

Maple Syrup Video

0:05

Hello and welcome to the Kentucky 4-H Virtual Experience. My name is Joey Barnard and I'm the Extension Specialist for 4-H Camping, a part of the University of Kentucky's College of Agriculture, Food, and Environment. Today, we'll be visiting West Kentucky 4-H Camp where Nicole, the Camp Director, will be sharing with us the process of turning Sugar Maple Sap into Syrup. We hope you enjoy.

0:29

Welcome to the sugar bush. I'm Nicole Blanzzy, camp Director of the University of Kentucky's West Kentucky 4-H Camp. Today we're in a stand of trees primarily made up of hard woods, including sugar maples and we are going to be talking about the process of turning that sap into syrup.

0:50

All living things need water to survive, that includes trees. Water is drawn from the soil, into the roots, up the stem, out to the branches, and into the leaves of a tree. Water is one of the key components of a process called **photosynthesis**, or the process by which a plant make food from carbon dioxide and water.

1:16

The water travels through channels in a tree called **xylem**. Xylem is made up of fibrous tracheary elements that act like straws. Sap moves through the xylem in response to physical forces, pressure within and surrounding the tree, and osmotic gradients.

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In the summer, carbon dioxide enters the leaf through microscopic holes called **stomata**. As the carbon dioxide is coming in, water escapes (a lot like our breathing produces moisture). The loss of water is called **transpiration** and the void that it leaves creates negative pressure within the xylem. The negative pressure draws water up from lower in the plant to reach a point of equilibrium or balance. The sugar that are produced throughout the summer are stored in the branches, stem, and roots of the tree as starches for later use. These starches are stored in **ray cells**, living cells and dead wood fiber cells that surround the xylem. In the spring, when a tree needs to kickstart its growth, it releases an enzyme that transforms those stored starches into sugar. The Sugar is released into the sap filled xylem and moves into the branches where its energy is expended for flowering and growing leaves, or what we call budbreak.

2:58

It might not look like it, but there is a lot going on within these trees. We collect maple sap in the winter when there is a cycle of freezing cold nights and warm days. We are able to collect sap from Maple trees because they are not like most hardwoods. In the wintertime, the ray cells of many hardwoods are filled with water and the xylem is filled with gas. In Maple trees, the ray cells are filled with gas and the xylem is filled with water. When the temperature drops at night, the water filled xylem freezes and expands. The gas filled ray cells freeze and condense. Frost forms inside the ray cells, collecting sugar as it freezes. The freezing and condensing of gas cells in the tree creates negative pressure (like that created by transpiration), which then pulls more sap up the tree from the roots. We call this process recharging. When the temperature rises above freezing the next day, the frost melts away and the compressed gases expand generating positive pressure within the stem. Sugar from the ray cells enter the water filled xylem. The pressure within the tree becomes higher than the atmospheric pressure surrounding the tree. Because sap travels from areas of higher or positive pressure to areas of lower or negative pressure, tapping a hole into the sap wood, or xylem, gives the tree an outlet for releasing some of that pressure. Sap flows out of the hole and into our bucket!

4:28

Tapping a maple tree is relatively simple. You just need a few basic supplies, the first one being a spile. This little funnel is going to help carry the sap out of the sap wood or xylem and into the tubing. From the tubing the sap drains into a bucket. Be sure to start with a clean bucket with a lid so that you can keep bugs, other animals, and water out of your precious sap. Finally, you are going to need a power drill with a drill bit that fits the same size or diameter of your spile. I've wrapped some tape around my drill bit so that I don't go any deeper than two inches into the sapwood.

5:13

So we don't want to tap a tree that is less than 10" in diameter or less than 31" in circumference. I have here a piece of string that is 31" long and before we tap this tree we are going to be sure that it meets the minimum requirements. Now that we've confirmed that our tree meets the minimum requirements for a tappable tree, we are going to make our hole. I'm going to drill at a slightly upward angle to help gravity push the sap out of sapwood or the xylem and into our bucket. We do want to make sure that our bucket has a nice, level spot to sit while it collects the sap.

6:06

This is the hole that we just drilled. On a nice, sunny day with our temperatures above freezing with relatively colder temperatures last night, the sap is running. Now that we have our hole drilled we are going to tap our spile with the connected tube into the hole. Now that our spile is snugly tucked into the hole that we created we are going to attach the tubing into the hole in the side of our bucket. So, a

little bit of prep work ahead of time, we drilled a hole into the side of the bucket so that the lid can be completely closed. You might still get some ants, but that's okay because they won't eat much and that's why we filter the sap later before we filter it down. Make sure that your bucket is sitting nice and level so that as it fills it doesn't tip over.

7:18

We will be able to collect sap for as long as the freeze thaw cycle continues. When the pressure within the tree is no longer pushed above and below atmospheric pressure, the tree simply keeps sap flowing slowly up the tree through xylem to fill the void left by negative pressure resulting from transpiration. How does tapping a hole and collecting sap affect the tree? We will pull our taps before the tree's bud break. That is when the tree flowers and develops leaves. The hole we tapped will heal naturally in about 6 weeks. The amount of sap that we collect is a small portion of what this tree needs for bud break. However, we are very selective of the trees we tap and we never create more holes than a tree bare.

8:02

So, why Sugar Maples? Besides the physiological properties that cause positive and negative pressure variance, the sugar content in the sap of Sugar Maples averages at 2%. Now this might not seem like much, but it is considerably higher than sugar content of other trees. Sugar content can vary from one tree to another based on genetic variations, soil fertility, availability of water, canopy exposure and photosynthetic success, as well as stress brought on by pests or disease. The process of turning sap into syrup is as simple as boiling away the water and condensing the sugars. A higher sugar content at the start of the boiling process means less boiling time, saving maple syrup producers time and energy.

8:47

So we've brought our maple sap into the kitchen and we are getting ready to turn it into syrup. The first step in this process is to filter it and that's because as it sits out in the woods little bugs and forest debris are going to find their way into the bucket and we want to make sure that none of that is in the finished product. We use this fine cloth to catch all of that debris.

9:33

So we've brought our sap in from the woods, we filtered out all of that forest debris and now it's time to begin the process of evaporation. Remember when we started out our sugar content was 2, maybe 3% and the sap consisted mostly of water. Our goal is to reach 67% sugar. In order to do this, we are taking that liquid water and evaporating it away or turning it into steam. This happens when water reaches a temperature of 212 degrees F. Concentrating the sugars and increasing the density of the liquid also

raises the boiling temperature of syrup. Syrup boils at 219 degrees F. You can use temperature as a gauge to figure out whether or not your syrup is done, however it isn't completely accurate. We are going to use a hydrometer today to test the doneness of our maple syrup.

10:37

Behind me are three containers at various stages. This came from the middle pan. You can see that it is still quite clear however it has a nice aroma. You can pick out the maple scent and I'm sure it's starting to taste a little bit sweet. This last pan has been boiling the longest. It has developed this nice amber color. It does smell like maple syrup and its sugar content is much higher than the other pan. But, is it done? In order to figure that out we are going to pour this hot maple syrup into our test tube, leaving a little bit of room at the top. We are going to use this glass hydrometer. There are two lines and because we are testing hot maple syrup we are going to use this top line or the Brix scale. If this hydrometer floats and this red line is level with the top of our maple syrup, the syrup is done and we are going to pull it from the stove. However, if this sinks all the way to the bottom we will need to let our syrup boil just a little bit longer. What happens if this line floats way above the syrup? Well in that case we will add some of the less done maple syrup in order to lower the density or the sugar concentrations in order to reach 67% sugar.

12:22

So, let's give it a go. I'm going to be very careful not to drop this. Sure enough it sinks all the way to the bottom which means our syrup needs just a little bit more time to boil. It's important at this stage to keep a close eye on the syrup so that we don't burn the sugars and boil all of our hard work.

12:42

It's taken us several days, but we've finally boiled down all of the sap that we collected. We hit that magic number of 67% sugar content. This number is important because any higher and the sugars within the syrup will start to crystalize and form a granulated sugar. Anything lower than 67% and the syrup will no longer be shelf stable. It could spoil or mold. When you go to the grocery store you have lots of options available to you. Check out the maple syrup section and you will find that you'll be able to get 100% pure maple syrup where the ingredients list only maple syrup. You'll also be able to find other options, such as this one which lists corn syrup and high fructose corn syrup as well as other ingredients that give it that nice amber color and maple flavor that we enjoy so much. So, make yourself some pancakes, grab some maple syrup and enjoy!