Overview

The Trans-Canadian Research & Environmental Education (TREE) program involves students from across Canada being part of national research conducted by the Mistik Askiwin Dendrochronology Laboratory (MAD Lab) and the Canadian Light Source (CLS) that examines the impact the surrounding environment has on trembling aspen trees. The MAD Lab (studying tree growth) and the CLS (studying chemistry) are able to look at tree cores, specifically the chemistry of tree rings, and connect that information to a student-developed timeline of environmental events in your community. Students will learn about the life and nutrient cycles of trees, apply that knowledge to decipher information about the environment captured in tree rings, and the nutrients in soil by working through modules and activities designed to engage students in the areas of science, technology, engineering, and mathematics (STEM), and social studies with Indigenous perspectives. The TREE program takes on a multidisciplinary approach and is designed for Grade 8 curriculum across the provinces and territories but it is adaptable for different grade levels.

This is an example of the data your students can get from a tree core that has been analyzed by the MAD Lab and the CLS. The top three graphs show changes in 3 elements of interest while the bottom graph shows how the ring width changes over time, reflecting tree growth. By comparing the three graphs, students and researchers can make connections. Does the decline in tree ring width after 1995 have something to do with the slight increases in copper, nickel, and iron? What was happening in the community at this time? Why do these elements continue to increase and the ring width decreases as the tree ages? The TREE program tries to suggest answer these questions.
Introduction & Background

This program is a full partnership between scientific research led by the MAD Lab and science education led by the Canadian Light Source (CLS). Both institutions are on the University of Saskatchewan campus in Saskatoon, SK which is located on Treaty 6 Territory and the Traditional Homeland of the Métis.

From a scientific perspective, trembling aspen (Populus tremuloides) are a species of tree that is abundant throughout most of Canada. They also tolerate, even thrive, with much higher levels of toxins in their soil than most other species of trees and can potentially be used to remediate contaminated sites. The MAD Lab is interested in researching: what toxins are present in trembling aspen and how much these trees can tolerate and still thrive; if location or geography affect the accumulation of toxins; and if these factors can be related to climactic or human events in the time span of the tree. To conduct such research, geographically diverse samples are required from across the country. These samples allow members from the MAD Lab and the CLS (known as the Research Team) to conduct dendrochronological (tree ring) and spectroscopy (chemistry) experiments, and then return raw data and a report to the students so researchers and students can both learn about the tree(s) students collected samples from, and compare information gathered by students in other areas of the country.

From an educational perspective, learning about the life and nutrient cycles of trees, nutrients in soil, and tracking effects on trees over time provides a wealth of opportunity for student learning. The TREE program connects with curriculum across several subject areas and grade levels. It provides a multidisciplinary learning platform for students as they investigate trees and how they grow including nutrient cycles and cells; the effects of environmental conditions and the climate on soils and trees; economic and industrial history of their community related to the timeline of tree growth; local Indigenous knowledge related to the trees, history, and the environment; chemistry analysis and graphing as it relates to their data; and many more possibilities for expanding knowledge. Using equipment provided by the Research Team, students collect trembling aspen tree cores and soil samples as well as construct a timeline with information about the climate and environmental activities of the region of their tree. **There is no cost to the program!**

As well, all of this information is provided to the MAD Lab and the CLS and this integrates the students directly into the national research project. This information and the data collected will be posted online and accessible to the public so as to encourage other schools to compare data and connects to others across the country.

The TREE Project Curricular Outcomes

The TREE program has resources developed with a Grade 8 level focus but can be adapted to meet other grade levels throughout Canada. The curricular foundation of the TREE program reflects current science education research, takes on an inter-disciplinary approach, is responsive to changing demographics across the nation, and continues to be built upon.

Although science is at the core of the TREE program’s curricular agenda, attention has also been given to areas such as Indigenous Studies, Social Studies, English Language Arts, Mathematics, Art, and so much more. With respect to the diversity in learning throughout Canada, the TREE program attempts to ask broad questions that can be adapted to fit curricular outcomes in each province and territory. Educators are encouraged to apply their knowledge and adapt the content of the TREE program to meet any curricular outcomes fit for their jurisdiction. On the next page there is a working list of curricular connections TREE has to the Canadian provinces and territories. We ask that you kindly provide the CLS Education team with feedback regarding curricular outcomes you met in your engagement with the TREE program. Such feedback will serve as testimony to the range of this program and enable us to deepen the base of future editions of TREE.

Contributors

MAD Lab ([http://www.madlabsk.ca/](http://www.madlabsk.ca/)): Dr. Colin Laroque, [http://homepage.usask.ca/~ep585/](http://homepage.usask.ca/~ep585/), Zach Person (Masters Student), Teagan Lubinecki (Undergrad Research Assistant), and Chloe Canning (Undergrad Research Assistant)

CLS ([www.lightsource.ca/education](http://www.lightsource.ca/education)): Tracy Walker (Education Programs Lead, [education@lightsource.ca](mailto:education@lightsource.ca), 306-657-3525), Anna-Maria Boechler (Education Coordinator), Amanda Pfeiffer (Education Coordinator), Bernie Petit (Education Coordinator - Indigenous Programs), Dr. David Muir (IDEAS Scientist), Cooper Skjeie (Education Assistant - Indigenous Programs), Tylor Sôvé (Education Assistant - Science Programs), and Jesse Parenteau (Education Assistant - Science Programs)

We would like to acknowledge the Indigenous language support from Kato Carriere (Cree-Métis) of Cumberland House, SK and Theresa Toulejour (Dene-Métis) of La Loche, SK. See About the Indigenous Languages and Traditional Knowledge Used in TREE section for more information.
# General Curricular Connections

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**Unit C:** Light and Optical Systems  
**Historical Worldviews Examined:** Local and Current Affairs | Module 1, Module 3  
Section 5.2, Section 6.2, Section 6.3, Section 6.4  
Module 2, Section 5.1, Section 6.1 |
Section 4.2, Module 6 |
| BC/YT        | Science 8 (2016) | **Big Idea:** Life processes are performed at the cellular level  
**Big Idea:** Energy can be transferred as both a particle and a wave | Section 5.2, Section 6.2, Section 6.3, Section 6.4 |
|              | Social Studies 8 (2016) | **Big Idea:** Human and environmental factors shape changes in population and living standards | Module 2, Section 5.1, Section 6.1 |
|              | Mathematics 8 (2016) | **Big Idea:** Analyzing data by determining averages is one way to make sense of large data sets and enables us to compare and interpret | Section 4.2, Module 6 |
| MB           | Science 8 (2000) | **Cluster 1:** Cells and Systems  
**Cluster 2:** Optics | Module 1, Module 3  
Section 5.2, Section 6.2, Section 6.3, Section 6.4 |
|              | Social Studies 8 (2006) | **Cluster 1:** Understanding Societies Past and Present | Module 2, Section 5.1, Section 6.1 |
|              | Mathematics 8 (2013) | **Shape and Space:** Use direct or indirect measurement to solve problems  
**Statistics and Probability:** Collect, display, and analyze data to solve problems. | Section 4.2, Module 6 |
| NB           | Science 8 (2002) | **Unit 2:** Optics  
**Unit 4:** Cells, Tissues, Organs and Systems | Module 1, Module 3  
Section 5.2, Section 6.2, Section 6.3, Section 6.4 |
|              | Social Studies 8 (1998) | **Theme One:** Physical Setting  
**Theme Two:** Culture  
**Theme Three:** Economics  
**Theme Four:** Technology | Module 1, Module 2  
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|              | Mathematics 8 (2009) | Patterns & Relations  
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TREE Program Guide

This document serves as a guide for how to approach the TREE program. As well, there are videos that accompany each of these modules that are available online at: http://bit.ly/TREE_page. Instructions on how to register for the program can be found on the next page.

- **Module 1: Trees**
  - Module 1 addresses all things tree, from learning general tree anatomy, to identifying healthy and unhealthy trembling aspen, to understanding their various growing cycles.
    - Section 1.1: Tree Anatomy & Functions
    - Section 1.2: Trembling Aspen 101
    - Section 1.3: Aspen Health
    - Section 1.4: The Water Cycle
    - Section 1.5: The Nutrient Cycle
  - Curricular connections: Science (Biology, Chemistry, Physics), Math, Indigenous Studies

- **Module 2: Local Context**
  - Module 2 addresses contextual information accompanying the samples, including site location and local history. This module encourages students to investigate the territory’s Indigenous Knowledge, impact of human activity, and notable events in weather.
    - Section 2.1: Indigenous Knowledge & Uses of Trembling Aspen
    - Section 2.2: Traditional Stories & Poems
    - Section 2.3: Investigating Impacts on Local Forest (Creating the Timeline). *This timeline is essential information required for data interpretation & must be sent in with the samples.*
    - Section 2.4: Giving Back
  - Curricular connections: Social Studies, Indigenous Studies, Science (Biology, Chemistry, Physics), ELA
  - Lessons: How do Aspen Contribute to Our Communities, Traditional Stories, Bringing Stories to Life, Poet and I Know It

- **Module 3: Soil**
  - Module 3 addresses all things soil, from identifying different soil horizons, to understanding the nutrient cycle of soil
    - Section 3.1: Soil 101
    - Section 3.2: Soil Horizons
    - Section 3.3: The Nutrient Web
  - Curricular connections: Science (Biology, Chemistry, Physics)
  - Lessons: A Dirty Crossword

- **Module 4: Sampling**
  - Module 4 identifies the pieces of equipment in the TREE kit, how to use them, what kind of samples are needed, and how to collect the samples. *This module provides instructions to complete the TREE Sampling Form that must be completed by the teacher and students and provided with the samples.*
    - Section 4.1: What’s in the Package?
    - Section 4.2: Time to Collect Samples!
  - Curricular connections: Science, Math, Art
  - Lessons: Human or Tool? Who is More Accurate?
• **Module 5: Labs**
  - Module 5 introduces the MAD Lab team members who are conducting a dendrochronological study and the CLS team members who are conducting an elemental analysis of the samples and providing educational support for the TREE program.
    - Section 5.1: Mistik Askiwin Dendrochronology Lab
    - Section 5.2: Canadian Light Source
  - Curricular connections: Math, Science (Biology, Chemistry, Physics)

• **Module 6: Data**
  - Module 6 discusses the data you will receive from the MAD Lab and CLS, how to interpret the data, how this data connects to the provided timeline, and some ideas on what to do with this data.
    - Section 6.1: Dendrochronology
    - Section 6.2: X-Ray Fluorescence
    - Section 6.3: Interpreting Data Overview
    - Section 6.4: Your Data
  - Curricular connections: Math, Science (Biology, Chemistry, Physics)
  - Lessons: Shrinking Tree Rings

**How to Register**

To coordinate the mailout of the equipment required for sample collection, you can fill out our Registration Form online at our tree website: [https://tree.lightsource.ca](https://tree.lightsource.ca) or connect with CLS Education team either by education@lightsource.ca or 306-657-3525 as soon as possible. The TREE kit containing the equipment, the samples of tree core & soil (accompanied by the sampling form), and a timeline of environmental events are required for participation and are to be sent to the address below. A Return Label will be included with the kit when it is initially mailed out to you so there is no cost for participating! If you have any questions, feel free to email or call the CLS Education team.

Tracy Walker  
Canadian Light Source Inc  
44 Innovation Blvd  
Saskatoon, SK S7N 2V3
Module Icon Guide

Throughout both the printed and digital versions of the TREE Modules, you will come across the following icons. These are used to help draw readers’ attention to important pieces of information, encourage exploration of additional resources, link to videos that supplement understanding, and so much more.

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| ![Paper & Pen](image) | **Paper & Pen – Lesson/Activity**  
Signal to reader to check out a lesson/activity. |
| ![Presentation Screen](image) | **Presentation Screen – Video**  
Signal to reader to check out a video that helps supplement the content. |
| ![Question Head](image) | **Question Head – Question**  
Used to probe students to think deeper about a concept or idea. Also used to help check for understanding. |
| ![Warning Sign](image) | **Warning Sign – Remember/Important**  
Used for important notes to catch the reader’s attention. Such as for Module 4 remember to get all the equipment before heading out to sample or in Module 2, remember to complete the timeline and send it with your samples as this is data. |
| ![Magnifying Glass](image) | **Magnifying Glass – Explore More**  
Use to signal to readers to follow a link or resource (book title, newspaper article, scientific study) to get more information. |
| ![Journal](image) | **Journal – Student Field Book**  
Used to inform reader that content in a section can help students complete a portion of the Student Field Book. |
| ![Gears Head](image) | **Gears Head – During Reading**  
Much like the question icon, used to encourage the students to expand on their thinking and learn more about a concept. |
About the Indigenous Languages & Traditional Knowledge Used in TREE

Throughout the TREE program, there is reference to various Indigenous languages and Traditional Knowledge across present-day Canada. According to Statistics Canada, more than 70 Indigenous languages are spoken throughout Canada; however, the United Nations Educational, Scientific, and Cultural Organization (UNESCO) approximates this number as closer to 90. These statistics are a testimony to the diversity of Indigenous languages and Indigenous groups in Canada. It is also important to note the range of dialects that exist within these languages, the language family in which each language belongs to, and ways of knowing amongst each Indigenous group. We currently have referenced languages and knowledge from a total of twelve Indigenous groups ranging from east to west. When referring to Indigenous groups and languages, TREE first cites the endonym (internal name) that Indigenous Peoples call themselves, followed by the exonym (external name used outside of the group) where applicable. We encourage you to use the endonym when teaching with resources by and about Indigenous Peoples. Indigenous Peoples referenced in this edition include the Anishinaabeg (Ojibwe, Chippewa, or Saulteaux), Dakelh (Carrier), Denesųłiné (Dene), Kanien'kehá:ka (Mohawk), Métis/Michif, Nakoda (Assiniboin), Nêhiyawêwin (Cree), Niitsitapi (Blackfoot), Innu (Montagnais), and Secwepemc (Shuswap).

The above-mentioned Indigenous groups and their languages can be further explained by the following:

**Anishinaabemowin (Ojibwe, Chippewa, or Saulteaux):** is spoken by the Anishinaabeg people whose territories range from the Great Lakes westward. In the English language, the Anishinaabeg people are often referred to as Ojibwe, Chippewa, or Saulteaux. Anishinaabemowin is one language, but within this language exist a range of dialects where words are spelled with slight variations. For example, different dialects include Anihsinapemowin or Nakawemowin (Plains Ojibwe/Saulteaux); Anishinaabemowin (Nippising Region); and Anishininimowin (Severn Ojibwe) (Belcourt, 2007).

**Dakelh (Carrier):** is an Athabascan language spoken in Dakelh Keyoh, a territory consisting of many lakes and rivers extending from the Coastal Mountains into the north-central interior of present-day British Columbia, and eastward towards the Rocky Mountains (Carrier Sekani Tribal Council, 2011). In their language, “Dakelh” means “People Who Travel Upon Water.” According to the Canadian Encyclopedia (2018), a 2016 census estimated 1,265 Dakelh language speakers. Though we could not find a Dakelh word for “trembling aspen,” Dakelh knowledge and traditional uses of trembling aspen is cited in Module 2.

**Denesųłiné (Dene):** is the name for the language spoken by the Dene people. Though Denesųłiné is one language, many dialects branch off including Akaitcho; Deh Cho; Gwich’in; Sahtu; and Tlicho. According to The Dene Nation (2018), “Geographical conditions in Denendeh [The Land of the People] have created the groups of people who make up the Dene Nation — Denesoline (Chipewyan), Tlicho (Dogrib), Deh Gah Got’iine (Slavey) K’ashot’ine (Hareskin) and Dinjii Zhuh (Gwich’in, once called Loucheux).” Denesųłiné is a member of the larger Athabascan language family and is spoken across a large area from the subarctic interior of Alaska, northwestern Canada, the plains of Southern Alberta, and extending into the southern United States (Dene Nation, 2018).

**Kanien’kehá:ka (Mohawk):** Kanien’kehá:ka is an Iroquoian language spoken by the Kanien’kehá:ka People, which means “People of the Flint”. There is an estimated 3,350 current Kanien’kehá:ka speakers in Canada and parts of the United States. There are six predominant Kanien’kehá:ka speaking communities across present-day Ontario (ON), Quebec (QC), and New York State (NY). These communities are Tyendinaga (ON), Wáňta (ON), Ohswé:ken (ON), Kahnawá:ke (QC), Kanehsatá:ke (QC), and Akwesasne (QC, ON, and NY) (Kanien’kehá:ka, n.d.).

**Michif (Metis):** is the name for languages spoken by Métis people, whose territories range from Ontario westward across the Plains, into parts of the Northwest Territories and the northeastern tip of British Columbia. The Michif language is half-Cree (an Algonquian language) and half-French (an Indo-European language). In this way, Michif is described as a syncretic language since it is not classifiable as belonging to a single language family but derives from the combination of two distinct cultures (Barkwell, L. J., Dorion, L., & Hourie, A., 2006). There is an estimated 1,170 fluent Michif speakers in Canada today (Statistics Canada, 2017).
Mi’kmaq (Micmac): is an Algonquian language spoken by the Mi’kmaq People. The Mi’kmaq are Indigenous to the Atlantic region of present-day Canada. According to Mi’gmawei Mawiomi Secretariat (2019), the traditional territory of the Mi’kmaq is known as Mi’gma’gi, and this greater territory consists of seven districts including Unama’gi, Esge’gewa’gi, Sugapune’gati, Epwegwitig aq Pgitu, Gesugwitig, and Signigtewa’gi aq Gespe’gawa’gi. There are an estimated 8,870 Mi’kmaq speakers in Canada (Statistics Canada, 2017).

Innu-Aionun (Montagnais): is an Algonquian language spoken by the Innu, which means “The People.” Innu territory is located on the eastern portion of the present-day Québec-Labrador Peninsula. The Innu-Aionun language is closely related to the Nêhiyawêwin (Cree) language. Both Innu-Aionun and Nêhiyawêwin, as with many Algonquian languages, are polysynthetic languages meaning that sentences are composed of long, highly structured words and complex verbs (Native Languages, 2016). Statistics Canada (2017) estimates there are 11,360 Innu-Aionun speakers in Canada.

Nakoda (Assiniboine): is a Siouan language of the Northern Plains in present-day Canada and the northern United States. The term “Nakoda” means “friend” or “ally.” Nakoda territory extends across parts of what is now Alberta, Saskatchewan, and Montana, with reserves in Saskatchewan and Alberta. There are an estimated 5,400 speakers in the Sioun language family (Statistics Canada, 2017).

Nêhiyawêwin (Cree): is the name for a language spoken by Nêhiyawak and Métis people. Nêhiyawêwin is a sub-language of the larger Algonquian language family (L. Burnouf, personal communication, June 6, 2016). Nêhiyawêwin is spoken in several dialects over a large geographical area in Canada. For example, in Saskatchewan, there are three dialects of Cree: Woodland Cree (“th” dialect), Swampy Cree (“n” dialect), and Plains Cree (“y” dialect). An example of how the dialects differ can be seen in the way each Cree language family identifies. The Woodland Cree refer to themselves as “níhithawak”, the Swampy Cree as “néhinawak”, and the Plains Cree as “néhiyawak” (Saskatchewan Indian Cultural Centre, n.d.)

Niitsitapi (Blackfoot): The Blackfoot language is one of the westernmost Algonquian languages and has been spoken for thousands of years in what is now Alberta, Saskatchewan, and Montana. The two main dialects are called Pikaniia and Siksika Blackfoot (Native Languages, 2016).

Secwepemctsin (Shuswap): is one of the Interior Salish languages of the larger Salishan language family. There are 43 consonants and 5 vowels in the Secwepemctsin sound system, and many of these sounds are not found in the English language. The current writing system for Secwepemctsin was developed approximately twenty years ago. Until then, Secwepemctsin was an oral language. In 1991, out of 7,597 members of the Secwepemc Nation, there were only 308 remaining speakers of the Secwepemctsin language (Matthews, 1999, as cited in Billy, 2009).

Nsyilxən (Okanagan): is an Interior Salish language spoken by the Syilx People of the present-day Okanagan Valley and extends into the United States. According to the Westbank First Nation, there are eight Syilx communities that speak this language including the Colville Confederated Tribes, Lower Similkameen Indian Band, Okanagan Indian Band, Osoyoos Indian Band, Penticton Indian Band, Upper Nicola Indian Band, Upper Similkameen Indian Band, and the Westbank First Nation (Westbank First Nation, 2019). There are an estimated 5,181 fluent nsyilxən speakers, which comprises 3.7% of the Syilx population. Though we could not find a Syilx word for “trembling aspen,” Syilx knowledge and traditional uses of trembling aspen is cited in Module 2.

We again acknowledge the diversity and regional variations of dialects, spellings, and pronunciations within each language. Select translations for Plains Cree (“Y” dialect) has been provided by Kato Carriere (Cree-Metis) of Cumberland House, SK. Reference to the Denešųį́nè language has been provided by Theresa Toulejour (Dene-Metis) of La Loche, SK. For a thorough compilation of resources cited in this overview or for further inquiry into language learning resources, websites, and smartphone apps, please see the References on the next page.
Language Resources

Below is a list of language resources for further inclusion within or beyond TREE. Where possible, we have included links to online dictionaries and smartphone or tablet apps. In the absence of a dictionary, we have provided links to history about the respective language and culture. Please forward any other websites or informative resources with regards to Indigenous languages and knowledge systems to education@lightsource.ca.

Websites:
Blackfoot Dictionary: https://dictionary.blackfoot.atlas-ling.ca/#/help
Blackfoot Language and Culture Twelve-Year Program Kindergarten to Grade 12: https://education.alberta.ca/media/563920/blackfoot-k-12.pdf
Dene History: http://www.sicc.sk.ca/dene_history.html
FirstVoices: https://www.firstvoices.com/
Nsyilxən Language: https://www.syilx.org/about-us/syilx-nation/nsyilxen-language/
Ojibwe People’s Dictionary: https://ojibwe.lib.umn.edu/about-ojibwe-language
Online Cree Dictionary: http://www.creedictionary.com

Apps:
Learn an Indigenous Language offers a list of educational apps, compiled in the App Store, to help facilitate Indigenous language learning in Canada.
Whose Land? is an informative app designed to help users identify whose Indigenous territory you are situated on.

References