothing more than the spile, a clean gallon milk jug and a 7/16 drill bit.

Fewer than twenty families expressed interest so I then contacted the **FFA** teacher at eastern Brown High School and made the same presentation to the whole group of one hundred high school students. Approximately twenty students expressed interest.

SAP FLOW

When the sap began to flow in early 2011, I called each 4-H group leader and the FFA teacher so they could notify their individual group members to tap their chosen tree. Each participant was supposed to collect sap for three consecutive days, and as each gallon jug filled up, cover the hole with tape and place it in their refrigerator.

We then posted the dates for two boil down days at Straight Creek Valley Farm, one for 4-H and the other for FFA participants. As participants arrived I recorded the location of each tree tapped, the number of gallons of sap run through the evaporator, and the resulting gallons of syrup at each of the boil down events.

PROBLEM!!!!

- The participants were so excited that many of them tapped as long as they could. They simply could not stop after only three days.
- Thus we could not determine the volume of sap per each tap as they tapped for a wide range of days and did not keep accurate records!!!!
- But what a wonderful problem!!!

4-H Taps and Gallons

February 26th, 2011

- 15 participants brought a total of 105 gallons of sap from a total of 29 trees
- 105 gallons of sap boiled down into 2.85 gallons of syrup or 364.8 oz of syrup
- 36.84 gallons of sap were reduced to 1 gallon of syrup ... thus a **37/1 ratio** sap/syrup
- The average distance to running water (river, creek, stream) was 1/3 mile
  - several trees were right on the banks of a stream or river
  - several trees were one mile from the nearest running water

- At the end of the day each participant returned home with anywhere from one 8oz jar of syrup to 3 quarts of syrup, and actually we continued the boil down as the day grew long and they returned the next day to pick up their percent share.

FFA Taps and Gallons

March 3rd, 2011

- 17 participants brought a total of 94 gallons of sap from a total of 20 trees
- 94 gallons of sap boiled down into 2.24 gallons of syrup or 300 oz of syrup
- 40.17 gallons of sap were reduced to 1 gallon of syrup ... thus a **40/1 ratio** sap/syrup
- The average distance to running water (river, creek, stream) was 2/5 mile
  - several trees were right on the banks of a stream or river
  - several trees were one mile from the nearest running water

- At the end of the day each participant returned home with anywhere from one 8oz jar of syrup to 2 quarts of syrup, and we were actually able to complete the boil down so that each participant returned home that same day with their percent share.

Empirical Results

- On January 26th 37/1 sap/syrup ratio
- On March 3rd 40/1 sap syrup ratio

THUS EARLIER IN SEASON BETTER RATIO

- 1/3 mile from water 37/1 sap syrup ratio
- 1/5 mile from water 40/1 sap syrup ratio

THUS CLOSER TO WATER POORER RATIO

Regardless …

- Southern Ohio, specifically Brown County, is a good place to produce maple syrup!

Best Results

- All participants were extremely excited and thrilled with the process
- Many did more boiling down on their own
- Many planned to boil down the next sugar season and have called this year with questions
- Everyone learned that they can produce their own maple syrup

Last but Far from Least!!

- It was then time for everyone to sit back and enjoy their own Brown County maple syrup.
- Try a new recipe for a maple syrup basted pork roast. Or simply prepare dinner biscuits topped with butter and 100% pure maple syrup.
- And of course, don't forget pancakes or waffles smothered in maple syrup. No doubt it all tastes good, but I also know that it all tastes especially good because we know that we have made the maple syrup ourselves from trees that we have grown to know and respect in a very unique way.
- ***Maple syrup really is the condensed energy of the trees sweetly crossing your lips and lightening up your heart.***
- Each taste is priceless!

Maple Facts

- Did you know that Maple Syrup is a 100% natural and organic product.
- Maple Syrup contains as much calcium as whole milk.
- Maple Syrup has only 40 calories per tablespoon, while corn syrup has 60.
- Maple Syrup is rich in minerals such as calcium, potassium, manganese, phosphorus, and iron.
- Maple Syrup contains vitamins B2, B5, B6 and niacin as well as folic acid.
- Maple Syrup even contains trace amounts amino acids, the basis of protein.

Happy Sugar’in!!!