

LEARNING FOR A
SUSTAINABLE
FUTURE

INQUIRY CHAPTER FOUR

Environmental Impacts and Restoration



EMPOWERING LEARNERS IN A WARMING WORLD

A Climate Change Inquiry Guide for 7-12 Educators

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4. Environmental Impacts & Restoration

This inquiry delves deeper into the multifaceted environmental effects of climate change. We encourage students to harness their curiosity of the local environment by examining changes to the ecosystem, species at risk, large scale environmental impacts, etc. or by connecting with a community expert and exploring restorative practices. We have included a multitude of external resources and guiding questions to help support and extend student research.



Photo by: NASA/Kathryn Hansen

Before you Begin: Background Information for Educators

Regions across Canada are already experiencing the effects of climate change. Many ecosystems are changing rapidly, and animals' habitats are changing at a faster rate than they can adapt. The [Living Planet Report](#) shows an average decline of 60% in animal populations between 1970 and 2014. In order to conceptualize some of the major environmental effects that can be attributed to climate change and trends that could emerge in coming years, the effects have been broken down into the following sub-categories: changes in temperature and precipitation, changes to the [cryosphere](#) (portions of Earth's surface where water is in solid

form, including ice caps, glaciers, sea ice, snow cover, etc.), changes to freshwater resources, changes to ocean climate, and biodiversity changes.

Changes in Temperature and Precipitation:

- In Canada, temperatures have increased by [1.5 degrees](#) above pre-industrial levels. Canada's position in the far northern hemisphere means that we are experiencing the effects of climate change at a higher rate than many other regions in the world .
- Warmer air has the potential to absorb more [surface water](#), resulting in both droughts and more intense precipitation events. Overall trends indicate that [Canada has become wetter in the past decade](#), with increased rainfall and decreased snowfall across many regions of southern Canada.
- Temperature and weather extremes are expected (very hot and very cold as well as very wet and very dry) leading to a higher risk of associated environmental hazards such as floods and droughts.
- Overall temperature warming is enhanced in the northern latitudes of the country

Changes to the Cryosphere

- [Permafrost](#) temperatures in Northern Canada have been fairly consistently rising 0.2 degrees per decade over the past 20-30 years
 - Globally between 2007 and 2016, there has been an average increase of 0.29°C ± 0.12°C in permafrost temperatures ([IPCC, 2019](#))
 - The effects of melting permafrost include release of harmful [greenhouse gases](#) previously trapped within the ice and reduction of structural support in regions previously covered by permafrost
- [Glaciers have been melting at an accelerated rate since the beginning of the 20th century](#)—glaciers lost 11% and 25% of their surface area in Alberta and British Columbia, respectively, between 1985 and 2005.

[Changes to Freshwater Resources](#)

- Changes to freshwater resources across Canada are difficult to categorize as a whole, nationally, due to the extreme regional variation that exists
- Canadian data shows that water quality has remained stable in the vast majority of monitoring stations across the country (81%) between 2002 and 2016, improved in 10% of locations, and decreased in 9%.
- However, the levels of [PBDEs](#) (Polybrominated diphenyl ethers, persistent organic pollutants) remain above prescribed guidelines in the following locations: The Great Lakes, Pacific Coastal, St. Lawrence.
- Excessive nutrients in both the Winnipeg River Basin and The Great Lakes area have caused detrimental [algae blooms](#) in these locations

Changes in the Ocean Climate

- [Trends in the Pacific, Atlantic and Arctic oceans indicate long-term warming of approximately 0.1 percent per decade](#), both surface temperatures and bottom waters

- Ocean temperature, acidity, and oxygen levels are affected by increasing atmospheric carbon dioxide levels
 - Since the 1980's the ocean has absorbed between 20-30% of total anthropogenic carbon dioxide emissions
- The rate of ocean warming has more than doubled since 1993 ([IPCC](#)).
- Ocean levels are rising at a concerning fast rate (in part due to the melting ice caps), which is increasing the risks of flooding and potential contamination of freshwater and groundwater, among other issues
 - In Canada, a country surrounded by three different ocean bodies, the changes to ocean levels, temperature and composition are of paramount importance

Biodiversity changes in Canada:

- Increases in the frequency and intensity of droughts, forest fires, and insect outbreaks in combination with direct human impacts like deforestation, pollution and overharvesting are resulting in habitat loss and threatening the survival of many species ([Canada and a Changing Climate](#)).
- Changes to season lengths and times (such as earlier springs) are changing the growth and reproduction patterns of many plant species, which directly affects animals that rely on them for food and habitat
- Physical changes in the landscape (e.g. higher water levels or human barriers such as roads, farms, and dams) can prevent animals from accessing food or breeding/rearing areas



A. Provocations: Impacts on the Environment

To hook student interest, choose one or more of the provocation ideas to initiate student thinking.

Idea 1) Picture prompts

Images can provoke strong responses. Find some topical photos and ask students “What do you think this image is saying?” A few suggestions are listed below. (For more ideas on how to use them, go to the New York Times resource on [How to use Picture Prompts](#).)

Click on the links below to access the following picture prompts

- [Falling Bottles](#)
- [In Your Head](#)
- [Student Climate Strikes](#)

Idea 2) Videos

[1 °C and its impacts: what does climate change mean for Canada?](#) [Climate Atlas]: 2:49 minutes

Climatologist, Damen Matthews describes how the climate changes that are being observed are human-caused and “unparalleled in geologic history.”

[How we children save the world](#) [Plant for the Planet]: 5:21 minutes

The story behind Plant for the Planet—a youth perspective on how children can change the world and make a real impact in the climate crisis.

[Canada Living Report](#) [World Wildlife Fund]

WWF’s 2017 living planet report brings attention to the significant wildlife loss and takes a look forward to see “what can be done?”

[Ask the Experts about Climate Change](#) [CBC] - Watch to 1:38

Nicole Mortillaro, CBC News science reporter, Ulrich Wortmann, professor of Earth Sciences, and Mark Winfield, environmental policy expert answer questions on climate change.

[Why we must adapt where we live to reduce weather impact](#) [Global News]: 10:16 minutes.

Senior Climatologist for Environment Canada, David Phillips believes that governments should be putting restrictions on building in flood zones and preventing paving lawns, “investing in green infrastructure not grey infrastructure”.

Idea 3) Neighbourhood Walk

Go for a walk around your school yard or neighbourhood and ask students to three to five “[I wonders](#)” about how climate change is affecting or may affect the environment in your local area. Compile “I wonders” into a list for students to refer back to when developing umbrella questions. For example, “I wonder how bees are being affected by climate change.”

Biodiversity or species at risk modification:

Before leaving for your walk, encourage students to download the free app, [iNaturalist](#). The app allows them to take photos of plants, animals or insects for identification and will suggest probable species. Data uploaded into iNaturalist is shared with scientists to help conduct research and monitor invasive species.



B. Question Generation

Using the “[Question Formulation Technique \(QFT\)](#)”

Reflecting back on “I wonders” from the neighbourhood walk, ask students in groups to generate as many questions as they can in the allotted time (suggested 5 min). To generate questions, follow QFT rules for producing questions:

- Ask as many questions as you can
- Do not stop to answer, judge or to discuss the questions
- Write down every question exactly as it is stated
- Change any statement into a question

Review the difference between open-ended and closed-ended questions and ask students in groups to identify open questions with an “O” and closed questions with a “C”. Ask students to rewrite three closed-ended questions into open-ended questions and three open-ended questions into closed-ended questions.

Prioritize questions

Next ask students to review their questions and prioritize them according to which ones they believe will help the class better understand how local natural systems are being affected by climate change.

Sample questions:

- What is the biggest environmental impact in our area?
- Which species are most at risk in our area and why? What are the main risks?
- What adaptation strategies do we have to protect areas most at risk of environmental impact (e.g. flooding or droughts)?



C. Knowledge Building

Invite a speaker

Invite a local community expert to learn about local climate impacts and local climate action responses.

Places to look for a local community expert:

- Naturalist groups
- Climate adaptation representative (municipal, provincial)
- Ministry of Natural Resources
- Conservation Authority/Agency

- Conservation NGO

Students can have the questions they generated on hand to prompt them to ask the speaker.



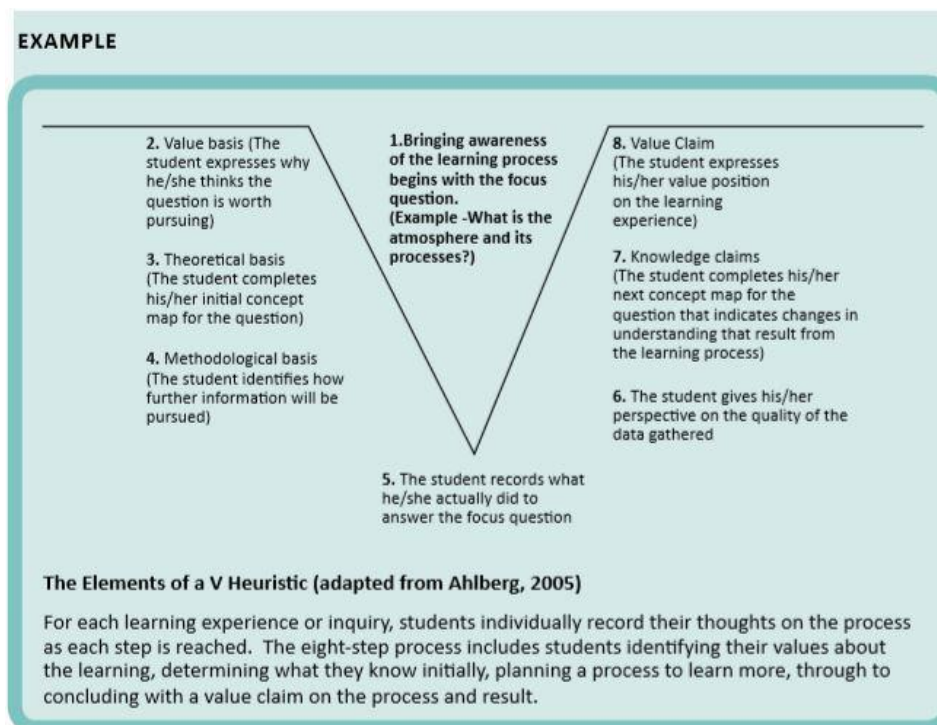
D. Determining Understanding

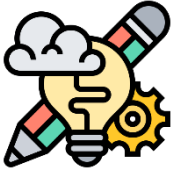
V-heuristic

After hearing from a guest speaker, have students review their questions, make notes about what they've learned and develop any new questions.

Then ask students to select one question as a top priority. Working with this question, students will each go through the v-heuristic process steps 2-4. These steps will help students focus on how and where to direct their learning.

EXAMPLE





E. Pursuing Learning: Impacts on the Environment

Individual or group research

At this point, students can individually pursue their own research process, or you can facilitate students working in groups as they begin to conduct research.

What is the biggest environmental impact in our area?

- [Climate Atlas of Canada](#)
- [An Overview of Canada's Changing Climate; in Canada in a Changing Climate: Sector Perspectives on Impacts and Adaptation](#)

Which species are most at risk in our area and why? What are the main risks?

- Government of Canada's [Species at Risk Public Registry](#)
- [Biodiversity and Protected Areas: in Canada in a Changing Climate: Sector Perspectives on Impacts and Adaptation](#) p. 159-190

How are we all connected? How do the environmental impacts across the country affect us in our location?

- [Climate Atlas of Canada](#)
- [An Overview of Canada's Changing Climate; in Canada in a Changing Climate: Sector Perspectives on Impacts and Adaptation](#)

What adaptation strategies do we have to protect areas most at high risk of environmental impact (Example: flooding or droughts)?

- [Federation of Canadian Municipalities Resource Database](#) (2019)
*Search for local municipal examples among 49 case studies from Canadian municipalities
- Government of Canada's [Long Term Infrastructure Plan](#) (2018). [See Green Infrastructure section]

What are the best restoration actions for mitigating climate impacts?

- [Examining the viability of planting trees to help mitigate climate change.](#) NASA
- [5 things to know about fighting climate change by planting trees.](#) Science News.
- [To Ensure a Stable Planet, 30% of the Earth needs protection by 2030.](#) National Geographic.



F. Consolidation

After students have had an opportunity to do some extensive research, a valuable consolidation tool to conceptualize and organize large amounts of information is a [reverse mind map](#). Students can complete a reverse mind map in a group with other students who have chosen to address a similar topic. By combining all of the research that students did, information can be consolidated and hopefully some clarity will begin to arise.

Assessment Idea



Teachers will assess learning at different points throughout the inquiry using multiple methods. The following assessment provides an alternative evaluation method to standard quizzes and tests, that can be used after consolidation or at any point in the lesson to check for understanding.

< 3-2-1 Strategy

The [3-2-1 exit slip strategy](#) is a method for students to summarize their learning as follows:

Three: Students write three things they learned in today's lesson.

Two: Next, students write two things they would like to learn more about.

One: Finally, students write one question they still have about the lesson.

Find more information on this strategy [here](#).



G. Take Action:

Allowing time for students to take action is an essential part of the learning process on climate change, as it empowers students and eases their eco anxiety.

Ideas for Taking Action:

- Plant trees
- Habitat restoration
- Collect data as citizen scientist
- Support policies that improve environmental conservation and climate
- Join student council, municipal youth committee, or youth advisory board of a non-governmental organization
- Innovate sustainable solutions for school or community questions and problems
- Share your learning within your school and share your learning outside the class

Action Project Examples

- Ecological Park- Masseur Elementary School - Regina, SK (2013)
 - Students created an endangered ecosystem and species ecological park on the school grounds. [See their project here.](#)
- CBS Ocean Monitoring - Holy Spirit School - Conception Bay, NL (2015)
 - Students collaborated with fishers, scientists and fellow citizen scientists to develop a better understanding of Conception Bay. Goals included: familiarizing students with the conditions of the ocean and ultimately creating a database to track changes caused by climate change. [See their project here.](#)
- Earth Day: Sustainable Hands-On Workshops - Miles Macdonell Collegiate - Winnipeg, MB (2019)
 - Students took on two different initiatives. First they wanted to tackle waste from single-use plastics. Using creative thinking skills and entrepreneurship, the class held a workshop teaching staff and students to make their own reusable and compostable beeswax and cotton food wrap to replace plastic bags and plastic food wrap. To further promote their initiatives, the students planned and implemented an Earth Week sustainability campaign, where students who were observed participating in sustainable behaviours were entered into draws to win eco-friendly prizes like reusable water bottles or the handmade food wrap. They report that “students and staff have reported eye-opening transformations on their consumption of single-use plastics.” For Earth Day, students organized presentations and workshop sessions from several keynotes and facilitators about topics ranging from Climate Change, Environmental Justice, Indigenous Art and so forth. [See their project here.](#)

- Carden Water Quality Monitoring - Patrick Fogarty Catholic Secondary School - Orillia, ON (2015)
 - Students partnered with a local conservation authority to assess their local watershed, which they found to be at risk. They learned to perform numerous water quality tests and conducted an observational survey of the creek to determine its health, designed and carried out a survey of local residents to explore possible causes and awareness of the issue, and interviewed members of the Ministries of Natural Resources & Forestry and of the Environment & Climate Change. They then took their findings to the Orillia Environmental Advisory Committee (EAC), making a deputation on the results of their research and their recommendations for action. The EAC formed a working group a few weeks later to conclusively determine the cause of the issue and investigate and implement solutions. [See their project here.](#)
- Solar Greenhouse - Ecole McTavish - Fort McMurray, AB (2016)
 - Students at Ecole McTavish created a solar greenhouse for their school. Through this process, they educated themselves on alternative energy, methods of planting and growing inside a greenhouse, and educated their community about farm to table production as it contributes to an eco-friendly lifestyle. [See their project here.](#)