Lesson Plans for Maple Sugaring Process

Overall Goals: Introduce students to the process of making Pure Maple Syrup by experiencing it first hand in their classroom. Wisconsin consistently ranks as 4th or 5th in the nation for Maple Syrup production. It is an important industry in the state.

Each lesson begins with reference to Wisconsin State Academic Standards listed in 2018 at https://dpi.wi.gov/standards. Lessons also refer to a Power Point Slide show created by WMSPA (available on USB and at www.wismaple.org). This slide show has more slides than needed, but the extras have been retained for options for further study if desired. The lessons will lead you through the steps of making maple syrup with your students. Enjoy!!

These lessons are designed with grade 3-5 students in mind. Feel free to adapt as needed for your classroom.

Resources:

*Most resources are also listed at the beginning of each lesson. This list contains additional stories and links (marked with *).*

A Beginner's Guide for Everyone—included in this packet
Wisconsin Maple Syrup Producer's Association http://www.wismaple.org/resources/
Wisconsin Maple Syrup Producer's Slide Show (on USB or at www.wismaple.org included in this packet)
*At Grandpa's Sugar Bush by Margaret Carney (Author), Janet Wilson (Illustrator)
*Maple Moon by Connie Brummel Crook
*Sugarbush Spring by Marsha Wilson Chall

Contents:

Introduction and History of Pure Maple Syrup

This lesson could be inserted anytime during a study of Maple Syrup. The numbered lessons are meant to be presented in order.

Science: Engineering and Technology	SCI.ETS2.B.3-5 People's needs and wants change over time, as do their demands for new and improved technologies. When new technologies become available, they can bring about changes in the way people live and interact with one another.
ELA: Research	Conduct short research projects that build knowledge about a topic.
ELA: Writing	Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories.
ELA: Language	Acquire and use accurately grade-appropriate conversational, general academic, and **domain specific words** and phrases, including those that signal spatial and temporal relationships (e.g., After dinner that night we went looking for them)

Objectives:

- Students will explore history of making maple syrup
- Students will be exposed to the general process of making Pure Maple Syrup.

Resources:
A Beginner's Guide for Everyone
Wisconsin Maple Producers Google Slide presentation (1-9)
Wisconsin First Nations video Spring:Ziigwan https://wpteducation.org/series/episode/spring-ziigwan *(you must register, it is a free resource)*

Materials:

- Science journal for each student
- Pure maple syrup to taste (optional as an introduction to Pure Maple Syrup)

Introduction:
Discuss Maple Syrup, taste it, encourage students to share their experiences with pure maple syrup.

Over the next few days we're going to learn where Maple Syrup comes from and how it is made. Did you know that Maple Syrup is ONLY made in a relatively small region of North America! Today we will do some research to find the answer to this question "Where did Pure Maple Syrup come from?"

Lesson:
Show the first part of the Wisconsin Maple Producers Slide Show (slides 1-4).
Show the first part of this video: Wisconsin First Nations Spring: Ziigwan
https://wpteducation.org/series/episode/spring-ziigwan *(you must register, it is a free resource)*

Divide the class into groups. Each group can read and prepare a brief presentation to the class about the origins of Pure Maple Syrup. Give each group a time limit and categories to share:

1. What tribe is represented in this history?
2. Tell the legend of the discovery of Maple Syrup from this tribe
3. What tools were used?
4. Did they make Maple Sugar or Maple Syrup? How was it used?

Legends and other information about the Native America processing for groups to explore:

- http://www.native-languages.org/ojibwestory.htm (Ojibwe)
- http://www.mbq-tmt.org/assets/Wellbeing/FamHealthChildDev/OriginsofMapleSyrup-Sugar.pdf (Mohawk)
- http://sugarmakerstimes.blogspot.com/2007/10/native-americans-and-legend-of-maple.html (Iroquois)
- http://www.d.umn.edu/cla/faculty/troufs/Buffalo/PB06.html (Mille Lacs, MN)
- https://www.youtube.com/watch?v=Pnvh66A1Wvc (Colonists learning)

Groups share their presentations.

Wrap-up:

Review by showing slides 1-9 of the Wisconsin Maple Syrup Producers slide show
Students record in Science Journal. Be sure they record these topics:

- Who discovered Maple Syrup?
- What tools were used to make it?
- How was it used?

Lesson #1: How can I tell which one is a Maple Tree?

Science	SCI.CC1.3-5 Students identify similarities and differences in order to sort and classify natural objects and designed products. They identify patterns related to time, including simple rates of change and cycles, and use these patterns to make predictions.
Science	SCI.SEP4.A.3-5 Students begin to use quantitative approaches to collect data
Science	Communicate scientific and technical information orally or in written formats, including various forms of media, which may include tables, diagrams, and charts.
Social Studies	Geograpy1c: Mental Mapping/Maps from memory (k-2)SS.Geog1.c.1 Draw a map of a familiar place (i.e., bedroom, classroom, playground) using title, compass rose, and symbols. (3-5) SS.Geog1.c.4-5 Create and label a map of the local community, state, tribal lands, and country, including both physical (e.g., water and land formations) and human (e.g., roads, buildings) characteristics. Identify and draw regions in the Wisconsin and the United States.

Objectives:

- The students will identify Maple Trees based on physical properties.
- Students will create a map identifying the location of maple trees in your setting
- Students will record and reflect on their experience in writing

Resources:
A Beginner's Guide for Everyone (p. 5-7)
Wisconsin Maple Producers Google Slide presentation (10-13)
Sugar Maple Identification page (in this packet or at http://2.bp.blogspot.com/-1I2OnCT_SqQ/T0uyy16EXEI/AAAAAAAAAis/NzvksKCg61M/s1600/Suger-Maple-ID.jpg)

Materials:

- Science journal for each student (sample format included in this packet)
- Pure maple syrup to taste (optional as an introduction to Pure Maple Syrup)
- Maple leaf
- Measuring tape for each group
- Sugar Maple Identification resource (copy in this packet; optional)
- Colored material to tie on to tree
- Colored pencils (optional)
- Where do maple trees grow? (copy in this packet; optional)
- Where is maple syrup made? (copy in this packet; optional)

Introduction:
Discuss Maple Syrup, taste it, encourage students to share their experiences with pure maple syrup.

Over the next few days we're going to learn where Maple Syrup comes from and how it is made. Did you know that Maple Syrup is ONLY made in a relatively small region of North America! Today we'll start by identifying maple trees.

Lesson:
Show a maple leaf. It's easy to tell a Maple Tree in the fall or summer
How can we tell which is a Maple Tree when there's no leaves? (p5 of A Beginner's Guide & slides 10-13)

- Dense trees with rounded crowns
- Straight trunks free of branches for two-thirds or more of the heights
- Bark is usually light to dark grey with vertical smooth strips that may curl
- Branches, stems and leaves grow in opposite position.
    - Look for stems arranged on the branches in opposite position
    - Other trees have this pattern, but maple stems are fine rather than course

How big should a tree be if we want to tap it to make maple syrup? (p5 Beginners Guide)

- A tree is big enough if it is at LEAST 10 inches in diameter at chest height.

Have students record Maple Tree Identification criteria (and size they need to find) in a Science Journal.

Arrange teams of students to identify trees in your school yard. The number of teams will depend on how many trees you have that are tapping size (at least 10inches in diameter). Adapt for your situation, a demonstration of the following will also work here.

Teams will need: 1 bright ribbon to tie around their tree, measuring tape or ruler, science journals, pencils (colored pencils are optional)

Outside:
Explain the task, each team will:

- Identify a maple tree using the criteria they recorded in their science journal.
- Mark their tree with a bright colored ribbon or cloth for another time.
- Each person will add details of their specific tree into their journal.
    - Record physical attributes using quantitative data (must record circumference & diameter to be sure it is big enough).
    - Draw their tree and the shape of the crown, formation of the stems and branches, color of the bark, etc.

If time and weather allow:

Gather all students into one area so they can see the entire space. On another page in their journal ask them to draw a quick map of the area identifying the maple trees and other landmarks. Even though the map can be a quick sketch, it should have the basic parts of a map (title, compass rose, key)

Ideas for further study*---Maple Syrup is ONLY made in a relatively small region of North America! What's the region? Why is that?* ***Where do Maple Trees Grow?*** *(slide 13 and maps). Also point out that Wisconsin was actually the 4th largest producer of Maple Syrup in 2012 (show graphs from* ***Where is Maple Syrup Made?)***

Wrap Up:
Review how to identify a maple tree and how big one should be to tap.

Give students time to write predictions or questions they have about the next parts of making maple syrup in their science journals.

Lesson#2: How does the sap come out of the tree?

Science: Life Science	(gr. 3-5) SCI.LS1.C.5 Food provides animals with the materials and energy they need for body repair, growth, warmth, and motion. Plants acquire material for growth chiefly from air, water, and process matter, and obtain energy from sunlight, which is used to maintain conditions necessary for survival. (gr 6-8) SCI.LS1.C.m Plants use the energy from light to make sugars through photosynthesis. Within individual organisms, food is broken down through a series of chemical reactions that rearrange molecules and release energy.
Science: Chemical Energy	SCI.PS3.D.4, 5 Plants capture energy from sunlight which can be used as fuel or food. Stored energy in food or fuel can be converted to useable energy.
Science	Communicate scientific and technical information orally or in written formats, including various forms of media, which may include tables, diagrams, and charts.

Objectives:

- Students will understand the basic idea of how to make maple syrup.
- Students will be able to describe what is happening inside the tree that makes the sap flow
- Students will tap a tree ***(you will need to time the tapping according to page 7 in the beginner guide. Watch the upcoming weather patterns for your area and local syrup producer activities)***

Resources:
https://www.uvm.edu/~uvmaple/maplesapexudation.pdf

https://botanistinthekitchen.blog/2013/03/18/maple-syrup-mechanics/
(some good pictures of the xylem, phloem and inside a twig)
Wisconsin Maple Producers Slide Show (Slides 14-18 & 18-25)

Materials:

- Drill with 7/16" drill bit. (this can be cordless or hand drill)
  - Be sure to mark on the bit so that you don't drill too deep (1 ½ -2inches deep)
- 7/16" tap
- Hammer
- Measuring tape
- Sap sacks and holders
- Science journals
- Extra adult help (optional)

Introduction:
Show Slide Show to demonstrate the overall Maple Syrup process.

Lesson:
Show Slides 14-18
Explain/Demonstrate how to tap a tree and hang the sap sacks. (Beginner's Guide p8-12)

Teachers choose to record in science journals before or after going outside to tap the trees.

Ask students to record quantitative information: steps for tapping, distance between taps, depth of tap hole, size of tap/drill, weather conditions needed for the right tapping time.

Outside: Tap your trees and hang the sap sacks. *See sack assembly directions, p12 Beginner's Guide.* Depending on your situation and students have groups tap the tree they previously identified, take turns or watch as you demonstrate the process

Inside: (continue the lesson)
What is going on inside the tree that makes this possible?

Basically, all trees draw water and nutrients from the roots, combine it with the sunlight during photosynthesis process in the leaves to create sugar all summer. This sugary sap is maintained in the trees throughout the year. During the dormant season, the sap flow slows due to the temperatures and corresponding internal pressure of the tree.

In early spring, sap is drawn up into the tree from the roots during the cold nights (freezing temps), in maple trees this action does NOT push water out of the tree because the sap at this time of the year is carried through capillary system containing air pockets rather than typical water displacement (phloem)as in other trees. As the temperature drops at night, MORE water is drawn up through the xylem and freezes like frost on a window pane. It can be thought of as a sponge absorbing water as it freezes. When the temperature warms during the day (above 40 °F) the sap thaws and is drawn back down to the roots by gravity and negative root pressure. This is when sap can be harvested through tap holes. The fact that sap comes out of these holes is evidence that the internal pressure of the tree is greater than that of the air outside of it.

Slides 18-25 and/or this video from the New York Maple Syrup Producers association explains the above process. https://vimeo.com/82816054

Wrap Up:
Students create a tree diagram to show the factors that impact sap flow in maple trees.

Criteria for the diagram:

- Label internal parts of the tree (sapwood, xylem, capillary action)
- Identify temperature needed at night and during the day.
- Show that when pressure inside the tree is greater than the pressure outside the tree, the sap flows.

A few ideas:
https://www.bostonglobe.com/metro/2012/03/08/maple-syrup-producers-grapple-with-side-effects-warm-weather/N4sjekRFEiDfuBwgTXfo4K/story.html
http://slideplayer.com/slide/11524737/
https://www.slideshare.net/MedfordCooperative/maple-syrup-for-beginners-seminar
http://slideplayer.com/slide/5716111/
http://iijima-jk.heteml.jp/webcreative/d/1209/yagi/chukan_maple/10_OrderDeliveryAndFee_page/index.html

Lesson #3: Collecting and measuring the density of sap (this lesson requires collected sap)

Life Science	(gr 6-8) SCI.LS1.C.m Plants use the energy from light to make sugars through photosynthesis. Within individual organisms, food is broken down through a series of chemical reactions that rearrange molecules and release energy.
Physical Science	(3-5) SCI.PS1.A.5 Matter exists as particles that are too small to see. Matter is always conserved even if it seems to disappear. Measurements of a variety of observable properties can be used to identify particular materials.
Physical Science	SCI.PS3.D.4, 5 Plants capture energy from sunlight which can be used as fuel or food. Stored energy in food or fuel can be converted to useable energy. SCI.PS3.D.4, 5 Plants capture energy from sunlight which can be used as fuel or food. Stored energy in food or fuel can be converted to useable energy.
Engineering	SCI.SEP5.A.3-5 Students extend quantitative measurements to a variety of physical properties, using computation and mathematics to analyze data. This includes the following: Organize simple data sets to reveal patterns that suggest relationships. Describe, measure, estimate, and/or graph quantities such as area, volume, weight, and time to address scientific and engineering questions and problems. Create and use graphs or charts generated from simple algorithms to compare alternative solutions to an engineering problem.
Cross Cutting Concept	SCI.CCS3.3-5 Students recognize natural objects and observable phenomena exist from the very small to the immensely large. They use standard units to measure and describe physical quantities such as mass, time, temperature, and volume
Science	Communicate scientific and technical information orally or in written formats, including various forms of media, which may include tables, diagrams, and charts.

Objectives:

- Students will be able to measure the sugar content of sap using concept of density.
- Students will collect and store sap properly for cooking later
- Students will identify steps in syrup making process

Resources: Beginners Guide pages 13-15; Slides 27-29; 35

Materials:

- SAP hydrometer
- Tall glass jar or a hydrometer cup
- Sap
- Science journals
- Food grade containers with a cover to store sap in a COLD place

Introduction:

What have we learned so far about making Pure Maple Syrup? (how to identify, how to tap, what's happening inside the tree)

Lesson:
The sap of the maple tree is already sweet! The tree has created sugar through the process of photosynthesis (review that process as needed). The process of making pure maple syrup is really simply using what the tree has made and boiling off the extra water to condense the sugar. So pure maple syrup is really concentrated sunshine (and other minerals created by the trees hard work). Today we'll collect some sap and measure how much sugar is in it. We'll store it to boil later.

Outside:
Collect sap in a food grade container with a cover. Be sure to choose a container that has NOT held other food in it, sometimes flavors from the previous food can leach into a plastic bucket and transfer to the sap. This will make your syrup taste funny. (Beginners Guide p. 13-15; Slides 27-29)

Inside:
Sap characteristics:

- During an average season, you can expect to collect a gallon of sap a day from each tap hole.
- In general, the sugar content of maple sap is between 1-5%. It takes, on average, 40 gallons of sap to make 1 gallon of syrup.
- **Taste the sap-**Give students a chance to see if they can even taste the sweetness. They may be surprised that it looks like water and they may not be able to tell if it's sweet at all. A typical question: How does it get brown? Do you add coloring? NO! The minerals and sugar present in the sap turn that syrup-caramel color as the liquid is condensed through boiling and evaporation.
- Use a gallon milk jug to make the point---40 gallons = 1 gallon. That's a ratio of 40:1 (explain the concept of ratio as appropriate)

    If we want to make 1 gallon of SYRUP each day, how many taps would we need?

Sap is not ALWAYS the same, so we can test our sap to determine its sugar content, this can help us predict how much syrup we'll be able to make.

Testing your sap
Fill your glass jar with some sap you have gathered (be sure the sap is still cold, about 38 F) See directions on page 13-14 of Beginners Guide.

Why does the hydrometer float differently? How does the hydrometer measure the sugar?
Sap contains water, sugar and minerals (details of chemical composition of sap can be found here): https://www.uvm.edu/~pmrc/syrup_chapter.pdf)

The more sugar dissolved in the water, the more **dense** the liquid. The hydrometer doesn't actually understand sugar, it only knows the liquid is dense. Discuss the liquid state of matter (molecules flow over one another) by acting it out with students flowing past one another inside a "container". When sugar is also in the water, they still flow but there is more "stuff" making the liquid more crowded or saturated with molecules. We can't see it but it's sort of like the liquid is heavier (add some sugar kids to the flowing molecule demonstration). The more saturated the solution, the hydrometer floats higher because the water is more dense/heavy which holds the instrument up. The hydrometer is measuring **DENSITY.** *(A brief explanation of how scientists/mathematicians could establish the sugar percentage correlated to the float height based on molecular calculations may be appropriate)*

Use the Rule of 86 (p14 of Beginners Guide & slide 35 in presentation) to predict how much of YOUR sap it will take to make a gallon of syrup. (86 divided by the sap percentage)

Storing your sap

Depending on your situation, it may take a few days of collecting to get enough sap to start boiling. To store your sap, keep it covered and as cold as possible (below 40°F) in a refrigerator, outside or in a freezer. (see p15 in Beginners Guide for details). Be sure to put your sap in a cold storage place **as soon as possible.** Sap will not keep if it gets warm. **DO NOT let it sit in your classroom all day**!

Wrap Up:

Have students record what they learned about sap characteristic in their science journal. Include:

- Sugar content of your sap
- How much sap it will take to make one gallon (either average or your rule of 86 calculations)
- Explanation of density (and hydrometer use)

More Options: *If you need to collect sap over a few days, it might be interesting to measure the sugar content each day and graph it. The content will change. You could also take the measurements from each tree separately, groups can graph their own tree's sugar content. You can also average all the trees together to come up with your class sugar content and use that information to predict syrup production.*

Lesson #4: How do you make maple syrup? (may flow into two days)

Cross Cutting Concepts: scale, quantity	SCI.CCS3.3-5 Students recognize natural objects and observable phenomena exist from the very small to the immensely large. They use standard units to measure and describe physical quantities such as mass, time, temperature, and volume.
Cross Cutting Concepts: Energy & Matter	SCI.CC5.3-5 Students understand matter is made of particles and energy can be transferred in various ways and between objects. Students observe the conservation of matter by tracking matter flows and cycles before and after processes, recognizing the total mass of substances does not change.
Physical Science	(3-5) SCI.PS1.A.5 Matter exists as particles that are too small to see. Matter is always conserved even if it seems to disappear. Measurements of a variety of observable properties can be used to identify particular materials. (6-8) SCI.PS1.A.m The fact that matter is composed of atoms and molecules can be used to explain the properties of substances, diversity of materials, states of matter, phase changes, and conservation of matter.
Science	Communicate scientific and technical information orally or in written formats, including various forms of media, which may include tables, diagrams, and charts.

Objectives:

- Students will make maple syrup
- Students will identify steps in the process of making maple syrup
- Students will review states of matter, transfer of heat energy and conservation of matter through the process of evaporation.
- Students will demonstrate that their syrup meets the criteria for pure maple syrup.

Resources:
Beginners Guide (p16-20)
Wisconsin Maple Syrup Producers slide presentation (36-39)
Density: https://www.youtube.com/watch?v=vYAEAlO60qQ

Materials:

- Collected sap (at least 2-3 gallons to start, more is better IF you can keep it all below 40°F)
- Heat source and large flat pan for boiling sap.
    - *A large flat heated pan is the best, a large electric frying pan or roasting pan with sides about 3 inches high can work. It will take a very long time to boil enough sap to make syrup. Whatever you use, fill it only 2 inches at a time and check it often.*
- Science Journals
- Thermometer (candy thermometer that can read above 212)
- SYRUP hydrometer
- Tall glass canning jar (that can handle high heat) OR hydrometer cup

Introduction:
Today we have enough sap to start cooking! This process will start today and will likely take all day and possibly a second day to finish. *(Optional: slides 36-39 show boiling using an evaporator)*

Lesson:
Review the information you learned about sugar content in your sap. Finished Maple syrup has a density of 66-67 Brix. That's a lot of water that needs to be removed.
How will we do that? Evaporation. Review what happens during **evaporation**. The water does NOT disappear---it changes form (into a gas) and remains in the air. Sometimes we'll see it **condense** when it meets a cooler surface. That's proof that it's still here, it didn't disappear. That's conservation of matter---it can change form, but it doesn't actually go away.

In order to get the water to evaporate, we need to apply heat. Heat energy is transferred to the sap molecules, the water in the sap picks up the heat energy and start to move so fast that they change from liquid form to gas form. Review the changing states of matter as needed. (This can be acted out with kids in a "container" as the liquid in our density explanation. When heat energy is added the liquid molecules move more quickly and need more space, they move out of the confined container and into the air.)

Set up the evaporation process. Once this is started, you will need to be sure to keep watch on it for the rest of the day. Consider setting a timer or a student to keep an eye on it. The sap should be continually replenished to maintain 2 inches in your pan.

***NEVER** let the pan boil dry, this will scorch your syrup and you'll have to start over! It will STINK!*

How will we know when it is done?
Indicators:

- Syrup looks darker, almost the color you expect
- Boiled down to about a 10^{th} of its original volume and some foam is on top
- Temperature is around 219. (Finished syrup boils at 7 degrees above the boiling point of water)

Then it is time to test your syrup. Using the same tall glass jar (mason or something that can handle the heat) or a hydrometer cup, test the density with the SYRUP hydrometer. The density should read 66 Brix (hot). See p. 15-20 in Beginners Guide. Slide 43 in presentation.
Video from Univ. Vermont: Density: https://www.youtube.com/watch?v=vYAEAlO60qQ

Criteria for real PURE MAPLE SYRUP:

- 66-67 Brix
- Uniform color
- No off flavor
- Clear (nothing floating in it)

Wrap-Up:
Students record in science journal:

- Process of evaporation (heat source for transfer of heat energy, changing state of matter from liquid to gas).
- Indicators that the syrup is getting close to done
- Definition of finished pure maple syrup

For the teacher: *when you leave school for the day remove the syrup from the heat source. It should be OK to sit at room temperature in the pan until the next morning (if it smells sweet and has a little caramel color to it, it's starting to turn to syrup and can stand overnight). If your sap is still almost clear, it is be best to put it in the refrigerator overnight).*

Lesson #5: Finishing up!

Science	Same as lesson #4
Science	Communicate scientific and technical information orally or in written formats, including various forms of media, which may include tables, diagrams, and charts.
ELA: Research	Conduct short research projects that build knowledge about a topic.
ELA: Writing	Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories.
ELA: Language	Acquire and use accurately grade-appropriate conversational, general academic, and **domain specific words** and phrases, including those that signal spatial and temporal relationships (e.g., After dinner that night we went looking for them)

Objectives:

- Students will continue to make maple syrup
- Students will identify steps in the process of making maple syrup

Introduction

Review the indicators for knowing when our syrup is almost done. Review the criteria of real maple syrup (legal definition).

Lesson

When syrup is showing the indicator signs from the previous lesson, test your syrup (p 15-20 in the Beginners guide). The syrup will be a bit cloudy. This is normal, there is natural sediment in the sap that needs to be filtered out. Filtering is best done when the syrup is very hot (nearly boiling). Filtration will take a long time, so be prepared to be patient. Cheese cloth will work to get some clarity, fold it over a few times to get a better filter. With small amounts of syrup, you can fasten the cheese cloth to the top of a glass mason jar or similar with a canning lid. Pour the syrup through in small amounts. A coffee filter works well to get more clear syrup, however it is MUCH slower and will need to be replaced often. The coffee filter will drip for a while and then it may need to be squeezed out. This may be something to demonstrate to the class and complete at another time.

Wrap-Up:

Have students create a diagram of the maple syrup process from tree to table in their science journal or assign partnerships to create a poster, power point or other representation of the entire process. (Be sure they include technical information such as sap flow in the tree, density, evaporation, etc.)

Options for further exploration:

History and Technology impacts on Maple Syrup Industry

Science: Engineering and Technology	SCI.ETS2.B.3-5 People's needs and wants change over time, as do their demands for new and improved technologies. Engineers improve existing technologies or develop new ones to increase their benefits, decrease known risks, and meet societal demands. When new technologies become available, they can bring about changes in the way people live and interact with one another.
ELA: Research	Conduct short research projects that build knowledge about a topic.
ELA: Writing	Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories.
ELA: Language	Acquire and use accurately grade-appropriate conversational, general academic, and **domain specific words** and phrases, including those that signal spatial and temporal relationships (e.g., After dinner that night we went looking for them)

Objectives:

- Students will explore history of making maple syrup
- Students will identify how technology has changed the process

Teams research these topics and prepare the following points to share with classmates:

Topic	Things to identify/share	Web-sites/Resources
Native Americans	Legends & process Tools/technology used	• http://www.native-languages.org/ojibwestory.htm • http://www.mbq-tmt.org/assets/Wellbeing/FamHealthChildDev/OriginsofMapleSyrup-Sugar.pdf • http://sugarmakerstimes.blogspot.com/2007/10/native-americans-and-legend-of-maple.html • http://www.d.umn.edu/cla/faculty/troufs/Buffalo/PB06.html
Using buckets and an open pan outside	Describe process Tools/technology used	
Using sap sacks and an evaporator inside	Describe process Tools/Technology used	Slide 39 in presentation
Using tubing with gravity or vacuum pump	Describe the process Tools/Technology Used	Slides 30-34 in presentation Internet searches
Using Reverse Osmosis machine	Describe the process Tools/Technology Used	Slides 40-42 in presentation Internet searches

More options for further exploration:

Grading pure maple syrup
Objectives:

- Students will use physical properties to assign a grade to pure maple syrup

Grading system uses 4 criteria (color, flavor, clarity and density)
Slides 46-47 in presentation (grading)
Slide 48 (flavor)

Use videos from UVM to guide
Color: https://www.youtube.com/watch?v=fzU34I7zGxU

Clarity: https://www.youtube.com/watch?v=ilE4RL8rvgY

Flavor: https://www.youtube.com/watch?v=vjNSzclTK_0

Density: https://www.youtube.com/watch?v=vYAEAlO60qQ

Concerns for the Industry (slides 57-58 in presentation)

What is the impact of climate change on the timing and duration of Syrup Season?

http://www.climatecentral.org/gallery/maps/warming-maple-tapping-season

https://www.canadiangeographic.ca/article/will-maple-syrup-disappear

https://blog.nationalgeographic.org/2013/04/07/geography-in-the-news-maple-syrup-time/

Habitats of maple trees

Impact of technology on volume of production and trade (tubing, Reverse Osmosis, etc)

Changes in fuel sources (wood, fuel oil, green energy) and impact on environment. Explore ways to reduce carbon footprint of manufacturing and transporting.

Maple Syrup as a business. Costs & benefits of gathering, preparation, cooking, transporting, selling bulk, selling retail, advertising, regulations, etc.

Nutritional benefits of Pure Maple Syrup as a sweetener