

Climate Change in the Maple Syrup Industry: an Inquiry

...for high school geography, science and environmental studies



1. Initiate and Plan the Inquiry

- **Observe:** As a class, begin with a pancake breakfast using maple syrup and corn syrup as toppings for comparison.
- **Question:** *Will maple syrup still be available and affordable by 2050? Then open discussion on: Cost is linked to supply and demand. What aspect of climate might impact supply of maple syrup? Is this just changes in the weather or is the climate changing? How do we know? Where can we find out?* Teacher directed discussion to create a list of possible inquiry performance tasks.

[Serve pancake breakfast in class with syrup/corn syrup options. Initiate follow up with *Will Maple Syrup be available in 2050* written on board. Probably a think pair share breakout in class to begin generating some ideas. Share session be recorded as bullet list of brainstorm topics on board, hopefully hitting on tree range, drought / waterfall, severe storm damage, invasive species as some useful possibilities. Each of these can be discussed in part with students at this point, just to provide teaser info for them, to get them thinking. Groups will be assigned. Once in groups, go over the process and definition of an inquiry with students so they understand the “assignment.” They will be given time in groups to discuss the list from board and pick the inquiry topic they would like to explore.]

[**Other Questions to Spark The Inquiry:** *What if maple syrup cost \$100 / litre? What if all our maple syrup was shipped to China? Why do maple producers watch the weather report like eagles?*]

[**Other options for general discussion:** Explain how people have utilized their understanding of weather patterns for various purposes (e.g., to harvest sap and produce maple syrup). **OR** Explain the role of weather dynamics in environmental phenomena and consider the consequences to humans of changes in weather (e.g., global warming and its impact on maple syrup production).]

- **Plan:** Following the open discussion, students choose and plan their ***Inquiry performance task***. Planning could be initiated in a guided class session and/or by providing students with the *Student Guide to Conducting An Inquiry into Climate Change Where I Live* [coming soon]. Form groups around common Inquiry performance tasks. Students plan:

Climate Change in the Maple Syrup Industry is one of a series of Inquiries — called ***Climate Change Where I Live*** — that enable students to examine the impacts of climate change where they live, identify the mitigation and adaptation measures required to address these changes, and take action.

Climate Change in the Maple Syrup Industry was developed by Tim Alguire, Gananoque Secondary School; Paul Frey, Carleton Place High School and Jim Wilson, Athens District High School with Gordon Harrison of GreenLearning Canada.

The Inquiry Method: For more on using the Inquiry-method to explore climate change, see

- *A Teacher’s Guide to Conducting CCWIL Inquiries* [coming soon];
- *A Student Guide to Investigating Climate Change Where I Live* [coming soon].

Ontario Curriculum Fits for *Climate Change in the Maple Syrup Industry: an Inquiry*

- SNC2P1
- SNC2D
- CGC1D
- CGC1P
- SVN3E
- SVN3M

Curriculum Fits to be completed for other provinces.

Assessment Rubrics can be found below.

Collaborating Among Classes and/or Teacher-to-Teacher: Students in the same class or school or in another province can collaborate to plan and conduct an Inquiry (for example, in a Municipal Inquiry, a

- Perform (Investigate) and Record
- Analyze and Interpret
- Communicate: At the outset, students plan how they will communicate their Inquiry. Communication could target the community; for example, in the case of maple syrup: a public service announcement (PSA), create an info-graphic poem / song and present this to their local area maple syrup producers association or become involved in a local maple syrup event. Students can contact the [Ontario Maple Syrup Producers Association](#) to find local producers and events.
- Evaluate: plan as a class using the Assessment Rubrics below.
- **Hypothesize:** More generally, *how do you think climate change is/can affect our area (community, syrup industry, agritourism, etc.)?*

During this step and throughout the inquiry, students may ask questions or raise comments such as “I’ve heard that climate change is a hoax.” This is an opportunity for a side-inquiry; one resource that can help your students and you explore these questions, is [coming soon].

2. Perform (Investigate) and Record

- In groups, students read, select, evaluate and integrate information from various sources, including electronic and print resources, to answer the questions chosen.

Resources to support the **Maple Inquiry** appropriate for students have been identified and added to the COOL 2.0 Database; **see side bar**.

Students can also conduct a wider search in the COOL 2.0 Database using such search words as *CCWIL*, *maple*, *climate change*, etc. — keep an eye on the COOL 2.0 Database as new resources are added on an on-going basis.

They can also search the web for resources to support their Inquiry; if you or students find a resource(s) to support this Inquiry, please add to the COOL 2.0 Database.

To gather data relevant to their inquiry, students can engage **experts** such as local producers or producers’ associations or others available through the COOL 2.0 database; **again see side bar**.

- The [Greenhouse Gas Emissions Calculator](#) enables students to identify and track personal actions to reduce their GHG emissions.

3. Analyze and Interpret

- Students reflect on and discuss their preliminary findings and observations to compare this to their previous knowledge and they clarify and modify their focus question(s) and inquiry plan.
- Students review and evaluate the information they collected and record this information

series of collaborations to cover different parts of the city); OR, meet virtually to share the results of their Inquiries and do peer review; OR, meet virtually to plan joint presentations or action project. You and another teacher(s) can use the **Collaborative Space** in COOL 2.0 to collaborate in developing an Inquiry. Contact GreenLearning at info@greenlearning.ca for help in finding a class to collaborate with or to set up a collaborative project of your own.

Showcase Student Inquiries — and your versions of these Inquiries — in the COOL 2.0 Database: [text to be added]

Resources to Support a Student Inquiry into *Climate Change in the Maple Syrup Industry* — primary source materials, experts ready to work with your students, and other resources can be found in the COOL 2.0 Database [add url of CCWIL “section” of DB] including:

- **Dr. Brenda Murphy**, Associate Professor, Society, Culture, and Environment and Geography at Wilfrid Laurier University. Her work focuses on developing approaches to undertaking research across disciplines and cultures, particularly in the context of climate change. Students prepare their question or questions and go to [Dr. Brenda Murphy’s Ask-an-Expert listing in the COOL 2.0 Database](#), follow the instructions, and submit their questions.
- Maple syrup producers associations such as the [Ontario Maple Syrup Producers Association](#) to find local producers and events.
- The [Greenhouse Gas Emissions Calculator](#) enables students to identify and track personal actions to reduce their GHG emissions.
- Resources to support the **Maple Inquiry** appropriate for students have been identified and added to the COOL 2.0 Database:
 - [Sugaring](#) [See below for questions to guide student discussion and assist them in developing their inquiry]
 - [Maple Syrup, Moose and the Impacts of Climate Change](#) [See below for questions to guide student discussion and assist them in developing their inquiry]
 - [Maple Syrup Threatened by Climate Change \(First Peoples Worldwide\)](#) [See below for questions to guide student discussion and assist them in developing their

- Students use their information to answer their inquiry question(s), test their hypotheses, describe patterns and draw conclusions
 - Students reflect on their findings to create new questions and hypotheses.
- Find and compare birch syrup with maple syrup with respect to supply and demand as a class to revisit the initial questions from the Initiate and Plan stage. Lead discussion around climate affecting supply and demand, contrasting with individual or group findings from the various inquiries performed.

4. Communicate

- **Communication, general thoughts:** Once your students have conducted an Inquiry into Climate Change in the Maple Syrup Industry, there are rich learning opportunities in communicating their findings back to their community, engaging their community in action. Students share their final project at a farmers markets, syrup producers meetings, local radio station, mall display, local fairs, science fairs, etc.
- **Specific:** Student a public service announcement (PSA), create a mind-map, an infographic, or a poem / song and present this to their local area maple syrup producers association or become involved in a local maple syrup event [contact the [Ontario Maple Syrup Producers Association](#) for local producers and events].
- Students reflect on their findings to create new questions and hypotheses.

inquiry]

- [Maple Syrup and Climate Change](#) [See below for questions to guide student discussion and assist them in developing their inquiry]
- [Scientists: Climate Change Not Sweet For Sugar Maples](#) [See below for questions to guide student discussion and assist them in developing their inquiry]
- Students can also conduct a wider search in the COOL 2.0 Database using such search words as *CCWIL*, *maple*, *climate change*, etc. — keep an eye on the COOL 2.0 Database as new resources are added on an on-going basis.
- They can also search the web for resources to support their Inquiry; if you or students find a resource(s) to support this Inquiry, please add to the COOL 2.0 Database

Resources for *Climate Change in the Maple Syrup Industry* with Questions

Resources to support the Maple Inquiry appropriate for students have been identified and added to the COOL 2.0 Database, listed below, with questions to guide student discussion and assist them in developing their inquiry:

- [Maple Syrup and Climate Change:](#)
 - Currently, when is the best time to collect maple sap?
 - How will climate change affect the collection period?
 - What are the best conditions for collecting maple sap?
 - What happens inside of the tree that causes sap to flow?
 - How will climate change cause changes in the collection period for sap?
 - How do farmers turn sap into sugar?
 - What is changing the flow of the sap in Wisconsin?
 - How have Vermont sugar tappers met the challenges of a shortened tapping season?
- [Maple Syrup Threatened by Climate Change \(First Peoples Worldwide\):](#)
 - According to legend how did the first nations discover maple syrup?
 - What has been the impact of warmer weather on maple trees?

- When might the maple sugar industry in the United States be wiped and how big is this industry?
- **Maple Syrup, Moose and the Impacts of Climate Change:**
 - Describe some of the impacts that climate change is having on the northern hardwood forests by describing change to the following; length of seasons, snowpack, soil, animals, parasites, and economic activity.
- **The Slow, Trickling Threat of Climate Change:**
 - What do skiing and maple syrup production have in common?
 - How many gallons of sap are needed to produce one gallon of maple syrup?
 - What two effects is the gradual warming caused by climate change having on maple trees?
- **Why Are Maple Syrup Yields Shrinking?:**
 - List some of the theories behind the drop in maple syrup production in Nova Scotia.
- **Will Maple Syrup Disappear?:**
 - How much of the world's maple syrup is produced in Canada and what is its value?
 - How much has maple sap production dropped in the past 5 years?
 - List three factors that may account for reduced maple syrup production?
 - Why is the solution to reduced maple syrup production in the United States not as simple as the range of maple trees migrating northward?

Sample Rubrics for the *Climate Change in the Maple Syrup Industry*

Mind Map, Achievement Chart

Criteria	Level R	Level 1	Level 2	Level 3	Level 4
Appropriateness of Key Images	Very little or no evidence of key images. Images that used are ineffective or inappropriate.	Some evidence of key images, however, some or most of the images used are ineffective or inappropriate.	Use of images is evident, but either too few or inappropriate at times.	Good use of images that are appropriate and correct in number and have a good connection to central image.	Dynamic use of key images that are highly suitable and have a deep connection to central image.
Appropriateness of Key Words	No use or very limited use of key words to explain importance of images to the main idea or connections between ideas. Very limited understanding of topic is demonstrated.	Limited use of key words to explain importance of images to the main idea or the connections to main ideas. Limited understanding of topic is demonstrated.	Key words are used for images in order to explain their importance and/or connections, however at times, not always suitable or relevant. Mediocre understanding of topic is demonstrated.	Good use of keywords to demonstrate the relevance and importance of images and ideas to main topic. A good understanding of topic is demonstrated.	There is a highly effective use of keywords to demonstrate the relevance and importance of images and ideas to main topic. A deep understanding of topic is demonstrated.

Overall Structure	Ideas do not radiate outward from centre from most complex to least complex or no apparent connection between ideas and central image.	Little or no indication that ideas are connected to or radiate out from centre from most complex to least complex.	Some indication that ideas are connected and radiate out from central image and for the most part ideas are moving from most complex to least complex.	A clear indication that ideas are connected and radiate out from the central image in a hierarchical manner from most complex to least complex.	A clear and highly effective indication of the connection between ideas and central image is present. The ideas consistently and accurately move in a hierarchical manner from most complex to least complex.
Colour Selection and Appropriateness	No or very little evidence for effective use of colour, codes and/symbols. Most of these efforts lack total purpose and have no positive effective on clarity or understanding of the mind map.	There is some evidence for the use of colour, codes and/or symbols, however, these efforts lack purpose and clarity and do not bring clarity to the mind map.	There is an obvious, earnest attempt at the employment of colour, codes and/or symbols to clarify and highlight the connections for some aspects of the mind map, however, it is not totally effective.	For the most part, there is good use of colour, codes or symbols that help to clarify and highlight the connections for most of the aspects of this mind map.	There is a highly effective use of colour, codes or symbols that help to clarify and highlight the connections for all aspects of this mind map.
Central Image	Not present or not clear at all and cannot be separated from other images with any degree of successfulness	Not very clear and difficult to separate from other images and words in the map	Somewhat clear, but lacking in suitability with topic at hand	Clear picture, relates well to topic at hand, some imagination and creativity involved.	Picture stands out, Very clear, memorable and a high degree of imagination and creativity involved.

Poem / Song Performance, Achievement Chart

Criteria	Level R	Level 1	Level 2	Level 3	Level 4
Presentation of Information Presentation of the elements impacting maple syrup production	Minimal number of elements are presented	Limited number of elements is presented.	Some elements are presented	Considerable number of elements are presented	Thorough presentation of the elements
Accuracy in the presentation of the elements impacting maple syrup production	Contains more than two major errors or more than three minor errors	Contains at least one major error or three minor errors	Contains no more than three minor errors	Contains no more than two minor errors	All events are accurate
Knowledge and Understanding Organization of the song/poem respects the processes involved in maple syrup production	Information is disorganized and difficult to follow	Information is poorly organized with more than three errors	Information is well organized with no more than two errors	Information is well organized with more than one minor error	All information is well organized in a logical order
Communication	The message is unclear	The message is unclear	The message to the	The message to the	The message to the

Delivery of the message	or impossible for the listener to follow	or impossible for the listener to follow	viewer is clear. Most listeners would have understood the message	viewer is clear. The listeners would have understood the message	viewers is clear and strong. It would have been easy for the listener to understand
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Infographic, Achievement Chart

Criteria	Level R	Level 1	Level 2	Level 3	Level 4
Application Research period Has the student effectively used print and/or internet sources to research the topic?	- very little research has been demonstrated	- little research has been demonstrated	- some research has been demonstrated	- considerable research has been demonstrated	- a high degree of research has been demonstrated
Thinking / Inquiry Has the student thought about and completed the task in a creative manner?	- creative thinking skills have been utilized with very little effectiveness	- creative thinking skills have been utilized with little effectiveness	- creative thinking skills have been utilized with moderate effectiveness	- creative thinking skills have been utilized with considerable effectiveness	- creative thinking skills have been utilized with a high degree of effectiveness
Communication Has the student included a title, background, colour accurately and NEATLY?	- a title, background, and colour have been done with very little accuracy and neatness	- a title, background, and colour have been done with little accuracy and neatness	- a title, background, and colour have been done with some accuracy and neatness	- a title, background, and colour have been done with considerable accuracy and neatness	- a title, background, and colour have been done with thorough accuracy and neatness
Knowledge / Understanding Did the visual material (minimum 2 pictures and 1 diagram) accurately depict the topic?	- visual material did not accurately depict the climate factor	- visual material depicted the climate factor with little accuracy	- visual material depicted the climate factor with some accuracy	- visual material depicted the climate factor with considerable accuracy	- visual material depicted the climate factor in a thoroughly accurate manner
Communication Has the student effectively answered the questions?	Questions answered with very little clarity	Questions answered with little clarity	Questions answered with moderate clarity	Questions answered with considerable clarity	Questions answered with a high degree of clarity