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| School Program Name: | Maple Sugaring Science |
| Name of Sanctuary: | Moose Hill Wildlife Sanctuary |
| Grade Level: | Grades 6 – 8 |
| Location Options: | At the sanctuary (or your site) |
| Time: | 2 hours or combine with a second program for a full-day field trip |
| For more info: | moosehilledu@massaudubon.org |

Program Description

This program includes an outdoor maple sugaring tour and an inside lab where students measure the density of sap samples to determine which maple species has the highest sugar yield, and learn the density requirements for syrup. Enjoy the woods as you learn how trees function as sugar factories, compare the taste of sap and syrup, and observe the change in tool technology since Native American times!

Significant savings are offered when you select a second program to create a full-day of hands-on learning at Moose Hill. This program combines well with Changing Ecosystems, Adaptations and the Food Web, or another program from our catalog. Because of our large trail system and full-day option, we can serve up to 130 students for many programs. We provide a ratio of one Moose Hill teacher-naturalist to 12 to 14 students.

Massachusetts State Curriculum Frameworks

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| Subject: | Science and Technology |
| Topic: | Life Science |

Energy and Living Things

6-8 Life Science #16: Recognize that producers (plants that contain chlorophyll) use the energy from sunlight to make sugars from carbon dioxide and water through a process called photosynthesis. This food can be used immediately, stored for later use, or used by other organisms.

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| Subject: | Science and Technology |
| Topic: | Earth Science |

The Earth in the Solar System

6-8 Earth Science #11: Explain how the tilt of the earth and its revolution around the sun result in an uneven heating of the earth, which in turn causes the seasons.



Subject: Science and Technology

Topic: Physical Science

Properties of Matter

6-8 Physical Science #2: Differentiate between volume and mass. Define density.

6-8 Physical Science #3: Recognize that the measurement of volume and mass requires understanding of the sensitivity of measurement tools (e.g., rulers, graduated cylinders, balances) and knowledge and appropriate use of significant digits.

6-8 Physical Science #4: Explain and give examples of how mass is conserved in a closed system.

Elements, Compounds, and Mixtures

6-8 Physical Science #9: Recognize that a substance (element or compound) has a melting point and a boiling point, both of which are independent of the amount of the sample.

6-8 Physical Science #10: Differentiate between physical changes and chemical changes.

Subject: Science and Technology

Topic: Technology/Engineering

Materials, Tools, and Machines

6-8 Technology #1.2: Identify and explain appropriate measuring tools, hand tools, and power tools used to hold, lift, carry, fasten, and separate, and explain their safe and proper use.

Subject: English Language Arts

Topic: Language

Discussion

PreK-12 Language #1: Students will use agreed-upon rules for informal and formal discussions in small and large groups.

Questioning, Listening, and Contributing

PreK-12 Language #2: Students will pose questions, listen to the ideas of others, and contribute their own information or ideas in group discussions or interviews in order to acquire new knowledge.

Vocabulary and Concept Development

PreK-12 Language #4: Students will understand and acquire new vocabulary and use it correctly in reading and writing.



Subject: Math

Topic: Math

Measurement

PreK-6 Math #M1: Understand measurable attributes of objects and the units, systems, and processes of measurement.

PreK-6 Math #M2: Apply appropriate techniques, tools, and formulas to determine measurements.

Lesson Objectives

Students will know and be able to:

- Understand basic tree anatomy and physiology
- Identify and understand the properties of a solution such as maple sap and maple syrup
- Understand the properties of density and use both Sap and Syrup Density Charts
- Read a thermometer, temperature strips, and a hydrometer
- Use a Temperature Adjustment Chart to determine the sap density and syrup density from unknown maple tree samples
- Understand that the type of maple tree, condition of the tree and its habitat, as well as the previous year’s weather conditions, are the basis behind maple sap and sugar yield
- Understand the cost difference between pure maple syrup and “pancake syrup”
- Observe the change in tool technology since Native American times, compare this to modern sugaring technologies, and discover how both Native American and colonial methods for sugaring differed

Vocabulary

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|---------------------|----------------|-----------------------|
| Solution | Cost analysis | Chemical properties |
| Density | Maple sugaring | Physical properties |
| Thermometer | Maple sap | Processed syrup |
| Hydrometer | Technology | Environmental factors |
| Syrup Density Chart | Sugar maple | Habitat |
| Sap Density Chart | Red maple | Tree health |

Assessments

How will the Mass Audubon educator know that the students have met the standards?

- Mass Audubon educator will observe students exploring, observing, and identifying __basic tree anatomy and physiology, chemical and physical properties of maple sap and maple syrup, the many tools required for maple sugaring in the modern era and during Native American and





colonial times, the cost difference between pure maple syrup and the processed variety, and the condition of different types of maple trees in their natural habitat

- Students will participate in answering teacher prompted questions.
- Students will demonstrate their understanding of the chemical and physical properties of maple sap and maple syrup, modern and historical tool technology used in maple sugaring, the cost difference between pure maple syrup and the processed variety, the maple tree species that produce quality sap, and the environmental factors influencing maple sugar production by these tree through participating in a wrap-up activity.

Summarizer

How will the Mass Audubon educator close the lesson to see if students met your objective?

- Students will be able to discuss the economics of maple sugaring and determine why maple syrup is often referred to as “liquid gold”
- As a group, the students will be able to demonstrate how both historical tool technology and modern technology have been used in maple sugaring, and will be able to explain how technological advances have increased output (while maintaining the demand)
- When shown different maple tree specimens and pictures of maple trees in various states of health, the students will be able to determine which trees will produce the best quality sap and therefore the best quality maple syrup



Mass Audubon School Programs

At Mass Audubon we strive to create learning experiences that are enriching, innovative, meaningful, and engaging. All our school programs are aligned with Massachusetts Curriculum Frameworks. Our network of wildlife sanctuaries and nature centers located in urban, suburban, and rural communities around the state enable us to have strong relationships with local schools.

Our Education Foundations

- Place-based education is an educational philosophy that connects learning to what is local for an individual. We help build conservation communities, working with students and teachers in cities and towns to develop place-based environmental education that is linked directly to their home community.
 - Inquiry-based learning is focused on teamwork, being learner-centered, questioning ourselves and the world around us, providing a more focused, time-intensive exploration, promoting lifelong learning, communication, and learning as fun.
 - We are fully committed to creating a positive and supportive environment for all learners.
 - We strive to be culturally sensitive, recognizing and embracing cultural differences.
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Differentiated Instruction

- We strive to create a positive learning environment that is inclusive, supportive to all learners, and sensitive to cultural diversity.
 - Outdoor classroom experiences are structured to meet the needs of the particular learners.
 - Students work in small groups using hands-on materials.
 - A variety of educational media are used, including colorful illustrations.
 - With advance notice, efforts will be made to accommodate all learning styles and physical needs.
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Notes

- Nature exploration is dependent upon the weather and other conditions. A class might observe different wildlife than they expected to see. An outdoor lesson can sometimes provide unexpected, but enriching teachable moments on a natural history topic that was not planned.
- Mass Audubon nature centers each have a unique landscape and will customize programs to work best at their particular site.
- Our lessons can be adapted to incorporate a classroom teacher's needs when given enough notice.

