Climate Change Education Inquiries in the Secondary Classroom: A Practical Guide

A Portfolio Completed in Partial Fulfillment of the Requirements of the Degree of Master of Education

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Chapter 1: Introduction

In today's society, teaching students about climate change is a complex task. While there are more resources and policies in place to assist in educating students in a rapidly changing world, along with it comes controversy, student apathy and anxiety, and lack of support (Hughes, 2017). With the current state of the environment and human impact causing global warming, acting fast to both educate and inspire future generations to get involved and create positive change is of the highest priority. However, how do we go about this? There are potential opportunities through cross-curricular approaches that foster holistic and systemic ways of knowing; these instructional approaches allow for interdisciplinary problem-solving and help teachers and students co-learn in this area, where research is emerging and there is no single solution.

"Ecophobia," is said to be a fear of the ecological problems of the world like oil spills, rainforest destruction, or the fear of simply being outside (Sobel, 1995). "The result of decades of 'gloom and doom' messages is a generation of informed but disillusioned and depressed youth." (Sobel, 1995). To engage and ignite curiosity in students on a topic that they are likely to be afraid of is a difficult task. Moreover, mainstream media's climate change reporting has predominantly had a doomsday frame (Armstrong, 2018), making it almost impossible to see any hope to try to get involved and to see the possibilities in taking action for hopeful futures (IPCC, 2019).

Before my time at Lakehead University, I completed my Bachelor of Education at Queen's University completing my intermediate/ senior qualifications in Geography and Biology. During this time, I also decided to focus in Environmental Education, a requirement for students to specialize in a field of their choice during the B.Ed program. During my first placement in the Fall of 2017, I taught two sections of Gr.9 Geography. I was alarmed at the lack of knowledge and awareness on the basics of climate change and environmental awareness. This immediately piqued my interest, especially because when I went to look for resources to help teach the corresponding units, I struggled. After engaging in conversations with both Geography and Science teachers, where climate change is its own unit in the Gr. 10 Science curriculum, they too felt at a loss for finding appropriate resources to support them in teaching climate change education. Immediately upon being admitted to the Master of Education program at Lakehead

University specializing in Environmental and Sustainability Education, I knew my interests would take me to focus on climate change education.

This is what allowed me to take my knowledge and questions from my teaching practice, as a guide for my research. I was fortunate enough that during my time as a graduate student in the M.Ed program, I worked on several projects that focus on climate change education: 1) a curriculum analysis of each province's climate change expectations; 2) the development of a climate change inquiry guide for secondary teachers; and, 3) assisting with the development and instruction of an interdisciplinary studies course, entitled Local Responses to Climate Change.

As Dr. Ellen Field's research assistant, I assisted in a national curricula analysis for climate change expectations across all subject areas focusing on science and geography. These results provided an overview of how climate change education is integrated into the respective provincial curricula and policy and are considered in relation to international climate change policy and empirical evidence of effective climate change education strategies. The content analysis was of the Ministry of Education curriculum documents from grades 7-12 from each of Canada's 13 provinces and territories. In the territories (Yukon, Northwest Territories and Nunavut) some documents are used from partnering provinces and were noted for what grade and subject this occurred for. The results from the study show: 1) which provinces have the most integration and depth, 2) climate change expectations that occur in which subject areas and at what grade levels, and 3) climate change expectations' occurrence in elective or core courses. We are currently writing these results up for publication.

Through these projects, I have had the opportunity to develop an understanding of climate change education research and pedagogical best practice, curriculum policy, and curriculum development. The work profiled in my portfolio begins with a brief overview of the provincial curriculum analysis project, followed by a literature review of climate change education research and best practice, and ends with the secondary inquiry guide. The secondary inquiry guide presented was developed by me in consultation with Dr. Field. Learning for a Sustainable Future worked with my inquiry ideas to develop their forthcoming resource, *Empowering learners in a warming world: An inquiry guide for secondary teachers* due for publication September 2020.

Chapter 2: Literature Review

Introduction

The purpose of this literature review is to report on current climate change education research focused on best practice for climate change pedagogy at the secondary level. Through the literature, I demonstrate the importance of developing an understanding of climate change while creating a deeper and emotional connection to the environment with the goal of educating students who are active and engaged citizens, motivated to be future changemakers. Reid (2019) asks, "What are the risks and benefits of having climate change education focus primarily on, say, cognitive awareness, emotions, and/or behaviour change?" (p.974). While teaching climate science is essential to understand the foundational knowledge, the end goal is to create active citizens who will one day leave the classroom as those changemakers and policy drivers. Having an underlying educational purpose of motivating students to understand and develop a passion for making change requires this emotional switch to be activated and stimulated.
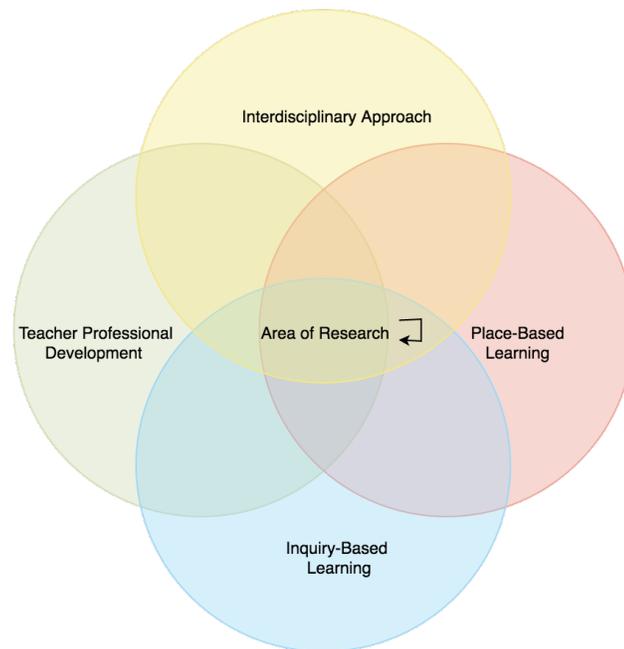

Figure 1. Area of Research

The Venn diagram above illustrates how I came to find my area of research. When initially creating the inquiry guide, Dr. Field and the partners at Learning for a Sustainable Future (LSF) developed the eight themes that structure the inquiry guide. As I began to develop those themes and examine current literature, I found four main areas that intersect with my area of research. My literature review focuses on:

1. An interdisciplinary approach to climate change education, viewing the topic from various lenses to gain a broader understanding of a constantly evolving issue;
2. Place-based and localized learning to foster an emotional connection and relationship to the more-than-human world;
3. The role of teacher professional development and the effectiveness of various teaching strategies when addressing climate change education;
4. The benefits of inquiry-based learning for fostering collaboration, discussions, and knowledge mobilization while teaching climate change.

The intersection of these four areas provides a research area that I used as a holistic approach when developing the inquiry-guide.

Current Climate Change Inquiry Guides

To begin my research, I examined what other inquiry guides existed to identify any strengths and potential gaps when teaching climate change from an inquiry-based perspective. I found international high school resources that focused on inquiry-based climate change education. Overall, while there are individual lesson plans, videos, and resource links for teachers on teaching climate change, there are very few resources that articulate an inquiry learning pathway to the extent that a teacher could replicate it, if s/he desired. For example, the Alliance for Climate Change Education (2020) discusses the importance of educating students through action fellowship, emphasizing the significance of social and place-based learning and examples of climate change impacts. Place-based learning is a powerful tool to reach youth and develop a personal connection to such a large-scale issue and a component of the inquiry process; however, the resource does not enough provide enough detail to support a teacher through a pedagogical approach that is new to them.

Another example is the U.S. Global Change Research Program (2020) handbook. This is a guide for teachers to integrate climate change content into their classrooms. This extensive resource has a strong science focus, mentioning scientific injury and the power of this educational tool, but no further mention. I began to discover this is a common trend for many of these other resources - a strong climate science focus, which is essential for foundational knowledge, but limited extensions to the social impacts. Canadian Geographic (2020) created a teacher guide, titled, *Canada in a Changing Climate: The Living World.* While this guide provided inquiry opportunities in the lessons and activities, they offered to students, but they were not integrated, creating a collection of activities rather than a holistic guide. While they provided teacher knowledge to build confidence, there was limited opportunity for student choice, which does not allow the guide to be adapted to student or teacher preference or current issues in a rapidly evolving and changing topic like climate change.

The newly developed New Brunswick Climate Education Plan (2019) proports that teachers will be guided through sustainable living projects that promote a willingness for students to act on climate change through inquiry. They make it clear that some teachers may even misuse these resources without direct guidance. Therefore, professional development workshops provide an opportunity to empower teachers to implement CCE lesson plans, activities and projects into a variety of subjects at all levels. This action plan mentions inquiry strategies in the plan, but no clear path of how this will be integrated. The Government of New Zealand (2020) discusses inquiry-based learning for their approach to climate change, offering an explanation, summary and steps for teachers to use in partnership with resources. They emphasize the opportunity inquiry brings for a multidisciplinary approach, and it is essential to guide students through a process of reflection involving scaffolded discussions that lead to creating opportunities for students to share with others and explore solutions or actions. There is no exact guide or instructions on how to go about a specific inquiry, with only a summary of the framework that, while beneficial, does not directly benefit educators when implementing this into their teaching practice.

The first climate change inquiry was from Green Learning Canada (2018). This resource provided several example inquiries for different subject areas for teachers to use. Replicating the traditional inquiry process, it provided a foundation of specific curriculum links and a "spark" activity to guide the research process into question generation, researching, and communicating

new knowledge and findings. Also, it noted that in this particular theme example, "How is Climate Change Affecting Freshwater Recreation Where You Live?", that time extent could be between 5-7 lessons, emphasizing the need to allow students to take the time needed to investigate, ask questions and connect their learning thoroughly. The second inquiry guide was created by the Yukon Government (2017) and approached climate change education with a cross-curricular framework with an Indigenous perspective. The guide provided a rationale for using the inquiry process alongside three inquiry activities, all building on one another, looking at climate science, applying that knowledge to how it impacts the Yukon and applying the experience in the future. Each activity gave several teachers prompts and resources within each inquiry if deemed necessary. It allowed for some choice and a student-centred approach. Lastly, the guide provided details for assessment for teachers as well as next steps and connecting with elders when discussing the environment. Overall, while there were connections between the language arts and science, the topic of climate change was not looked at other than from a science perspective with limited impacts outside direct human impact on the environment.

By examining the current inquires and climate change guides for teachers, the gaps that exist are: focusing too much on the scientific lens, a rigid structure that does not allow for student or teacher choice, and lack of teacher guidance on how to navigate through an inquiry-based lesson or unit. From these gaps, the goal of developing these inquiries is twofold: 1) to provide examples of how to integrate climate change content in classroom practice through interdisciplinary themes and 2) to provide clarity around the learning pathway stages of the inquiry process as this may be new to many teachers, especially secondary teachers. In general, teachers have a lot of questions and uncertainty of how inquiry functions (Ontario Ministry of Education, 2013) and this guide attempts to walk a delicate balance of showing how to conduct an inquiry through multiple entry points, to adapt to the specific teaching context, curriculum expectations and subject area of the classroom. I recognize that high school teachers are still bound to subject boundaries; however, research shows that best practice for teaching climate change is a holistic or interdisciplinary approach (Pharo et al., 2012). This guide is an attempt to bridge those two together in the hopes that not only science teachers will see the opportunity to teach about climate change education and perhaps allow for co-teaching and subject integration with this new platform to do so. My literature review below will examine what has been

substantiated by research as best practice for content and teaching strategies for climate change education.

Interdisciplinary Approach

Traditionally, climate change has been taught from a science lens, yet research shows that there are benefits to widening this perspective (Pharo et al., 2012).This leads to using a multidisciplinary approach when addressing climate change, to give students the opportunity to understand this complex topic from both a scientific, social, and environmental perspective.

Kagawa and Selby (2010) discuss that there can be no ethical and adequately responsive climate change education without global climate justice education. The educational response to climate change needs to be both local and global. Wherever it takes place, climate change education needs to be a social and holistic learning process. Cantell, Tolppanen, Aarnio-Linnanvuori & Lehtonen (2019) use a term named "the bicycle" model for climate change education. They describe, like a bicycle, climate change is one entity that requires all of its parts to function together. Furthermore, to understand the challenges of climate change mitigation and adaptation, information on human behaviour and political and economic impacts need to be considered. Complex environmental issues like climate change are difficult to teach in the current formal school setting, where there is a separation of subject areas with little subject integration (Busch et al., 2019). The end goal when teaching climate change, other than climate science knowledge, is the ability to foster societal change to mitigate climate impacts (Bangay & Blum, 2010). So, how better to prepare students than by giving them an interdisciplinary foundation? While bringing in ethical aspects, for example, can bring challenges in classroom discussion, it has also demonstrated the potential for success in teaching from an interdisciplinary perspective (Todd & O'Brien, 2016).

Anderson (2012), recommends that climate change literacy can be improved through sustained, active learning activities using integrated, cross-discipline curricula. An integrated, cross-discipline curriculum grounded in the core knowledge and application of climate and environmental science would allow students to connect various aspects and models of environmental and climate science to one another. This, then, enables them to integrate their knowledge into their understanding of climate change and their active role in it. Anderson (2012) argues that it is critical that climate change education is not introduced as a separate, stand-alone

subject area, or solely within the science section, but instead integrated across existing subject areas such as science, citizenship education, geography, social studies, history, language, drama, and the arts. Furthermore, this integrates humans as part of the multidisciplinary process and not as separate entities that create a habit of mind where respect and care for the environment are seen as moral obligations (Beckford, Jacobs, Williams & Nahdee, 2010).

Looking specifically at climate science, Roychoudhury, Shepardson & Hirsch (2017) through their study, illustrate that when students learned about climate science, they were not able to make the connections on their own, to other factors that play a role, viewing climate science as a larger system. Students need to be given the platform and opportunity to begin looking at a topic like climate change through multiple lenses, but if it is not brought to their attention, how can educators expect them to do so? This emphasizes the idea of a multidisciplinary approach of systems thinking of connecting knowledge; however, they argue the curriculum needs to reflect this for it to be practiced in climate science teaching.

Overall, with a complex topic like climate change, an interdisplinary approach is necessary for all perspectives to be understood in order for students to formulate educated responses and to have holistic understandings. If educators are able to bring these connections and showcase the various perspectives, the teaching practice remains current, and allows for consistent real-world application with any new information.

Place-Based Learning

Place-based learning allows for students to build an emotional connection and sense of ownership to what happens in the location they live their day-to-day lives. Strife (2010) discusses that while the stereotypical depiction of the polar bear on the lone ice cap may stir emotion, it could be argued that stronger images or ways to bring more personal connection to a distant environmental issue could be more meaningful. When an ecological issue is geographically distant or one which people feel does not affect them, it is hard for anyone, especially students, to want to learn more and make a difference. This is where Strife (2010) argues that there is no "one size fits all," and localizing education is essential.

When students are able to connect what is happening to a local example, there is an increase in engagement. Morse, Jickling & Quay (2018) add to this idea, by exploring wild pedagogies. Wildness, education, and the realities of an emerging geological epoch, sometimes

called the Anthropocene, are all tied together in the learning process. Responding to such issues requires action and a reimagining of this relationship between humans and the changing environment, and where educators begin to play a significant role in facilitating and localizing these experiences. Pulkki, Dahlin & Värri (2016) note that familiarising ourselves with our homes can give us a sense of place in both our lived bodies and our surroundings and gives opportunities for us to experience and notice what is in us and in nature to build a capacity to care. They highlight the importance of being present in one's home and surroundings. This can allow ourselves to connect on a deeper level beyond being physically present. This approach is also important to cultivate for students in the school community.

Climate change education needs to pay attention to cultivating emotional engagement for further behavioural engagement. Both subjective norms and place attachment might not be easily changed by an educational program, although Hu and Chen (2016) argue that proper facilitation can allow a willingness for action. Chong, Gero & Treichel (2015) conducted a study based on the project's implementation and focus-group discussions (FGDs) with children, for developing evidence-based, local-level indicators of effective adaptation for climate change. The project looked to address the gap that climate change education is rarely localized. Their community-based project looked at developing evidence-based, local-level indicators of effective climate change education adaptation Chong et al. (2015). Results showed that children's communication and knowledge skills significantly increased with activities and they could articulate the local impacts of climate change. This proved significant, as when students were able to study local effects of climate change in a group setting that allowed for communication and discussion, it directly translated into knowledge building.

Groulx, Fishback & Winegardner (2019) added to the emphasis on learning on location with the *Arctic's Edge* program. Results indicated that participants' overall sense of nature relatedness, place identity and natural place attachment was higher after the *Arctic's Edge* program, showing the importance place-based education can hold. While having programs in these remote locations is not always possible, the research suggests benefits to learning outside with nature and not in the classroom.

Place-based learning allows for students to localize the issue of climate change education, this allowing for a deeper emotional connection and engagement to the issue, beyond the classroom experience. Educators strive to encourage lifelong learning, and make an issue local,

allows for real-world application, something that is found to be best practice for societal issues like climate change education.

Teacher Professional Development (PD)

Bieler, Haluza- Delay, Dale & McKenzie (2019) researched Canadian K-12 curriculum and policy analysis and found several blind spots or subjects that are left almost entirely unaddressed in some provinces. This included climate or education policies, primarily reflecting local responses to climate change and climate change pedagogy. There was some reference to Indigenous communities and Indigenous knowledge systems in two of the four case study provinces. The lack of curriculum can be associated with a lack of preparedness and support to teach climate change, emphasizing the need for teacher professional development if the curriculum is not going to provide that support for educators. Learning via "learning communities" as part of professional development or participating in professional associations allows teachers to enter a dialogue with representatives of government agencies and non-governmental organizations, thus looking externally for support to eliminate the gaps that are there for teachers (Marcinkowski, 2009; Tolppanen & Aksela, 2018).

Looking at the results of the study by Field, Schwartzberg and Berger (2019), only 32% of closed-sample educators felt they had the knowledge and skills to teach about climate change. Educators said they need professional development, classroom resources, current information on climate science, curriculum policy, information on the economics and politics of climate change, and national/provincial climate data. In one example of climate change education in initial teacher education, although teachers came from various backgrounds and some with no experience in climate change education, their unavoidable stress and worries were strongly alleviated with the help of peers and learning from one another with strong resources (Berger, Gerum & Moon, 2015). It is likely that professional development can also help in-service teachers become prepared to teach about climate change.

Many teachers are uncomfortable instructing on climate change and global warming because they feel that they do not possess the necessary background information on the subject as they received little if any instruction on it (Chambers, 2011; Porter et al., 2011). Scholars argue that there is a need for formal climate change education and that teachers need better training, more resources, and more time to adequately teach climate change in their classrooms

(Breslyn et al., 2015; Chambers, 2011; Porter et al., 2011). Through consistent reinforcement where students are supported through appropriate instruction by educators (in formal and informal settings), they can be guided toward an understanding of a scientifically informed view of climate change (Breslyn et al., 2015; Foss & Ko 2019).

Walker et al. (2017) wrote that teachers often feel the pressure to cover all of the standards and benchmarks and this does not leave them time to allow for in-depth experiential learning. With this in mind, integrating climate change education into existing curriculums is therefore recommended so that it is embedded within pre-existing frameworks and across disciplines.

In summary, teacher professional development is necessary to fill the gaps in the current Canadian curriculum and provide additional support and strategies to educators. Through this, the hope is that educators begin to feel more comfortable and prepared to teach about climate change to their students.

Inquiry-Based Learning

Inquiry-based learning is an approach to teaching and learning that places students' questions, ideas and observations at the centre of the learning experience. Underlying this approach is the idea that both educators and students share responsibility for learning through open-ended investigations into a question or a problem, requiring them to engage in evidence-based reasoning and creative problem-solving, as well as "problem finding" (Ontario Ministry of Education, 2013).

Steele, Hives & Scott (2016) note that students are often asked to explain their thinking in logical sequences, to answer questions, and to propose and then take action centred on a topic. In today's context, with the possibilities of twenty-first-century innovative technology, their work examines the potential of learners documenting and/or contributing to the documentation of their learning. Climate change inquiry focuses on content learning as well as a reflection on a student's moral and emotional positioning to events occurring in the world. As Steele et al. (2016) mention, emotional responses allow for the 'aha' moments of knowledge and skill acquisition and human wonderment. This can be aided by recording inquiry in various formats; in their case, using video.

McCright (2012) suggest that based on results from his study with STEM students, participation in a sociological inquiry-based learning project helped in various ways. Often in the education system, climate change is viewed from one lens, a scientific lens. However, McCright (2012) argued that looking at a scientific problem from a multidisciplinary approach can allow for success in the initial problem and perhaps a more in-depth understanding.

When it comes to climate change, there are many negative emotions involved in the issue. While those are still valid and necessary to address, moving forward to inspire students requires allowing for motivation to act on climate change, opportunities to foster engaged citizens, and capacity to prepare students for the future (Ojala, 2012; Schreiner et al., 2005). Are teachers and science teachers, in particular, willing and able to provide climate education for empowerment? Giving such an education means that the teacher must move into subject areas and teaching methods that may be new to them. Ojala (2012) and Schreiner et al. (2005) believe that climate education should engage students in articulating, discussing and eventually acting on a particular problem. This allows for a co-learning process on something that does not have 'an answer', alleviating teacher stress.

Stevenson et al. (2017) suggest that climate change education cannot be confined to traditional structures and formal curriculum spaces of education but needs to draw on new informal and hybrid (e.g. school/community) areas offering alternative possibilities for learning and action. Such areas provide opportunities for students to engage in inquiry/project-based and action-oriented learning that includes the community. This can allow for investigations and activities related to local climate impacts, and new and expanded forms of citizen science that engage students in all phases of community-based research. Grant (1997) expands on this specific idea of inquiry looking at case studies. He felt that this was a positive and proactive response to dealing with 'flat' classroom discussions as it allows for meaningful learning and real-life application. As an educator, using this form of inquiry, he found students could connect more abstract concepts such as place, culture, and locality with real-world examples.

Knowledge integration (KI) in reference to science education, is a term that describes students struggle while learning complex and conflicting science concepts and phenomena. In the process of learning these concepts and phenomena, students generate a repertoire of ideas during the inquiry process, and the KI framework promotes that they use these ideas together to

provide a deeper understanding of scientific concepts (Namdar, 2018). Through inquiry-based activities employing KI caused significant learning gains in the pre-service teachers' integrated climate change understanding which could be applied to instructional strategies used in high school classrooms.

Automated guidance is an educational approach where students, especially with low prior knowledge, generate their own ideas and integrate them into the learning process instead of strictly receiving teacher instruction and selecting from specific options. This can then prompt students to reconsider their explanations, revisit an activity, or critique student explanations (Donnelly, Vitale, & Linn 2015). Walsh and Whitehouse (2017) add to this by looking at technology-enabled inquiry, improving students' engagement with STEM education. They argue that data are being used to document the climate emergency and study climate change; however, it is time to bring technology-enabled inquiry into classrooms and to focus on climate inquiries.

Sellmann and Bogner (2011), through a two-day environmental education programme combine indoor and outdoor activities in an ecological botanical garden and aim to confront students with a common misconception about climate change and the greenhouse effect. While students had the necessary information available to fully understand the greenhouse effect, it was inquiry design that allowed them to make new connections and a more accurate understanding.

While not the same thing as inquiry learning, hands-on, active learning and action-focused learning share similar ideas with inquiry-based learning. An 'action perspective' looks at using action, or hands-on experiences for students to learn in an alternative format. Jensen & Schnack (2006) argue that while an action perspective is important to environmental education, too much focus on individual actions without building capacities to take collective action is problematic. If the actions that are set up only deal with the individual or school level (as in building a compost heap only for the use of the school or turning out the lights on leaving the classroom), we run the risk of teaching students a simplistic and individualistic approach to environmental problems and their causes. Does the action of turning out the light when leaving the room give more insight into issues concerning energy consumption and climate change? Anderson (2012) argues that active learning should be connected to local problem-solving. Hands-on educational activities with a regional focus seem to create successful learning outcomes, uniquely when integrated into a regular school curriculum (Pruneau et al. 2003). Instructional techniques that connect climate change with not only local issues, but also

individual behaviour and impacts offer tremendous promise, both by making abstract concepts tangible and by linking the global phenomenon to personal actions.

Hermans and Korhonen (2017) demand a shift away from the cognition-oriented approach to climate change education which is predominant in the Finnish national curriculum for grades 7–9 (Finnish National Board of Education, 2004, 2014). Their results showed that Finnish ninth graders experience climate change as a risk. According to the study, the students' willingness to act is limited. The students' input into the design and content of climate change education are identified as significant predictors of student engagement. This finding suggests that when teachers allow students to direct their learning, they have higher engagement. The question that arises is how to support teachers to foster more student input and directed learning?

Next Steps

Looking at some key themes of this literature review, an interdisciplinary approach, place-based learning, and inquiry-based learning, the literature supports these approaches to teaching climate change which have proven effective in case studies and research examples. While inquiry-based learning has been shown to be an effective method of teaching climate change, where do teachers begin? Within the literature, a student-led approach is highlighted as best practice. This leads to questions of how do we guide student curiosity and question generation? This is not to discredit the importance of climate science, as it is the foundational understanding of climate, but to create deeper engagement, students must connect on a personal level which goes beyond the numbers or recent statistics.

When approaching content related to climate change in the curriculum, teachers should acknowledge the seriousness and risks of climate change but should focus on a positive message to foster student empowerment and action (Anderson, 2012). Formal education should make climate change personal and locally relevant to students to then have a better understanding, cognitive awareness and emotional connection (Pelo, 2015). Partnering with this, teachers need to have the resources, teaching material and training to deliver this locally relevant and significant way of teaching climate change to students (Chambers, 2011). My inquiry guide aims to integrate these findings of climate change education best practice into eight climate inquiries which are being developed for secondary teachers.

Chapter 3: Methods

The inquiry guide was created to be used in Canadian high school classrooms for grades 9-12. The inquiry style of learning allows teachers to draw on local examples and connections that best suits their respective province or area of their school community. While climate change is predominantly taught within the subjects of science and geography as this is where it is found in most curricula, this is not to discourage teachers of other subject areas from integrating these inquiries or parts of these inquiries in their teaching practice.

While some inquires have a time frame, this guide is designed to adapt to the needs of each specific teacher. It is not meant to be used as a lesson or unit plan and to be followed step by step with no other knowledge building on extensions. The goal is for teachers to be able to use specific themes that are more relevant to them through several entry points. Depending on the relevant and applicable curriculum connections, these inquiries could take several classes or be used as a foundation for an entire unit. If it is a time-sensitive situation, and a teacher wants to use the inquiry guide for a single lesson, I would still recommend at least a follow-up in the next class to debrief the inquiry and have an opportunity to reflect and connect what the students learned and discovered through the inquiry process. This is an essential component of the inquiry process, as this is where many students make real-life connections and can inspire interest in the classroom environment. This guide was developed for LSF (Learning for a Sustainable Future) and the initial framework and inquiry pathways were developed with their vision in mind.

My goal when creating these inquiries was that teachers could use these as a jumping-off point or a guide with ideas and a generalized path so they can be used across grade levels and subject areas that meet various curriculum requirements. Each inquiry starts with an inquiry path map which gives teachers a guide of the steps that the inquiry will take. Teachers can modify the inquires as they see fit.

This guide will provide educators with a blend of quality content (resources, websites, books, videos and ideas) and exemplary pedagogy to guide you through an inquiry-driven approach to climate change learning.
It draws upon seven key strategies that transform learning described in LSF's *Connecting the Dots*:

- Learning Locally

- Integrated Learning

- Acting on Learning

- Real-World Connections

- Considering Alternative Perspectives

- Inquiry

- Sharing Responsibility for Learning with Students

In climate change education, these seven strategies can be applied and while inquiry is the 6th strategy, it can be applied and used to encompass the rest. Inquiry-based learning allows a student-centred approach to education, focusing directly on question- generating, researching, and problem-solving on a specific topic. Climate change is an interdisciplinary problem, and when educating students as a collective group within a school community, we must focus on how we: 1) inspire students to think that it is a problem worth focusing on, 2) ensure student voices are heard, and 3) model effective practice in following through on questions, ideas and solutions.
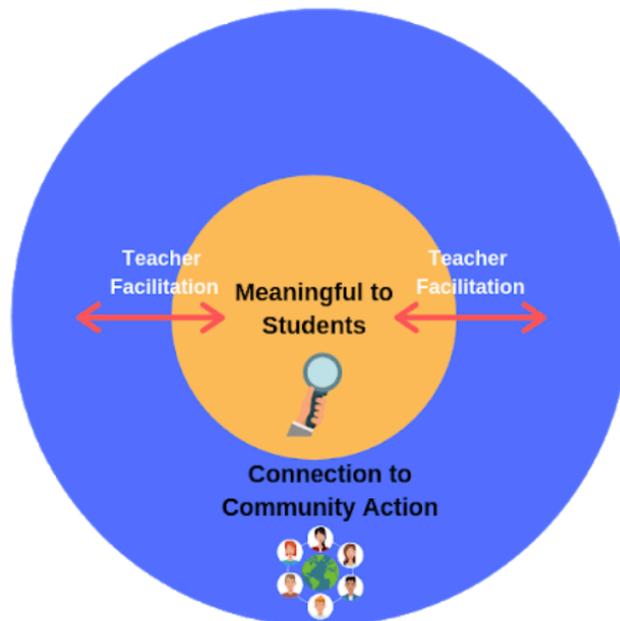

Figure 2- Goal of Inquiry-Based Learning

Chapter 4: Climate Change Inquiry Guide

Inquiry-Based Learning & Rationale for the Guide

The focus of my approach to inquiry-based learning is to first, spark an interest that makes the topic meaningful and significant to students through the initial stages of the inquiry process. Second, it is to further continue and use the ignited spark, create a local connection and follow through with community action to make learning significant and develop the idea of lifelong learning. This entire process cannot happen without the constant support of teacher facilitation by modelling best practices, motivating students throughout the inquiry process (Darling-Hammond, Flook, Cook-Harvey, Barron & Osher, 2020). Teachers are a bridge between making climate change meaningful, providing opportunities and inspiration for community action. Through the eight inquiries in the Guide, students have the opportunity to select and focus on areas within the theme that are relevant and meaningful to climate change in their school communities. This gives students motivation and action to get involved in responding to climate change.

Connecting an Emotional Response to Community Engagement

In order for students to feel engaged in addressing climate change, students need to be actively involved with the issue outside of the classroom to allow for real-world application (Kelsey & O'Brien, 2011). This authentically occurs when teachers and students look past the four walls of their classrooms. By engaging with the outside world, it allows the connection to a sense of wonder and re-enchantment with the natural world. However, when we bring the real-world problems associated with climate change and the reality of the issue, it also brings along emotional risks. However, if we want to re-enchant students to foster emotional understanding, we need to allow for all emotions to come through, both positive and negative. To be re-enchanted, students need to go off of what they are currently doing, reflect, analyze, and begin their sense of wonder and connection through local and familiar places (Kelsey & O'Brien, 2011).

Teachers can facilitate this. "The ever-present awareness of the ecological and communal context of our school enables and encourages teachers to individualize learning programs and respond spontaneously to opportunities, sometimes unexpected, to generate learning"

(Blenkinsop, 2014, p. 151). In this way, as educators, we create space for a student-centred approach to learning that arises from community-building within the classroom, school, and surrounding environment. When students are comfortable to reflect and ask questions, this can direct the classroom conversations and topics covered, and help bring student interest to life. Classroom learning, then, may also be driven by students.

As educators, it is our responsibility to bring the outside world in. The school community beyond the classroom is what can allow students to develop an understanding and connection to their sense of place and take responsibility for the world around them.

Through the eight inquiries in this guide, students will have the opportunity to ask critical questions and collectively explore answers through various forms of data collection and knowledge building.

The inquiry themes include:

- **Introductory Inquiry: What is Climate Change and Why Care?**
  - o This inquiry focuses on the question: "What worries you about climate change?" It provides foundational science and social knowledge on climate change, reviews the scientific consensus on climate science, and generates discussions focused on breaking down the emotional barriers of climate change education.
- **Inquiry 1: Current Status of Climate Change**
  - o This inquiry focuses on global perspectives, policies, agreements in place, and reviews mitigation and adaptation strategies from different levels of Canadian government.
- **Inquiry 2: Monitoring Change**
  - o How to monitor climate impacts through the Climate Atlas of Canada. Through the Atlas, a person can investigate predictions for various weather and climate variables for a local area.
- **Inquiry 3: Environmental Impacts**
  - o This inquiry helps student identify environmental impacts, including droughts, storms, floods, fires, mudslides, habitat loss, and species at risk. Students also consider mitigation and adaptation strategies for addressing environmental impacts. In this section, students also learn about Indigenous and First Nations perspectives and relationships to the environment.
- **Inquiry 4: Human Health Impacts**
  - o In this inquiry students identify health risks, including illnesses related to extreme cold and heat events, vector-borne diseases, and social and mental stress.
- **Inquiry 5: Economic Dimensions**
  - o In this inquiry, students learn about the economic dimensions of climate change. In particular, questions such as: "Why should the average Canadian citizen care about national-level climate change-related costs and insurance?" are explored along with cost analysis of natural disasters in Canada.

- **Inquiry 6: Ethical Dimensions for Children, Youth, and Liveable Futures**
  - In this inquiry, students explore the focus question: If the majority of the world's population is under 30, how does this impact future decision making?
- **Inquiry 7: Taking Action**
  - In the final inquiry, students explore how citizenship is an antidote to anxiety, the importance of local action, and the power of community partnerships and school-wide initiatives.

Introductory Inquiry

What is Climate Change and Why Care?	
Topics Covered: • *"What do you already know about climate change?"* • *"Climate change is not new, why now?"* • *"What worries you about climate change?"*	• Teacher Background Information • Mini Inquiry Activity • Tool: "Record of Learning" • Relevant Teaching Artifacts

Take-Away Message

Examining and dialling into what worries students most about climate change and using that as a driving force for focusing interest and engagement with climate change learning.

Teacher Background Information

Throughout history, the Earth's climate has been continuously changing, going through periods of extreme heat and cold. Since 1948, Canada's annual average temperature over land has increased by approximately 1.7°C which is approximately double the global average (NASA, 2019). The expert panel at the Council of Canadian Academies (2019) identified 12 major areas of climate change risk facing Canada at a national level (see Figure 2 below): agriculture and food, coastal communities, ecosystems, fisheries, forestry, geopolitical dynamics, governance and capacity, human health and wellness; Indigenous ways of life; northern communities; physical infrastructure; and water. All 12 risk areas could lead to significant losses, damages, or disruptions over a 20-year timeframe (Council of Canadian Academies, 2019). Some of the direct environmental effects we have seen and will continue to see in Canada are:

- Melting permafrost, threatening northern buildings and transportation and releasing methane, which further accelerates global warming.
- East and West coast sea-level rise, threatening to flood cities, increase storm damage, and accelerate erosion.
- Increased activity of pest and invasive species, posing risks to our ecosystems and our economy.
- More variable and more extreme weather, with increased risk of weather-related catastrophes such as droughts and floods.
- Hotter summers, bringing increased risks of heat-related health problems as well as longer and more severe forest fire seasons.

(Climate Atlas of Canada, 2019)

This brings a sense of urgency regarding our actions and the role of climate change education in Canada.

Resource: Video

1 °C and its impacts: what does climate change mean for Canada? [2:48]

Damon Matthews, a climatologist from Concordia University, examines the evidence of our warming climate and what these changes mean for Canada and suggests that the case for a dramatic policy response is very clear.

Link: https://www.youtube.com/watch?v=9SvlT6z5nhc&feature=youtu.be
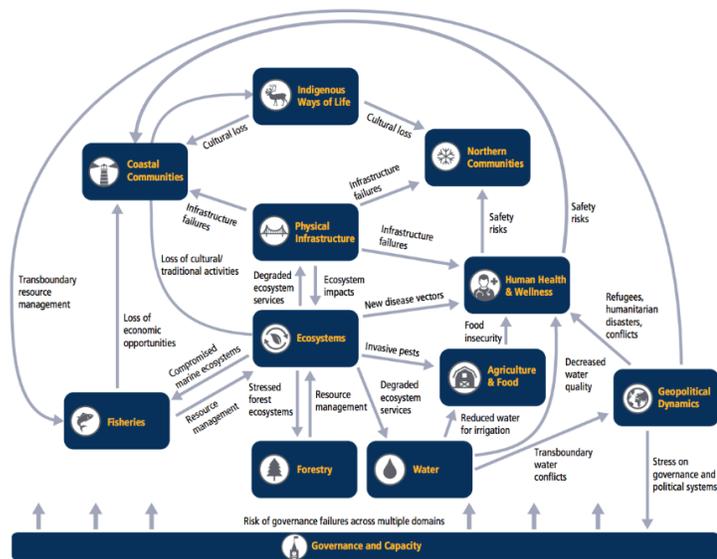

Figure 2.2
Interconnections Among Areas of Climate Change Risk
Climate-related risks are often interconnected through a dense web of causal relations. Note that the connections shown are illustrative and not exhaustive of all possible connections.

Figure 3- Interconnections Among Areas of Climate Change (Council of Canadian Academies, 2019)

**Resource:** Worldwide Climate Change Statistics

NASA's strongest points of evidence, to show rapid climate change is human-induced, include:

1. **Surface Temperature:** The planet's average surface temperature has risen about 2.0 degrees Fahrenheit (1.1 degrees Celsius) since the late 19th century, which can often be associated with the industrial revolution. 2016 was the warmest year on record, reaching an all-time high.
2. **Warming Oceans:** The oceans have absorbed much of this increased heat, with the top 700 meters of ocean showing warming of more than 0.4 degrees Fahrenheit since 1969.
3. **Shrinking Ice Sheets**: Data from NASA's Gravity Recovery and Climate Experiment show Greenland lost an average of 286 billion tons of ice per year between 1993 and 2016, while Antarctica lost about 127 billion tons of ice per year during the same time period. The rate of Antarctica ice mass loss has tripled in the last decade.

4. **Glacial Retreat:** Glaciers are retreating almost everywhere around the world — including in the Alps, Himalayas, Andes, Rockies, Alaska and Africa.
5. **Decreased Snow Cover:** Satellite observations reveal that the amount of spring snow cover in the Northern Hemisphere has decreased over the past five decades and that the snow is melting earlier.
6. **Sea- Level Rise:** Global sea level rose about 8 inches in the last century. The rate in the last two decades, however, is nearly double that of the last century and is accelerating slightly every year.
7. **Declining Arctic Sea Ice:** Both the extent and thickness of Arctic sea ice has declined rapidly over the last several decades.
8. **Extreme Events:** The number of record high-temperature events in the United States has been increasing, while the number of record low-temperature events has been decreasing, since 1950. The U.S. has also witnessed increasing numbers of intense rainfall events.
9. **Ocean Acidification:** Since the beginning of the Industrial Revolution, the acidity of surface ocean waters has increased by about 30 percent. This increase is the result of humans emitting more carbon dioxide into the atmosphere and hence more being absorbed into the oceans.

Link for more information: https://climate.nasa.gov/evidence/#footnote_15

Inquiry Map
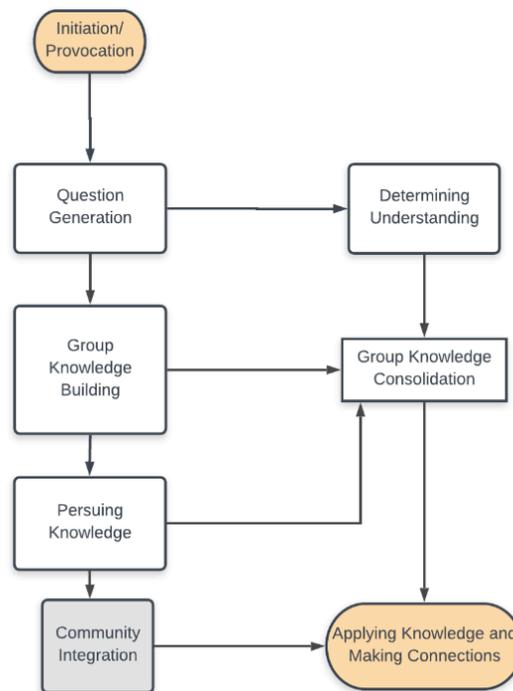
Figure 4- Introductory Inquiry Map

Overview

      To begin a discussion on climate change, it is important to start with the concerns and anxieties that learners have. The overarching question is, "*What worries us about climate change?*" However, to do so, it is important to be aware that this might spark an emotional response from students. Therefore, teachers need to provide a plan beforehand, such as an option to leave class if needed, or a reflection period at the need of the lesson. This inquiry allows students to formulate their own opinions while having the opportunity to share and learn from their peers. Additionally, giving students the opportunity to go back, change their opinions, and continue to ask questions throughout the inquiry process is important.

Tool: Record of Learning
When teaching students about a topic that can spark a variety of emotions, questions and concerns such as climate change, having a safe place for reflection is necessary. The main reason for developing a record of learning is for students to then be able to look back, and to track their growth and progression with their connection to climate change.   Creating a record of learning can happen either in a handwritten notebook or on a Google document that students can access at home or choose to share with their teacher at any time. This is a time for students to write in their journal that can be structured in lessons/ activities, or in their spare/ free time when needing to decompress.

Initiation/ Provocation

    If one were to follow this resource in order, this inquiry would be the first or could be used at the beginning of a climate change unit. It is important to first establish where students are coming from and get them both excited and motivated on the topic.

- In individual student journals under point #1, students should begin listing everything they have heard and know about climate change. These can be things that they have studied that they know to be true, information or topics related to climate change they have heard on the news or their own opinions or thoughts on the issue.
- Voluntarily, students can begin sharing some of the key things that stood out on their list, and as a teacher, record common answers on the board that can then be shared with students electronically.

Resource: Video

> **1) Climate change 101 with Bill Nye [4:09]**
>
> In this video, Bill Nye explains what causes climate change, how it affects our planet, why we need to act promptly to mitigate its effects, and how each of us can contribute to a solution.
>
> *Link: http://www.resources4rethinking.ca/en/resource/climate-change-101-with-bill-nye*
>
> 2) **The Cheeseburger Footprint [2:14]**
>
> In this video, students track the 10 pounds of carbon dioxide gas emitted from the production of a single cheeseburger. As the carbon dioxide amounts are extrapolated from the number of cheeseburgers consumed in a single year, the significant impact of this industry on greenhouse gas production and global climate change is made clear.
>
> *Link: http://resources4rethinking.ca/en/resource/my-cheeseburger-footprint*
>
> Both of these videos can be used as a quick introduction or a quick recap for students on the current status of climate change to help get students dialled into the conversation. By giving students examples they can relate to and simplifying the problem, it can help introduce some of the mixed feelings that accompany the discussion of climate change. However, introducing them in this format can allow for a more comfortable start rather than being overwhelmed, which is often associated with discussing climate change.

Provocation Continued & Question Generation

Now that students have begun the discussion on climate change, there can be a discussion to generate a question that is more specific to a particular aspect of the curriculum. Overall, the goal is to examine "What worries you about climate change?"

> ***Feeling Powerful:** Ask students to think of a time where they had to do something difficult but came out feeling powerful in the end. Write down an image or words that captures this feeling.
> **Think the Unthinkable:** The teacher asks students to each pick up 3 sticky notes and finishes the following sentences:

- *The thing that worries me most about climate change…*
- *The thing I prefer not to think about regarding climate change is…*
- *What scares me most about a hot planet is…*

> o Students are asked to reflect for a few minutes and record with words or pictures a climate nightmare. Students are asked to reflect for a few minutes and record with words or pictures something they love and those who feel comfortable can share.
> o In groups, have students come up with 3 topics related to what concerns them about climate change and what they love, to determine what the focus will be for the class, specifically, related to the effects of climate change.

Some sample questions that could be generated include:

1. How will we reduce the likeliness of forest fires?
2. How can we prevent flooding in our area?
3. How will I ensure a safe future for myself or for future children?
4. How can I do something to make a difference?

This activity was modified from the Sustainability Frontiers' (2011) activity Climate Change Despair and Empowerment, republished in Green Teacher (2017).

Determining Understanding

Using a KWL (Know, Want, Learned) Chart so students can refer back throughout their learning. It is suggested to focus the KWL around questions the students generated. This is something done individually but discussed in small groups. By this point, students have had the opportunity to think and reflect on key points they already know but additionally want to find out more about. This can be part of the record of their learning, or a handout exclusively used for this inquiry and collected by the teacher afterwards.

Group Knowledge Building

Knowledge Building Circles; what are they and how do they support inquiry? Knowledge Building Circles build upon classroom discussion (Kozak, S., & Elliot, S., 2014). It is class discussion time that is specifically reserved for working out students' emergent questions and ideas, rather than a teacher-directed forum for eliciting 'correct' answers to curriculum-based questions. Another key component of the inquiry process is a communal activity in which learners come together to pose questions, posit theories, and to revisit, negotiate, and refine their ideas. The collective goal is 'idea improvement'.

Circles are students' new/unresolved questions or theories, which in turn serve as entry points for further investigation (Anderson, Chiarotto & Comay, 2017, p. 11). Throughout the inquiries, various formats will be introduced of knowledge building circles other than the traditional open class discussion. The use of collaborative technology is essential with group knowledge building and the sharing of ideas. Many classes have a class website, but having online platforms where students can discuss, add and share information they learn can create a student-generated learning space. Additionally, this allows for the opportunity for teachers to work cross-curricularly with their colleagues over a common question or inquiry project. Some suggested platforms are Google classroom, online discussion boards, or online sharing platforms like *PADLET*.

Pursuing Knowledge

As this is an introductory activity, students conduct and record research from online sources. These can be academic journals, magazines, news articles, etc. Have students clearly outline where the knowledge is coming from as this is important in discussions on why certain information platforms may or may not have a particular view on climate change and what they choose to share.

Group Knowledge Consolidation

This inquiry focuses on emotions and what overall worries and concerns students as an overall theme of climate change, the opportunity for consolidation should exist at the beginning to ensure students are on track through class discussions, journaling, and in-class research opportunities. However, there should always be an opportunity for students to check-in on what is worrying them about climate change. Throughout the series of inquiries, these concerns can change. As a class, it is important to circle back to our initial question of what worries us most about climate change. As teachers, we need to provide these opportunities for students by:

- Checking in with students in the class; especially using smaller groups
- Using an online anonymous platform within the class website

Students can ask to have these knowledge-building circles through an online anonymous poll on the class website or routinely 1x or 2x a week. Using the journal as a tool for reflection and introducing it at this time can be of help. At the end of the unit, perform the same activity and share the changes in emotions.

Applying Knowledge & Skills

Based on the reflection circles, students can apply their knowledge by creating an online presentation where they can share their findings, changes in emotion, challenges, and triumphs with the climate change unit. Students can share and explain their journal entries through a PowerPoint, video, PREZI, collage, podcast, or through other means (with explanation). This is a project they can keep with them, especially as they leave the four walls of the class and enter the real-life challenges climate change education brings.

Making Connections & Moving on Beyond School & Community Integration

Based on the question the class decided to use as a focus for the overarching topic of "What worries you most about climate change?", could, for example, spark an action-research project involving the entire school community, both internally and externally. As a class, students could ask fellow students in the school, what worries them, and:

1. analyze and graph the data
2. create a "report" to share with the school administration
3. investigate what local initiatives exist on the main concerns of students
4. reach out to the local government to ask for further community consultation and sharing of concerns

Resource: Tool
An important notice throughout the inquiry process is to allow for a safe place in the school where students can talk about their concerns, learn from an expert, and hopefully get involved. Many highschools have environmental clubs or groups that can allow for de-briefing and open dialogue. However, there can be strategies teachers can implement throughout the inquires and when teaching about climate change education.   - Allowing for various methods of debriefing after each period. This can include journaling, open-discussion or sharing with a partner   - As an educator, having set times available to be able to meet with students if they would like to communicate face-to-face   - Having an online platform for anonymous feedback and student question. Google Forms are a great tool to create these anonymous feedback forms.

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Inquiry 1: Current Status of Climate Change

Current Status of Climate Change	

Topics Covered:
    • Global perspective (Policies, agreements in place)
      · Canadian Perspective (federal policies, Canada's commitment)
          • Current government mitigation and adaptation strategies (all levels of government)
	• Teacher Background Information
	• Mini Inquiry Activity
	• Reverse Mind-Map Activity

Take-Away Message

      Examining the policies that are currently in place at all levels of government to mitigate and adapt to the current and future impacts of climate change.
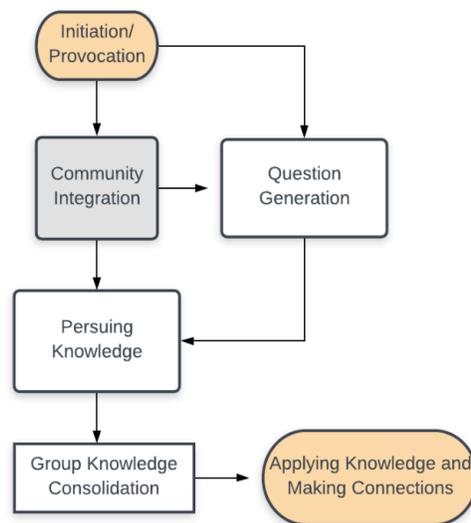
Inquiry Map

Figure 5- Inquiry Map for Inquiry 1

Overview

      When examining the current status of climate change, students are asked to look at and become familiar with current Canadian climate change policies. By allowing students to develop a connection to their sense of place and local community early on and have conversations with local government officials, this can spark both a sense of curiosity, engagement and critical thinking early on in the discussion on climate change. Comparing the current status of climate change at all levels of government allows students to formulate their own opinions on policy and where there is room for improvement.

Initiation & Provocation

Climate Change Walk

To get students thinking about climate change in the local area, taking a class outside to look for examples of climate change impacts can be an impactful starting point.

A suggested question to initiate this conversation is:

- Where do we see the effects, mitigation, or adaptation of climate change in our community?

This can allow students to begin thinking about what is happening locally, and to build a connection to the larger issues of climate change by finding purpose and significance with their local community and natural surroundings. Climate change impacts vary from region to region. Therefore, planning for and adapting to climate impacts is often undertaken from a city or municipal level. With this scale in mind, climate change inquiries should investigate local responses and focus on learning within the community by engaging directly with local experts. This ensures that learning is in alignment with the scale of jurisdictional response and helps to make climate change learning more personally relevant and meaningful to students. This can include a class trip to local government buildings, meeting the mayor or council member, Member of Parliament, or Member of Provincial Parliament, city planner, or climate change consultant, or inviting experts into class.

Resource: Activity
An additional activity that can be used as a provocation/initiation for this inquiry is one that also brings climate change awareness. More specifically through the tracking sheet provided in the link, students reflect on how their everyday actions and the community around them can impact climate change. They will look for evidence of systems or features that have been adapted for, or meant to mitigate, climate change. *Link: https://www.peelregion.ca/planning/teaching-planning/pdfs/4_My_Climate_Change_Awareness.pdf*

Question Generation & Pursuing Knowledge

Based on where students have seen the effects of climate change in their community and having the opportunity to meet and discuss with a government official, some sample questions the class could explore for this inquiry could be:

1. What role does the government have in protecting local communities from the effects of climate change?
2. How can we do more at a local level to mitigate the effects of climate change?
3. How do we spread awareness of strong policies or lack of policies in our local community?
4. How do we ensure our local community is doing its part to meet provincial, federal and global goals?

Students in small groups will look at and explore the following links:

- **Canada's action on climate change:** Carbon pricing, clean electricity, transportation, buildings, innovation, Pan-Canadian Framework.
  Link: https://www.canada.ca/en/services/environment/weather/climatechange/climate-action.html
- **Climate Change Planning:** Case Studies from Canadian Communities

  Link: https://glslcities.org/wp-content/uploads/2015/09/Climate_Change_Planning_-_Case_Studies_from_Canadian_Communities_2012.pdf

- **IPCC Special Report: Global Warming of 1.5 ºC:**
  An IPCC special report on the impacts of global warming of 1.5 °C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty.

  Link: https://www.ipcc.ch/sr15/

Using the IPCC report, Paris Climate agreement, provincial government research and information gained from speaking with local government members students can begin completing a reverse mind map to examine the current status of climate change at all levels of government. This can be completed individually or in groups, with certain members splitting up to focus on one area (e.g. federal) and then sharing their findings with the rest of the group. At the bottom of the page, students are encouraged to create a list of questions and concerns regarding how their local initiatives are meeting the federal and provincial goals set in place.

- *Link to a Reverse Mind Map: http://zoomthinking.com/reverse-mind-mapping/*

Group Knowledge Consolidation

After the *Reverse Mind Map Activity*, and knowledge building opportunity, have students participate in a "walkabout". A walkabout is where students anonymously share their work around the class, and students can spend 5-10 minutes looking at their peers' work, reflecting on their answers/concerns in comparison to others, and then come back and share any new ideas.

Following the walkabout, engage in a class discussion and create two "Top 3" lists. The first list addresses positive similarities students were able to find at all levels of government. The second list is the "Top 3" concerns students have with how the local government is doing their part to combat climate change.

Making Connections and Moving On

As a class, watch the video: *'What would a federal carbon tax mean for Canada?'* created by the Globe and Mail.

- **What would a federal carbon tax mean for Canada [1:53]**
  Link*: https://www.youtube.com/watch?v=9qefzvv-iAw*

Have a class discussion summarizing the video and answering the following questions:

- The reason for implementing a Carbon Tax
- Why was this implemented at a Federal Level?
- What implications does this have on Canadian citizens at a local level?

U-Shaped Debate

As an alternative to a traditional debate, it is important to encourage students to see that opinions are likely to change, especially when it comes to climate change. As we learn more information, listen to our peers, ask questions, and have discussions, it is okay to shift our thinking. That is why in a U-Shaped Debate, positions are oriented along a continuum. The goal is to encourage students to endorse positions provisionally while listening.

For this particular inquiry, we opted to look at using a modification of "Approach A" in the link below. After a brief Q&A after the video:

- Arrange the class in a U-shape.
- Ask students with polar views (i.e. either strongly agreeing or strongly disagreeing with if Canada should have imposed a carbon tax.)
- Ask students with mixed opinions on the carbon tax, and perhaps having it be up to each province, to position themselves at appropriate spots along the rounded part.
- Ask students at each tip of the U to state their position and offer a few reasons only.
- If there is a strong imbalance, as a teacher, position yourself on the weaker side to allow for discussion.
- Alternate from side to side, as students from all parts of the U, offer their views.
- The most important take-away is to encourage students to physically move along the spectrum. When they do move, therefore shifting their opinion on the carbon tax, ask students if they feel like sharing what caused them to change their minds.

Full access to a U-Shaped Discussion and corresponding handouts can be found here:

- **Link***: https://tc2.ca/uploads/PDFs/Ushapeddiscussion.pdf*

References

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Inquiry 2: Monitoring Change

Monitoring Change	Content Included

• Inquiry developed in collaboration with the Climate Atlas of Canada
  • Status/Trends of Current Local Area
  • Local Concerns (Developing a sense of place, experiential learning/ activities)
	• Inquiry
	• Teacher "Helper Guide" for navigating through the Climate Atlas of Canada

Take-Away Message

By using the Climate Atlas of Canada, students can examine their local area or place of significance and how climate change will impact them and why we should care about the potential changes.
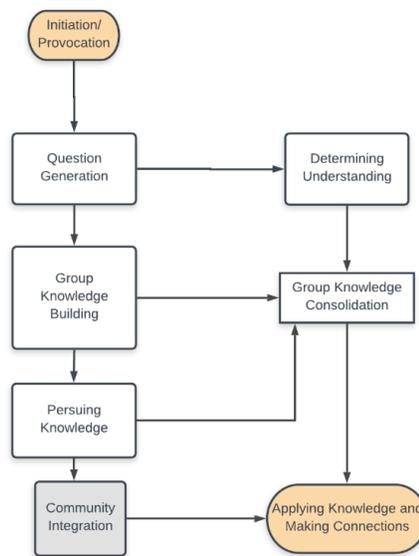
Inquiry Map

Figure 6- Inquiry Map for Inquiry 2

Teacher Background Information

In Canada, mitigation of anthropogenic climate change and global warming is being addressed more seriously than ever before. In the 2019 election, the federal leadership made climate change a top priority and pledged actions based on the best scientific evidence and advice.

Some of the key points the Liberal Government's Climate Action Plan are:
- Implement "legally binding" targets to make Canada's carbon emissions net-zero by 2050.

- Trudeau promises that a re-elected Liberal government would pay to plant two billion trees over the next decade as part of a wider $3-billion effort to use nature to combat climate change, and exceed the targets laid out under the Paris Agreement.
- Trudeau promises to help northern, remote and Indigenous communities' transition from diesel power to renewable energy sources by 2030.

(Liberal Party of Canada, 2020)

With the recent advancements in technology using GIS and satellite monitoring to track the changes in climate change, this allows scientists to ensure we are meeting the goals to keep the surface temperature below 2.0 degrees Celsius. However, this also allows scientists to narrow in and see the current and projected trends in specific areas, and how these will affect our day-to-day lives.

It is important to note that while there have been goals set by the current Liberal government, this does not mean Canada will meet its weak 2030 target for GHG emission reductions and does not put Canada on track to meet its Paris Agreement commitment. The current target is 30% below 2005 emissions by 2030 (Liberal Party of Canada, 2020); this is far from the path we need to be on.

Canada emits approximately 1.6% of global GHGs (Government of Canada, 2020). Looking at the total 330 Gt which is the global "carbon budget" – the total allowable GHG emissions to give a 66% chance of keeping average warming to 1.5 degrees Celsius (Mercator Research Institute, n.d.?), Canada's "current shares" part of the budget is 5.3 Gt. However, if we only have approximately 0.5% of the population, our "equal shares" part of the budget should only be 1.65 Gt. Making things worse, we are responsible for much more than our share of cumulative GHG emissions, so it could be argued that we should have an even smaller budget than "equal shares" based on our population.

With Canada's current emissions about 716 Mt/ year (Government of Canada, 2019), a straight-line decline to net-zero emissions over 30 years (2020 to 2050) would be 10.6 Gt emitted (1/2b x h: 15 x 716). This is double our "current shares" carbon budget and 6.5 times the "equal shares" budget. According to the Auditor General, if we do everything in the *PanCanadian Framework on Climate Change*, and in a timely fashion, we will still miss the 511 Mt target for 2030 by 66 Mt, hitting perhaps 577 Mt (Climate Change Canada, 2019). This is far above the straight-line decline used in the previous math, making the calculation above even worse. These few calculations emphasize that Canada needs to be much more aggressive in pursuing GHG reductions to do our part as a country on a global scale.

Resource: Video
Climate Modelling **[3:21]** For a further explanation on how climate modelling can help us when looking at climate change, the Climate Atlas of Canada (2019) breaks down the different parts of a model and explains how her work can help us understand and prepare for the future. ***Link: https://climateatlas.ca/video/modelling-climate***

Overview

Within this inquiry, students will become familiar with the Climate Atlas of Canada. Up until recently, it has been difficult to find student-friendly websites and modelling tools to show the effects of climate change across all categories (rainfall, temperature, growing season, etc.) over time. By allowing students to focus locally and continuing to foster that connection, they can bring the issue of climate change closer to home before looking into specific effects in the upcoming inquiries. For some people, it is when they see the statistics or numbers to support certain claims that they see the reality of an issue.

With the Climate Atlas allowing students to look at "More or Less" Climate Change (more or fewer carbon emissions), they can see the results with both a visual on the map or by data, making the issue more real than ever before. After using the Climate Atlas Map and recording the climate variables and discussing their findings, in groups students are asked to graph the top variables to be put on display for the school to share the impacts in an engaging way. To finish the inquiry and to continue moving forward in partnership with the community, a class trip to a local conservation area is encouraged to allow students to:

1) see how local groups are monitoring the effects and trends of climate change
2) seeing their concerns with the patterns they have noticed and
3) have an opportunity to use some of the sampling apparatus themselves and contribute to data collection initiatives

Initiation/ Provocation

There are countless benefits of being able to monitor and project the changes climate change will cause, but why should students care, and how does it affect them? To begin this inquiry, show the students the following video discussing the impacts climate change has on farming and how using climate modelling plays a role.

The video looks at Roy McLaren, an experienced farmer who has had a lifetime of farming in southwest Manitoba for over 70 years. He looks at the Climate Atlas maps of climate projections with concern as he sees the changes will alter the way he farms entirely.

- ***Video Link:*** *https://climateatlas.ca/video/roy-mclaren*

This video should give students the opportunity to begin connecting how climate monitoring cannot only provide useful information about local climate trends and predictions but how we can use that information to our benefit, and see the extreme effects if we do not act now and alter energy systems and food production" than making it sound like we need to make individual lifestyle choices.

Question Generation

Based on the discussion and response to the initiation/ provocation activity, the questions to prompt the overall question can include:

- Why should we rely so heavily on climate modelling?
- How can climate modelling help us at a local level?
- Can we trust climate monitoring tools and climate modelling? How?

Determining Understanding & Group Knowledge Building

To determine the understanding of the importance of climate modelling, based off of the video in the initiation/provocation, create a class mind map with "Climate Modelling" in the middle, and all the ways it can help us at all scales (locally, provincially, globally). Many students will not have a background in climate modelling and therefore, this will be ongoing throughout the inquiry where students are encouraged to add to the mind map as new information is learned.

Resource: Video

How scientists predict the future **[9:12]**

In this video, students can learn more about the support and science behind climate modelling. It explains in detail the history behind how we have changed the way we track the earth's climate over time and why we should trust it. We can ask students if they can think of any examples where this could potentially happen or has already happened in their local area. Why should we care what happens to farmers in the prairies? How does this impact us?

Link: https://www.youtube.com/watch?v=i9EyFghIt5o

Pursuing Knowledge

With the Climate Atlas, students have the opportunity to simply explore. They can begin looking at the variables of temperature (hot weather days, cold weather days), precipitation, and growing season. The guidebook provided includes many other detailed variables such as frost days or tropical nights. As mentioned, we often need the science and numbers to back a claim, and while most scientists agree climate change is caused by anthropogenic measures, this tool validates that by showing the impact carbon has on all of these climate variables.

Students are also able to focus on their specific area, whether it be where the school is located, where they grew up, or somewhere they want to live one day. What students will recognize immediately is that the effects of climate change are not the same across the country or even across one province. As a teacher, we can ask students: *Do the findings from the Climate Atlas make you think about where you want to live one day? Are you surprised which areas are more greatly impacted? Why or why not?*

Group Knowledge Consolidation & Applying Knowledge & Skills

After using the Climate Atlas Map and recording the climate variables and discussing, allow students to turn to a partner and "Think, Pair, Share" and then "Think, Pair, Square". Allow students to spend a few minutes thinking on their own, then share their thoughts on the below questions with a partner, and lastly to share their thoughts with another pair (creating a group of 4).

1. What surprised you most through the Climate Atlas Investigation?
2. What questions do you still have?
3. What concerns you most about where our school community is?
4. Why is climate monitoring so important?

In small groups, to share their findings with the rest of the school communities, there is an opportunity for an infographic activity. Students will break up into smaller groups and graph some of the key variables. The graph would be simple so that they can be put around the school hallways to spread awareness. The graph should include all three time periods and the results when "more" or "less" climate change is present, and therefore more or less carbon emissions. With the handout provided, students are asked to explain "why they should care" or "significance of the result". This is something brief, that can be included on the poster to further spark a conversation for students or staff walking by.

Making Connections, Moving on Beyond School Community Integration

To finish the inquiry and to continue moving forward in partnership with the community, a class trip to a local conservation area can continue that recent engagement with students' sense of place. Depending on the conversation areas near the school community and the educational opportunities they provide, students are able to explore the techniques and monitoring practices done to ensure their community is adapting to the effects of, and mitigating, climate change.

A hands-on opportunity would be to have students participate in some of the sampling practices themselves, to further understand the time and precision involved in keeping track of local changes. Lastly, this is a way to create a bridge between future careers and jobs within the field of climate change and environmental conservation.

Resource: Video
How to feed the world in 2050 [6:01] To put the importance of climate modelling with respect to agriculture, one of Canada's largest industries, this video highlights that to achieve food security in a changing climate the global community must operate within three limits: the quantity of food that can be produced under a given climate, the quantity needed by a growing and changing population, and the effect of food production on the climate. Climate modelling is an asset in helping learn where we should be growing our crops, what farming practices are most effective, and which crops are best suited for the climate changes that are to come. As a class, discuss how you can potentially inform local farmers about the climate atlas of Canada and bringing awareness or starting a conversation on the future of farming. *Link: http://www.resources4rethinking.ca/en/resource/how-to-feed-the-world-in-2050*

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Inquiry 3: Environmental Impacts

Environmental Impacts	

Topics Covered:
 	
• Identifying Risks, including droughts, storms, floods, fires, mudslides, habitat loss, species at risk in Canada
    • Identifying mitigation and adaptation strategies (Federal, Provincial, Municipal)
    • Indigenous Perspective on the Environment
	• Teacher Background Information
	• Inquiry Activity
	• Tool: "Case Study"
	• Relevant Teaching Artifacts

Take-Away Message

        Examining the effects climate change has on the environment and the risks climate impacts pose on both human and non-human living organisms.

Overview

        When we think of the effects of climate change, we often think of environmental impacts. These impacts can and will affect weather and climate patterns which in turn affect all living organisms. Using a children's book helps spark a sense of comfort and emotional connection to how the changes due to climate change affect things greater than ourselves. By using the jigsaw format students are able to break into groups and research the various aspects of the environmental impacts caused by climate change. By allowing students to create posters representing certain endangered species or environmental risks, their work and research have a sense of purpose in strengthening their emotional connection to their local area. To bring an Indigenous perspective to this inquiry guide, this theme also offers the opportunity to explore how climate change has impacted Canada's northern communities and allows for activities that celebrate traditional Indigenous teaching practices.

Teacher Background Information

        In Canada, temperatures have already increased by 1.7 degrees Celsius since 1948, Canada is experiencing a <u>higher rate of warming</u> than most other regions of the world, particularly in its far-north and west (Climate Change Canada, 2019). The effects can cause:

- **Permafrost and ice melt in the Arctic:** Sea ice is bright and reflective: <u>80 percent</u> of the sunlight that hits it is reflected back into space. But when it melts, the dark ocean surface is exposed – and absorbs as much as 90 percent of the sunlight that strikes it (see figure below). A dangerous feedback loop (Climate Change Canada, 2019).
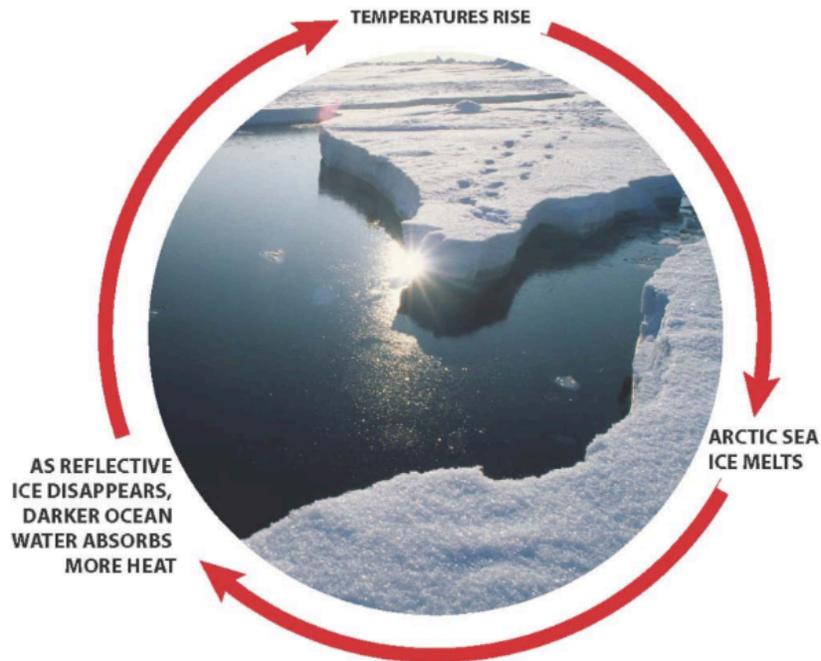
Figure 7-Climate Feedback Loop National Academies of Sciences, Engineering, and Medicine (2019)

- **Sea-level rise:** Driven by melting land ice and seawater warming and expanding, global sea levels could rise by a meter or more by the end of the century. This creates a problem for the 8 of 10 provinces that border a large body of water and the potential contamination of freshwater by the ocean flooding (Climate Change Canada, 2019).
- **Extreme Weather:** Canada is experiencing more frequent and severe extreme weather, such as once-uncommon heat extremes and major changes in precipitation: In Canada's west, wildfires rage stronger and harsher than ever before. Droughts and floods occur with increasing frequency and produce greater devastation for families and farmers whose homes, businesses and species are harmed (Climate Change Canada, 2019).

Indigenous Perspectives

Indigenous and Northern Affairs Canada (2019) outlines the challenges many northern communities face in relation to climate change. These include negative impacts on health, addressing the high and often fluctuating costs of energy, and promoting sustainable development that balances consideration of environmental, social and economic well-being.

Since climate change is affecting northern Canada at a faster rate than anywhere else in the country, these Indigenous and northern communities in Canada are particularly vulnerable (Brake, 2018) and not prepared for the changes that are unfortunately unavoidable and only able to be adapted to right now in respect to infrastructure, accessibility to basic living necessities, and transit.
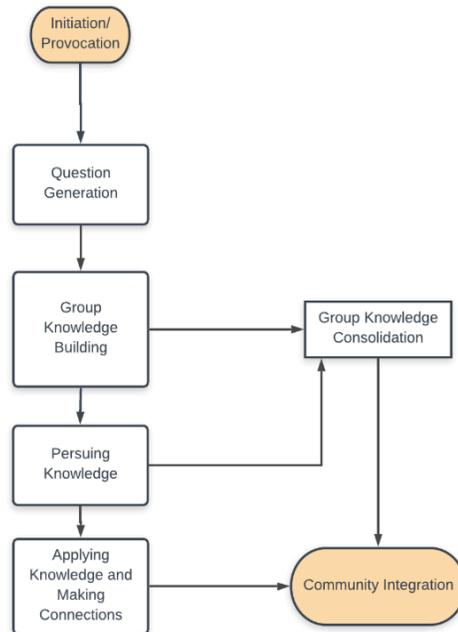
Inquiry Map

Figure 8- Inquiry Map for Inquiry 3

Initiation/ Provocation

Option 1: When we think of how to incorporate children's books into the classroom, we rarely think about using them with high school students. However, using children's books to spark a sense of comfort and calmness especially when talking about topics that can bring a lot of anxiety and stress can be beneficial. *Winston of Churchill* is a book that talks about a polar bear's journey in trying to save the place he calls home, spreading awareness, but most importantly recognizes that to instill change you have to take action yourself first. This allows students to simply listen, reflect and question who and what is affected by climate change, how it impacts them, and the role they play in the mitigation and adaptation process.

When we think of climate change, our mind often goes to polar bears as the only animals suffering alongside other arctic animals. While it is true, as explained in the book, they are seeing the impacts of climate change much more rapidly than most of Canada, we want to dial into what animals are being impacted in our local communities and how that impacts humans.

- We can ask students to think about how the effects of climate change in northern Canada impact your specific local community.

Resource: Video
Biodiversity and Climate Change [11:06] The video explores the chain of cause and effect that links climate change to a loss of biodiversity and concludes with an outline of possible responses aimed at mitigating this effect. The link between cause (climate change) and effect (loss of biodiversity) is explained through examples from various geographical regions that we can relate to in Canada. We can ask students if any other particular examples come to mind from their experiences and what aspect of biodiversity they believe is being most affected in their local area. ***Link: http://resources4rethinking.ca/en/resource/-biodiversity-and-climate-change***

Option 2:

To get students to consider Indigenous perspectives on climate change and relationships with nature. The four perspectives chosen to focus on are:

1. **First Nations and Métis Ways of Being:** *We respect and honour our Mother Earth. We give thanks for the gifts she gives us. We take only what we need and will use (Stuart Prosper).*
2. **Ecologist:** We must respect nature. We must leave an area as good as, or better than, when we found it.
3. **Utilitarian:** As human beings, everything placed on the Earth is ours to use as we wish, and for any purpose that we wish. We do not need to apologize or to answer to anyone.
4. **Conservationist:** It is important for us to know what the world looked like before we used it as we wanted to. We will develop certain areas that are untouched so that those who come after us can see what it used to look like. As long as we do this, we can use other parts.

Allow students to read through and discuss the four definitions. Which perspective do students most identify with? Why? Is it possible to identify with more than one?

Modified from:
http://resources4rethinking.ca/media/Cultural%20Perspectives%20on%20Sustainability.pdf

Question Generation

We can begin to ask students to think and reflect on who and what is affected by climate change with respect to more than human entities. We can also think about what natural disasters have been caused by climate change and who they impact other than ourselves.
Some sample questions are:

- What is the biggest environmental impact in our area?

- Which species are most at risk in our area and why? What is the main cause of this?
- What adaptation/mitigation strategies are we using to combat specific areas at most high-risk of environmental impact, for example, flooding or droughts.
- How are we all connected? How do the environmental impacts across the country affect us in our location?

Group Knowledge Building

Using an active discussion, allow students to discuss where they see the biggest environmental impacts either in their area or in the news.

- When do we think about the media, who/ and what are they often showing when looking at the environmental impacts of climate change? Does the media explicitly address the cause of the flooding, forest fires, the extinction of a species indirectly or directly related to climate change? Why or why not?
- For example, why would the media not want to potentially emphasize the latest forest fire in Alberta is related to climate change? What risks would be involved for them?

As always, students are encouraged to record any observations or questions during active discussions in their journals or records of their learning. Alternatively, to give students the opportunity to research and learn more about how the Indigenous communities are being impacted by climate change, allow them to embark on an investigation. In groups, students will create a mind map, with the center bubble being the question the class came up with. Students are encouraged to create rough notes separating their findings and data, and when creating the final mind map, grouping themes together as best as possible.

The links below will allow students to get started:

- **Indigenous and Northern Affairs Canada:** https://www.aadnc-aandc.gc.ca/eng/1100100034249/1100100034253

- **Canadian Geographic Article:** "It's time to listen to the Inuit on climate change": https://www.canadiangeographic.ca/article/its-time-listen-inuit-climate-change

- **Connected North Article:** "Indigenous Perspectives on Climate Change": http://www.climateaction150.ca/CA150ConnectedNorthFollowUpResources.pdf

- **Nunavut Climate Change Center:** https://www.climatechangenunavut.ca/en/understanding-climate-change/climate-change-impact

- **Aboriginal Peoples Television Network Article:** "'Literally life and death': Indigenous climate leaders critical of Canada's response to climate change report": https://aptnnews.ca/2018/10/17/literally-life-and-death-indigenous-climate-leaders-critical-of-canadas-response-to-climate-change-report/

Resource: Video
Inuit Observations on Climate Change [13:44] This video can be shown at the beginning of the knowledge building to highlight the impact of climate change from an Inuit perspective. The residents of Sachs Harbour on Banks Island in Canada's High Arctic, have experienced the effects of climate change to their everyday way of life. The video examines the effects on wildlife, how sea ice thinning impacts food security, infrastructure struggles and transportation. ***Link: http://resources4rethinking.ca/en/resource/-5***

Pursuing Knowledge

Students will partake in a jigsaw so in groups, they are able to investigate the various environmental impacts climate change brings. These range from the hazards and risks they pose, loss of habitat and species, air and water quality. For the jigsaw, students will break into groups investigating each impact. These impacts can include but are not limited to: effects on non-human living organisms, effects on temperature, effects on precipitation, effects on agriculture, and effects on water levels. After students complete the breakout sessions, they will come together and discuss with their peers.

Resource: Activity
Moving Oil The oil industry played an important role in Canada providing jobs and energy but must now be rapidly phased out to meet Canada's Paris Agreement commitments and to give us a chance at maintaining a livable climate. However, when it comes to its transport, there can be effects on the environment which in the long-term can impact climate change. In this activity or case study, students research a variety of information links and documents provided with the resource. Throughout the activity, is important to link it back to climate change by prompting students with questions such as: • Should Canada allow new oil and gas pipelines? ***Link: http://www.resources4rethinking.ca/en/resource/moving-oil-case-study***

Group Knowledge Consolidation

Option 1: Students will have the opportunity to give "mini-presentations' to the rest of the class to present their findings from the jigsaw activity. This presentation is a maximum of 5 minutes with an opportunity for questions at the end. What lingering questions do we have after the presentations? As a class, what was the most surprising and why? Did we find the answer to our inquiry question? What further questions do we have?

Option 2: To allow for knowledge consolidation in a traditional Indigenous format, use a Talking Circle to debrief the findings from the investigation and discuss the focus question. This

is an opportunity to work with Indigenous colleagues or community members to facilitate this activity.

Key points:

- In a talking circle, only one person speaks at a time. A stone or other object is passed from speaker to speaker. Silence is an acceptable response. Conclude by thanking students for their input.
- Ask students to discuss each area of their theme in relation to how climate change is viewed by specific Indigenous people or groups and how it is affecting them.
- Ask students to consider what needs to be done in order to support these communities.
- Using an exit card, ask students to answer the following: We can integrate the Indigenous perspective in climate change stewardship by...

Modified from:
http://resources4rethinking.ca/media/Cultural%20Perspectives%20on%20Sustainability.pdf
For further information on talking circles:
http://www.saskschools.ca/curr_content/aboriginal_res/

Applying Knowledge & Skills & Making Connections, Moving on Beyond School & Community Integration

Students will apply their knowledge learned through the jigsaw activity and focus on local species (flora and fauna) that are endangered or at risk. Additionally, the environmental risk factors that are most likely to occur in the area or region that surrounds their school community. Students will then create an online poster or infographic that promotes awareness and information on these species that includes image, location (provide a map), availability of habitat, population size, risk factors, genetic characteristics that help with survival, etc.

Students are encouraged to pick species within their region but are welcome to pick any endangered species in their province. The goal is to pick some of the posters selected by their peers, to be given to the conservation area to be used around the grounds or on social media accounts.

Tool: Case Study
Northern Species Using the article provided below, allow students to read and learn more about the Atlantic walrus and eastern migratory caribou, both of which have had "significant changes" in their populations. While hunting plays a role in the population decline, destruction of habitat is tied with climate change. From the Committee on the Status of Endangered Wildlife in Canada: "Climate change presents sort of a moving target. It's hard to know what the extent will be and how that might impact our recovery actions right now" (Riva, 2017). After students have the opportunity to read the article individually, we can give students more time to research additional information or articles related to each of the species. *Link: https://www.cbc.ca/news/technology/cosewic-climate-change-at-risk-species-1.4107238*

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Inquiry 4: Human Health Impacts

Human Health Impacts	

Topics Covered:
• Identifying health risks, including illnesses related to extreme
  cold and heat events, vector-borne diseases, social and mental
  stress
• Identifying mitigation and adaptation strategies
	• Teacher Background Information
	• Inquiry Activity
	• Relevant Teaching Artifacts

Take-Away Message

> *While climate change poses a risk to our body's physical health, the underlying mental health and psychological effects of climate change can go unnoticed and ignored. Until we address the doom and gloom of climate change, we cannot truly motivate our students to use that as fuel for positive change.*

Teacher Background Information

Physical Health: Governments, industries, communities and individuals are working to reduce greenhouse emissions, though not nearly fast enough. At the same time, there are a variety of actions which can be taken to help minimize the risks to health.
Some of the physical health risks climate change brings are:
- Temperature-related morbidity and mortality
- Illness related to extreme cold and heat events
- Respiratory and cardiovascular illnesses due to air quality
- Increased exposure to outdoor and indoor air pollutants and allergens
- Water- and food-borne contamination
- Intestinal disorders and illnesses caused by chemicals and biological contaminants
- Vector-Borne diseases

(Health Canada, 2019)

In December 2007, the Government committed to helping Canadians adapt to the challenges of a changing climate and its impacts. Several initiatives are underway, which will contribute to reducing health risks. They include:

- improved climate change scenarios
- regional adaptation work programs
- assessment of key vulnerabilities in Northern/Inuit communities
- climate and infectious health alert and response systems
- climate change and health adaptation in Northern/Inuit communities

(Health Canada, 2019)

Building on the research and findings of the Natural Resources Canada evaluation, Health Canada's has issued assessment reports on the scope and magnitude of the current and potential health impacts of climate change in Canada related to air quality, infectious disease and natural hazards.

Mental Health: Often, when climate change is brought up, it is in a negative manner. This dampens our mental health and changes the way we view the environment, and almost takes away all those connections and positive experiences from when we were children. For future generations, hearing what is to come if we don't combat climate change can cause extreme depression, and the worst part is, there is rarely an outlet (Kelsey & O'Brien, 2011).
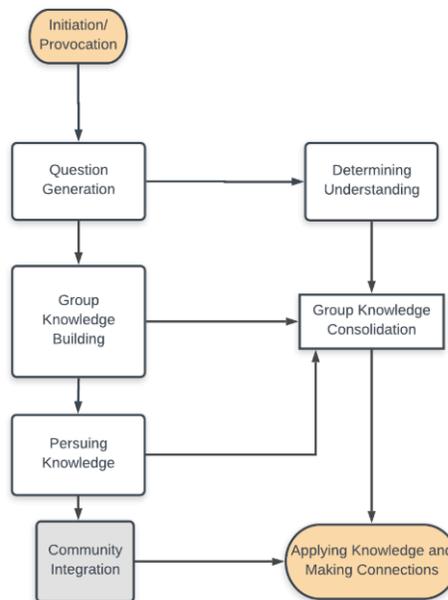
Inquiry Map

Figure 9- Inquiry Map for Inquiry 4

Overview

In this inquiry, students will have the opportunity to reflect individually and as a group on the mental health struggles that can go alongside with coming to understand the risk and uncertainty of climate change impacts. Students will discuss as a group, and then discover the challenges, concerns, and worries of this generation; they will then interview their peers in various grades. After sorting the data, students will have the opportunity to reconvene as a class and interpret their findings.

Using a comic is an effective way to give some humour, while also engaging in some critical thinking on sometimes sensitive topics like climate change. Using a comic pertaining to the health-related impacts of climate change, allow students a few minutes to enter the class and reflect individually on the meaning of the comic with the question being, "What concerns do we have on the health impacts of climate change?"

Resource: Video
How Climate Change Can Impact Your Health [6:01] Another option for an initiation/ provocation is a video published by CBC discussing the risks of diseases that Canada as a country has never had to deal with before. Examples include: 1) the higher risk of Lyme disease as the increase in temperature allows ticks to travel to never areas for longer periods of time 2) Air quality in Alberta after the forest fires worse than Beijing. The video also emphasizes a key term "Eco-Anxiety", which is a condition one has after living through a natural disaster. This can spark a class discussion if students can relate to this term either personally through experience, or someone they know who has lived through a natural disaster. ***Link: https://www.youtube.com/watch?v=PzM9vH0K980***

Question Generation

There are both physical and mental health implications that are important to address and when it comes to climate change. Through the video resources included, it is evident doctors and scientists are taking the right steps to try to combat these climate change-induced diseases as quickly as possible. However, what is not being addressed is the mental health effects of climate change. Therefore, the main focus of this inquiry is on mental health aspects, and as a teacher, the goal should be to facilitate the question generation process in that direction if possible.

If you are using this inquiry in a school community where the physical health impacts of climate change are dominant, such as the effects of forest fires on the body, then the inquiry may have a stronger impact focusing on what is happening directly in your community.
Some of the sample questions could include:

- How can we alleviate the stress/anxiety climate change causes?
- What happens if we do not deal with negative emotions from climate change?
- When and how do we start talking about climate change?

Determining Understanding

If our students are always working in groups, and feeding off of others' ideas, they may never develop their own sense of understanding, thoughts and opinions. While group work helps us build on what we know and challenges us, we also need personal reflection time to consider our own perspectives and thoughts. When talking about the negative mental health effects of climate change, allow students to first spend time journaling and what it means or how it has affected them. Then, using a "snowball" ask students what they think others in their generation is worried or concerned about most when it comes to climate change.

- *Snowball Technique – A Teaching Strategy:* https://bookunitsteacher.com/wp/?p=5826

Pursuing Knowledge

Students will go around to classes ranging from various subjects and grade levels asking the focus question chosen along the lines of "why does climate change cause so much stress and anxiety?" To record the thinking process and to keep anonymity, each student during the class visit will receive three sticky notes. These sticky notes will be used for students to write down their thoughts on "why does climate change cause so much stress and anxiety?" Students will be invited to place their sticky notes on the board or hand them in (once again to keep anonymity) to allow for a   discussion. Briefly, students from your class will share some of the trends and commonalities that stand out, before 1) taking a picture of the board and 2) collecting the notes and moving onto the next classroom. Students are encouraged to create themes that may emerge.

Some of these themes could be:
- Food insecurity
- Cost of living
- The future of their children/ grandchildren
- Species loss
- Risk of natural disasters

Who better to ask about the mental health concerns of climate change to find answers than those whose future it impacts directly?

Resource: Activity
Vector-Borne Diseases and Climate Change Students learn about vectors and the spread of infectious diseases. Students will develop hypotheses about how climate change may affect vectors, the pathogens they carry, and the diseases they spread. They perform an experiment to model the transmission of vector-borne diseases and discuss how climate change may impact the spread of such diseases. Where in Canada; is it on the news; how do we stop it; how can we spread awareness? **Link:** *http://resources4rethinking.ca/en/resource/whats-all-the-buzz-about*

Group Knowledge Consolidation

To consolidate the findings from our school-wide questionnaire, as a class record and group the results in a way that can be shared and accessed by all students. What themes emerge when we look at responses? What are the most significant themes? What could help other students relieve some of their stress and anxiety about climate change? How can we use these results? In a round table format, allow for open-ended discussion and facilitation to share what stood out most to students, especially looking at grade level.

Applying Knowledge & Skills

After analyzing and interpreting the data, give students the opportunity to go back and share the results with their peers. A follow-up activity could be using the same "sticky note" approach, asking students "think about your favourite memory with nature / the environment". Use these results to create a collage or mural for the school as motivation and positive encouragement when there is so much negativity surrounding climate change. This is a friendly reminder for the school community why we want to get involved, and combat climate change— to recreate these special and significant moments and interactions with our environment.

Community Integration, Making Connections & Moving on Beyond School

A way to get involved with the school community is to invite experts from the community to give talks and share their positive work with climate change. They can vary from all disciplines allowing for many classes to participate in these "expert talks". These "experts" can vary from university/ college professors, active community members, conversation/ park employees, NGO members to waste solution workers and indigenous community members.

Resource: Guest Speaker

Climate Reality Project Canada

"The Climate Reality Project Canada is a charity organization that serves as the Canadian component of a global movement of more than 19,000 diverse and dedicated volunteers from 152 countries around the world. These volunteers have been personally trained by former US Vice President and Nobel Laureate Al Gore to educate the public about the science and impacts of climate change as well as solutions to address the climate crisis." (Climate Reality Canada, 2019)

The Climate Reality Project Canada offers presentations to suit the needs of different groups and audiences. The meetings are from 30 minutes to 2 hours long with a 10-15-minute question period. This is a great opportunity to connect with individuals passionate about climate change in various fields all with one common goal to bring awareness and community engagement.

Link: https://www.climatereality.ca/what-we-do

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*See Guest Speaker Handout in Appendix

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Appendix for Theme 5

This handout is being included with this particular inquiry but can be used for any guest
speaker or school trip to keep students on track and record their thinking during the visit.

- Before the speaker comes in, take some time to give students some background
  information on the speaker and have students ask any questions/ concerns.
- As a class, fill out the "purpose of visit" box to allow both the students and teacher to be
  on the same page for what We fill out the purpose of the visit box together so they know
  what the goals and main takeaways of choosing this particular guest are.
- Encourage students to ask questions and try to come up with at least one question to ask
  the speaker (more are encouraged) and perhaps questions or topics they want to discuss
  post-visit.

Guest Speaker Notes

GUEST SPEAKER:

SPEAKER'S
BACKGROUND/
POSITION:

STUDENT'S NAME:
DATE:

PURPOSE OF VISIT

INTERSTING INFORMATION/ CONNECTION TO CLIMATE CHANGE

QUESTIONS

ANSWERS

Inquiry 5: Economic Dimensions

Economic Dimensions	

Renewable vs. Non-Renewable Energy
    •   Activity - systems analysis of costs over time
    •   Cost of Natural Disasters
    •   Insurance (Personal & Municipalities)
    •   Insurance premiums
    •   Insurance Bureau of Canada
	• Teacher Background Information
	• Inquiry Activity
	• Tool: "Case Study"
	• Relevant Teaching Artifacts

Take-Away Message

How are we as citizens paying the price for the effects of climate change?

Teacher Background Information

What is Carbon Pricing? There are many ways to fight climate change, including renewable energy, fuel efficiency, better building methods, and recycling. Carbon pricing, a method favoured by many economists for reducing greenhouse gas emissions (World Bank, 2020), charges those who emit carbon dioxide for these emissions. The polluters can decide for themselves whether to discontinue their polluting activity and reduce emissions or continue polluting and pay for it. Often, those who get hit the hardest are large scale companies and non-renewable energy companies.

What are the costs related to climate impacts and impacts on insurance rates? Blair Factors such as extreme weather events and the damages they cause, together contribute to an increase in insurance premiums, which over the course of the last five years are up about 20 to 25 percent he said, noting 15 percent of it is explained by water and flooding (Kirkup, 2019).

To put the costs related to climate change into perspective, we can examine two cities in Canada who are being affected in powerful yet different ways:
- Halifax, NS: Extreme winds and storm surge flooding
- Mississauga, ON: Ice storms and stormwater flooding

*For each weather event, the researchers (Insurance Bureau of Canada, 2015) *calculated what the economic costs to the city could be as a result of these weather events five years out (in 2020) and 25 years out (in 2040).*

Halifax by 2040:
The annual loss expectancy from extreme wind events could be about $18 million. A moderate increase in the rate of climate change could increase this amount to $20 million.
One extreme wind event (calculated as a 1-in-25-year event) could cost an estimated $123 million to $126 million.

Mississauga by 2040:
The annual loss expectancy from ice storms could be about $9 million. A moderate increase in the rate of climate change could increase this amount to about $12 million per year.
One severe ice storm (calculated as a 1-in-25-year event) could cost an estimated $23 million to $38 million.
(Insurance Bureau of Canada, 2015)

| **Resource:** *Additional Information* |
| --- |
| *Insurance Bureau of Canada*

"Established in 1964, **Insurance Bureau of Canada** (IBC) is the national industry association representing **Canada's** private home, auto and business insurers. Its member companies represent 90% of the **Canadian** property and casualty (P&C) **insurance** market" (Insurance Bureau of Canada, 2019).

A recent report from the Parliamentary Budget Officer emphasized the costs related to natural disasters linked to climate change, and those costs are much higher than ever projected. This is why IBC continues to call for a collaborative national climate change and specific flood program that will provide a framework for the financial management of flood risk, with shared responsibilities between the insurance industry, all tiers of government and consumers (Insurance Bureau of Canada, 2019).

The IBC commends the Canadian government's 2016 commitment to building climate-resilient communities in Canada. This is highlighted by the investment in helping grow Canada's clean economy while helping communities prepare for severe weather events. A recent example is the funding for the Province of Manitoba project to regulate lake levels and provide flood protection to individuals, businesses and communities around Lake Manitoba and Lake St. Martin (Insurance Bureau of Canada, 2019).

Link: http://www.ibc.ca/on/ |
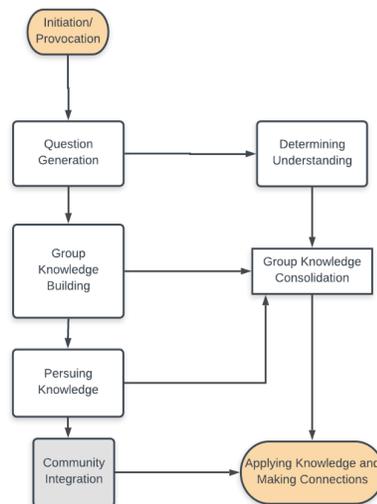
Inquiry Map

Figure 10- Inquiry Map for Inquiry 5

Overview

In this inquiry, students engage in two investigation activities: 1) examining how natural disasters are caused by climate change and pose an economic threat; and, 2) using local flood maps to determine the economic effects of climate change-related events. Working with community partners, students can draw upon their expertise and access local and relevant information on costs involved with climate change-related natural disasters. By connecting the flood map activity to local community partners, students can begin comparing and contrasting the costs and strategies involved in climate change mitigation and adaptation.

Resources: Articles

To give some background into the economics behind climate change-induced natural disasters, below are three sample articles that discuss the costs involved when they occur. These can be used for students to gain knowledge, or as a core material in the activities outlined later in the inquiry.

Climate Change and Wildfires- *Climate change is making wildfires in Canada bigger, hotter and more dangerous*

"These new fires are also costing more than fires used to cost. The Slave Lake fire cost insurance companies an estimated $700 million. The 2016 fire that burned much of Fort McMurray, an estimated $9 billion."

Link: *https://www.macleans.ca/news/canada/climate-change-is-making-wildfires-in-canada-hotter-and-more-dangerous/*

Climate Change and Flooding: Article #1 – *Climate change and poor planning are fuelling more floods. Here's what we can do about it*

"In High River, Alta., the provincial government bought homes that were damaged in the 2013 floods and built $100 million worth of berms, floodgates and dikes to protect against any further flooding.

"Man swept away by Red River clings to log until rescuers pull him to safety Kashechewan First Nation goes to Ontario legislature for action on annual flooding but solving the problem is not as simple as buying out homeowners, Harford said."
While some larger municipalities may be able to offer incentives or the opportunity to buy back land, that may not be so for smaller communities, she said."

Link: *https://www.cbc.ca/news/technology/climate-change-floods-1.5115447*

Climate Change and Flooding: Article #2 – *'100-year floods' are increasing in Canada due to climate change, officials say — is this true?*

"A 2017 report by the Munk School of Global Affairs found that flooding is now more costly than fire or theft for property owners. Almost two million households in Canada are at "very high risk" of flooding. Federal disaster relief has almost doubled over the last few years and it's projected to rise to as much as $650 million annually.

On Friday, Public Safety Minister Ralph Goodale said climate change means annual flooding that damages homes is not going away and it is only going to get worse."

Link: *https://globalnews.ca/news/5206116/100-year-floods-canada-increasing/*

Initiation/ Provocation

For this inquiry, we ask students the simple question, have you or someone you know been affected by a climate change-related disaster? This allows students to begin thinking and reflecting on how climate change has a financial impact on our individual lives.

*If your community has recently been severely affected by a natural disaster then use your professional judgement on student readiness to engage in this topic.

Question Generation

The question for this inquiry should revolve around how the economics of climate change can affect an everyday citizen and how the government accesses its funding for large scale disasters.

For example:

1. How do taxpayers end up paying for the repercussions of climate change natural disasters?
2. How do insurance companies support communities that have been affected by natural disasters related to climate change? What role do they play? What gaps leave people vulnerable?

Making Connections, Moving on Beyond School & Community Integration

A way to connect the flood map action plan or natural disaster action plan of the class' choosing is connecting with local community partners and comparing and contrasting the costs and strategies put in place to mitigate and adapt to the challenge's communities face in these situations. By doing this, students are able to find more recent and up to date information on the costs, people, and long-term effects involved with natural disasters caused by climate change. This also brings awareness to the people involved, as it goes beyond emergency response teams. This can include environmental organizations to access the impacts of more-than-human living organisms, healthcare specialists, community members volunteering their time for clean-up, and local businesses offering financial support to those affected.

Group Knowledge Building

In small groups, students will have the opportunity to examine recent climate change-related natural disasters in Canada and the costs they come with. Often in the media, we see the effects on the environment, the people involved, but never the costs related to it and the insurance companies' roles and where they access money from.

Pursuing Knowledge & Applying Knowledge & Skills

Using provincial flood maps like the one below:
- **Link:** *https://www.ontario.ca/law-and-safety/flood-forecasting-and-warning-program*

Allow students to go through the activity lab (see Flood Calculation Lab in Teaching Artifacts) for: 1) analyzing the flood risks in the school community; and, 2) how the Insurance Bureau of Canada (IBC) is involved.

*See Student Handouts in Appendix

Group Knowledge Consolidation

Moving forward, we need to ask our students how we can become more aware of the impact's climate change has on our finances. This can involve follow up research with the local government to where local taxes are going, mitigation and adaptation strategies the closest city has in place, and how we can spread the word. There are two follow-up activities that could be beneficial when examining the economic impacts associated with climate change.

1. *The first could involve going to a council meeting with your class and listening in on when adaptation and mitigation conversations are in place and consulting with insurance companies on new builds in high-risk areas due to climate change.*
2. *Investigating whether there is a climate adaptation planner employed in your municipality and if there is, ask them to visit your class and describe any projects they are currently working on.*

An example of projects that focus on the city's economic growth and development while keeping the best interest of its citizens is one developed in 2017 by the city of Barrie, ON. The purpose of the Climate Change Adaptation Strategy the city of Barrie created is to mainstream adaptation actions into City operations and to reduce the risk Climate Change poses to Barrie's physical, economic, social and ecological systems.

> "Economic losses from extreme weather events, changes to the production, price, and demand for goods and services, as well as impacts to several economic sectors, such as energy, tourism, recreation, freshwater fisheries, and transportation, are all likely to occur within the short and medium-term. Residents and citizens will also be affected as insurance premiums rise and damage to properties and homes is likely to increase as a result of extreme weather events. Local businesses could experience operational losses, business continuity issues, and disruptions to essential services (e.g. power, telecommunications) which are relied upon to deliver products and services to the local community." (City of Barrie, 2017)

- *Link: https://www.barrie.ca/Living/Environment/Conservation/Pages/Climate-Change.aspx*

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programs/pricing-carbon

Appendix for Theme 6

Climate Change Natural Disaster Research Worksheet Questions

Research a specific climate-induced natural disaster event in Canada. Answer the questions below based on your research.

1. What natural disaster are you examining?
2. What are the main conditions required for this type of natural disaster?
3. How were these conditions affected by climate change? What was the breakdown of the costs involved (insurance, clean-up, food shortage)?
4. What other human actions helped to make this disaster event more costly?
5. Use evidence to argue that climate change played or did not play a significant role in this natural disaster. Why or why not?
6. What role did the Insurance Bureau of Canada play? How much money was paid?

Flood Map Activity

Using the flood maps provided, answer the following questions in order and investigate your local area.

1. Locate your school community on the map; is it in a flood risk area?
2. Are there any rivers or streams and what course do they take? Would they have an effect on the watershed system?
3. Who or what is in the flood risk areas? Would this affect the economy? Using Google maps as a comparison, see what is currently in the flood risk area.
4. Examine: Does the flood risk area have any artificial flood controls (e.g. dams, channels, sea walls)
5. Conduct additional research: What are the costs associated with the artificial flood controls? Have these been expensive compared to the costs citizens have paid for the damages?
6. Using the IBC report, how much have taxpayers paid in your province on insurance damages on flood control? Where do you see economic benefits? Is it a smart financial decision to create artificial controls rather than pay for the damages once they happen?

Inquiry 6: Ethical Dimensions for Children, Youth, and Liveable Futures

Ethical Dimensions for children, youth, and liveable futures	
- Topics Covered: Focus Question: The majority of the world's population is under 30; how this impact future decision making - Identifying mitigation and adaptation strategies - Activity - imagine a hopeful future	- Teacher Background Information - Inquiry Activity - Tool: "Case Study" - Relevant Teaching Artifacts

Take-Away Message

The majority of the world's population is under 30, how should this impact future decision making?

Teacher Background Information

"If, as educators, we are to provide educational learning spaces that encourage young people to address issues in their local communities in meaningful and relevant ways, then we need to encourage them to use all the information, tools, and resources they have at their fingertips. It is through action that hopeful futures are created" (Field, 2017, pp. 85-86). Looking into future decision making, we need to allow students to be creative and inspired to create change, be active citizens, and allow them to be independent thinkers who can analyze and solve problems in their communities. Climate change will be impacting future generations and how they will need to adapt and mitigate the effects it has caused. Canada has a low vulnerability score and a high readiness to adapt to climate impacts.

While adaptation challenges still exist for Canada, as a country we are well-positioned to adapt: Canada is the 6th least vulnerable country and the 18th most ready country according to the Notre-Dame Global Adaptation Initiative (2019). Other countries will look to Canada for financial support due to the natural disasters related to climate change, climate migrants will see Canada as a destination, and Canadian resources, such as freshwater, will become increasingly significant. There is no straight answer on how to deal with these issues, but we can: 1) prepare our students to make these choices; and, 2) envision and plan for a hopeful future and envision and plan for a hopeful future, stressing adaptation and mitigation.
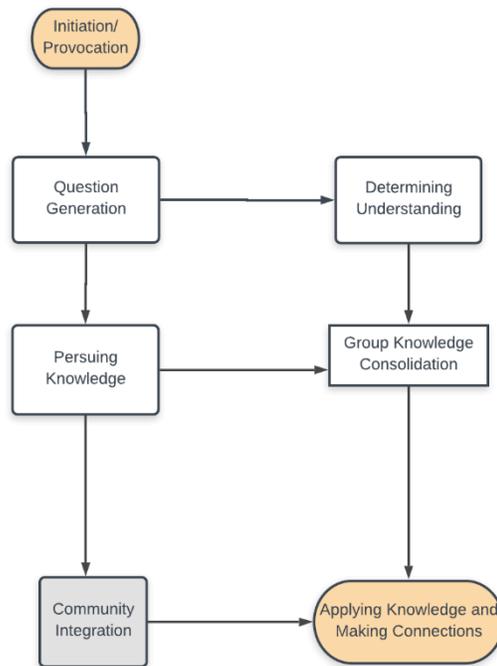
Inquiry Map

Figure 11- Inquiry Map for Inquiry 6

Overview

In this inquiry, students will have the opportunity to reflect, analyze, and research what it means to be an active citizen. Active citizenship is something we are able to see on a day-to-day basis, but how do we apply this to climate change? During this inquiry, students will have the opportunity to create their ideal city with what their citizen's roles are in order for that city to thrive. Lastly, students will have the opportunity to share with their peers and meet a community leader who is addressing climate change.

Initiation/ Provocation

We want students to begin thinking about what it means to be a good citizen and how an active community can work together to combat large scale issues like climate change. The questions we want to start asking are students revolve around:

- What choices do citizens need to make to become active citizens?
- What choices do the people in power (government officials, business owners, etc.) typically make that need to be made by both citizens as individuals, and by people in power, for citizens to become active citizens?

Resource: Article

Active Citizenship Can Change Your Country for the Better

"As we understand it, active citizenship is a combination of knowledge, attitude, skills and actions that aim to contribute to building and maintaining a democratic society. Active Citizenship supports democratic cooperation that is based on the acceptance of universal human rights and the rule of law, values diversity and includes the whole community. Education towards gaining this knowledge and developing and practicing the skills take place in all levels of our shared social life, but schools play a very important role in it."
(Nosko & Szeger, 2013)

After reading the article, students will begin to think about what it means to be an active citizen with respect to climate change. What role do the citizens play? How do they deal with social issues? How would they or do they plan for the future?

*Link: **https://www.opensocietyfoundations.org/voices/active-citizenship-can-change-your-country-better***

Tool: Sit Spot

Sit spots encourage children to slow down, and reward patience with new insights about nature and people's connection to it. Sit spots also provide children with an opportunity to hone their observation skills and reflect on all of the new sensations that they experience on a daily basis. As we have addressed throughout the several inquiries, we want to combat the fear of ecophobia.

Encourage students to find a spot on their own outdoors. This can be in the schoolyard, a local conservation area or park close by, or simply in front of the school. With spit spots, while there are benefits to them being in nature, this is not always possible, and the reality of what "nature" looks like in an urban school community can differ.

Students' Question Prompts:
- What are the different ecological systems working right now?
- How do we fit in the current environment?
- Who is a host and guest in your current surroundings? What role does each play (example humans vs. more than human living entities)?
- What are our current emotions sitting in this spot? Why?
- What do we see that we can create change within this moment?

Question Generation

The question for this theme should revolve around how young individuals in communities and cities can plan for the future and the ethical decisions that come with climate change.

- How do we educate our youth and make them aware to be both inspired to plan ahead but be able to handle the situations when they do arise? Think of the most successful cities or communities, both real and fictional, from books, movies etc. What do these cities have that make them great?

Determining Understanding

Allow students in a mind map format to think of a powerful changemaker or individual in a position of power. What qualities do these people have? How do they successfully handle problems? Based on your choice of the individual, what steps should an active citizen take when dealing with an ethical issue like climate change?

Resource: Video

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1)   *How We Children Save the World [5:21]*
To inspire the class on how children have taken initiative to become active citizens, introduce the organization "Plant-for-the-Planet," initiated by 9-year-old Felix Finkbeiner. It all started with a school presentation and today Plant-for-the-Planet is a global movement with an ambitious goal: to fight the climate crisis by planting trees around the world.

Inspired by Wangari Maathai, who planted 30 million trees in Africa in 30 years, Felix formulated his vision: Children could plant one million trees in every country on earth and thereby offset CO_2 emissions all on their own, while adults are still talking about doing it. Each tree binds a CO_2 intake of about 10 kg per year.

Link: https://www.youtube.com/watch?time_continue=1&v=iYABG1vSeF0

Plant for the Planet Website: https://www.plant-for-the-planet.org/en/home

2)   *The teen fighting to protect Canada's water — meet Autumn Peltier [7:52]*
She is the teen fighting to protect Canada's water — meet 13-year-old Canadian Autumn Peltier. She speaks bravely, confidently and passionately, and as a so-called water walker, Peltier pleaded with Justin Trudeau to protect Canada's water.

Link: https://www.youtube.com/watch?v=xqdE_7OZaqE

Pursuing Knowledge & Applying Knowledge & Skills

Refer to the PDF resource "How to become... An active Citizen". What can we add/ take-away from this list to apply it to future generations with respect to climate change? In groups, students will be asked to step into the role of an urban design planner and create your very own "Climate Change Friendly" city. As an urban design planner, you will also need to plan out what resources your city will use.

- What natural resources are located close to your city?
- What renewable/non-renewable forms of energy will you be using to power your city? What impact does the use of these resources have on the environment, and how does your city plan to deal with such consequences? How does your city display stewardship of important resources?
- What role do your citizens play in the success of this city and its mission to combat climate change?
- Why should people come and live in your city?

Additionally, give students the option to use the website Streetmix to give a small visual to their cities.

- *Link: (https://streetmix.net/-/636311)*

"How to become... An active Citizen" PDF

- *Link:*
  http://www.takepart.org/contentControl/documentControl/12714_how%20to%20becom
  e%20an%20active%20citizen.pdf

There are only three restrictions:
> 1. The population of your city should be above 10,000 people.
> 2. Your city must be located in an existing country - this means that you will have to research what natural resources are located where you plan to build. As well, make sure to also include a map of where your city is in the world.
> 3. Your city must show how they are going to comply with the Paris Climate Agreement. The agreement, which your country has joined (even if your country is the USA, your the city will still be complying with this agreement).

Resource: Video
Vancouver- Greenest city in the World [5:23] To give students an example of what a *Climate Change Friendly* city could look like, the video by the Climate Atlas of Canada shows how in 2009, Vancouver announced that it wanted to become the "Greenest City in the World by 2020". Their action plan hoped to encourage the use of bikes, transit and prioritize pedestrians and stop high use of fossil fuels. As a result, Vancouver now has the lowest carbon emissions of any city in North America. Vancouver showcases what can be done if citizens and city officials work in unison towards a common goal. *Link: https://climateatlas.ca/video/vancouver*

Group Knowledge Consolidation & Making Connections

Students will have the opportunity to take part in a gallery walk to view their peer's work. This is an opportunity for students to compare and contrast what they viewed as most important themes when it came to climate change citizenship and circling back to the two focus questions:

1. What role do your citizens play in the success of this city and its mission to combat climate change?
2. Why should people come and live in your city?

Teacher prompts for consolidation can include: What are the common themes that emerged throughout all fictional cities? Can we apply all of these strategies and ideas to our local community? Moving forward, what can you do to become an active citizen, even in high school?

Moving on Beyond School & Community Integration

This is an opportunity for an active community member to come to the class and speak about what they are doing in their daily life to help mitigate and adapt to climate change or invite an adaptation planner to discuss what the municipality or city is doing to plan for climate impacts. This can be members of a local community garden, freshwater cleanup, etc.

Resource: Activity

Community Engagement

The Toronto and York Regions of Ontario have developed partnerships with Evergreen to offer on-site technical advice and other resources to help ensure that school yard greening projects are successful. Qualified staff will visit your school and help you plan your planting site. Once your plans and approvals are in place, you can contact LEAF to order trees and shrubs.

This is just one example to show students that there are opportunities in their local communities to make a direct impact in the betterment of the community. These are welcoming, easy to participate opportunities for students and their families.

School Yard Greening Projects: https://www.yourleaf.org/schools

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Inquiry 7: Taking Action

Taking Action	
Topics Covered: • Promoting Citizenship (Antidote to "Eco-phobia") • Local Action (List of 100 things we can do to stop climate change (Drawdown)) • Community Partnerships and Involvement • Emphasis on School-wide Initiatives	• Teacher Background Information • Inquiry Activity • Case Study • Relevant Teaching Artifacts

Take-Away Message

Without taking action within our local community, we will never be able to combat climate change. Promoting action is an antidote for eco-phobia.

Teacher Background Information

Climate change is now affecting every country on every continent. It is disrupting national economies and affecting lives, costing people, communities and countries dearly today and even more tomorrow. Weather patterns are changing, sea levels are rising, weather events are becoming more extreme and greenhouse gas emissions are now at their highest levels in history. Without action, the world's average surface temperature is likely to surpass 3 degrees Celsius this century.

Climate change, however, is a global challenge that does not respect national borders. It is an issue that requires solutions that need to be coordinated at the international level to help developing countries move toward a low-carbon economy. We must get involved at a local level to ensure our local communities are engaged in mitigation and adaptation planning and motivate those directly around us to join in. Greta Thunberg sets the example that children's voices can be heard, and they can make a difference. She started a school strike for the climate outside the Swedish Parliament that has since spread all over the world and now involves over 100,000 schoolchildren. The movement is now called Fridays For Future. Thunberg has spoken at climate rallies in Stockholm, Helsinki, Brussels and London. She continues the rallies every Friday all over Europe, with plans to come to North America (Thunberg, 2019). Action 13 of the United Nations (UN) Sustainable Development Goals are a call for action by all countries to promote prosperity while protecting the planet. Through this goal, the UN recognizes that we must:

1. Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries.
2. Integrate climate change measures into national policies, strategies and planning.
3. Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning.
4. Implement the commitment undertaken by developed countries to the United Nations Framework Convention on Climate Change to jointly implement $100 billion annually by

2020 to address the needs of developing countries in the context of meaningful mitigation actions and transparency climate change implementation.

5. Promote mechanisms for raising capacity for effective climate change-related planning and management in the least developed countries and small island developing States, including focusing on women, youth and local and marginalized communities.

(United Nations, 2019)

Inquiry Map
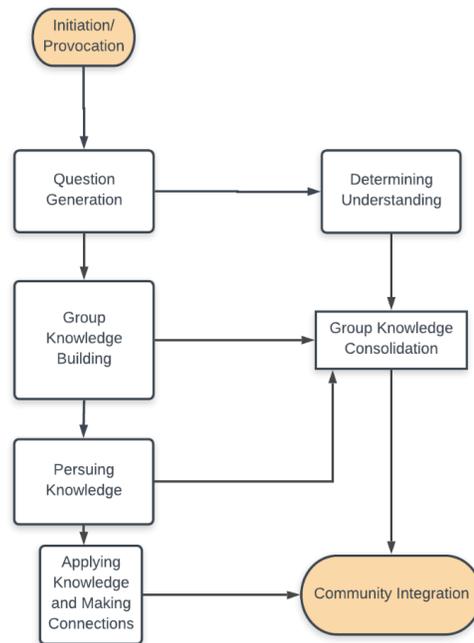
Figure 12- Inquiry Map for Inquiry 7

Overview

Students will have the opportunity to explore ways others, worldwide, are doing their part to take action to combat climate change. By being inspired by those around them, students are then encouraged to get involved in their local communities to address climate change. Through examples of what programs and initiatives are happening across Canada, we hope the class is able to participate in an activity as a class and hopefully be introduced to actions they can continue participating in once they leave the classroom.

Initiation/ Provocation

When we think of what first comes to mind about recent climate action and activism, we think of 16- year-old Greta Thunberg. Have students watch Greta's TedTalk:

- **Link:** *https://www.ted.com/talks/greta_thunberg_the_disarming_case_to_act_right_now_on_climate?language=en*

Afterwards, using an open-forum class-wide discussion, ask students to share their initial reactions to the video. Had they heard of her before? Were they surprised by her age? How has she used her depression related to climate change to spark change?

Question Generation

The question for this inquiry should revolve around ways students can take the most immediate action in their local communities.
- *How can we get more involved to address climate change?*
- *Are there existing groups I can join?*
- *What are Fridays for the Future? How can I do my part?*
- *What can I do to get my family involved to address climate change?*

Resource: Activity
Sensory Immersion   To build off sit spots where we give students focus questions to write or reflect on, sensory immersion allows for a deeper connection to one's surroundings. Students can use the idea of a sit spot to begin, but we want to build off of it and give more ownership to each individual.   • Sensory immersion sound maps are a quiet, individual activity where students can choose to sit however is comfortable for them.   • Students should begin by drawing a dot in the center of the paper to represent themselves. Space at the top of their paper, the space above the dot, is the space in front of them and the space at the bottom of the paper represents space behind them.   • Students can use letters or shapes to represent sounds. Each time they hear a repeated sound, they record should using the same symbol.   • Some students might do better if they close their eyes.   • Depending on the grade level and times repeating the task, give students 10-20 minutes for the activity.   • Once completed, students will finish by creating a legend to accompany their sound map.   Once again, we want to stress to students to express either in writing or orally how they felt during their time of reflection and sensory immersion by creating a sound map. What connection did they feel to their surroundings? How did they connect to that particular sense of place? Do they feel a connection to the sounds around them? Were the sounds human or more than human living entities?

Determining Understanding & Group Knowledge Building

"Mentimeter", a live online cloud app, allows students to share "what it means to them to get involved" using a few keywords. This allows the class to build a picture of how we describe activism.

What activism and action mean to people can vary greatly. Something that often arises is social media activism and awareness. While this can contribute to the cause, and help inform others, the impacts may not be the same. We need to encourage students that while social media can be a positive tool, direct involvement is what can truly empower us and help us feel that we are making a difference and feeding off one another, especially when trying to combat the depression and anxiety climate change can bring (CBC, 2019).

- *Link: https://www.mentimeter.com/*

Resource: Video

Wet'suwet'en solidarity protests: Widespread action, divided reaction [5:58]
 	
 The video showcases the many demonstrations and disruptions across Canada in solidarity of the Wet'suwet'en Nation's fight against the Coastal GasLink pipeline project. Protestors blocked the entrance to the BC Legislature, major intersections in Toronto, and the CN railway. Provinces are being ordered to remove the protestors, but the cause has gained followers and is using the hashtag #ShutDownCanada. What started as a protest about a pipeline in Houston has now expanded around North America.
 	
     • Does the *Wet'suwet'en* population have a valid reason to be protesting?
     • How does this type of activism make an impact? Is it positive or negative?
 	
 Link: https://www.youtube.com/watch?v=MEeTy1NmnIo

Pursuing Knowledge

Allow students, through group research, to investigate various ways youth are getting involved worldwide and specifically in Canada. Fridays for the Future, inspired by Greta Thunberg, is one that is of great popularity and easy to get involved in. What other ways can we get involved? The case study below is an excellent way for students to pursue knowledge and be inspired to see what is being done within one's school community, before looking at other large-scale climate change initiatives.

Case Study: UBC on Climate Change

UBC Schools talking to elementary students

A group of students at the University of British Columbia has facilitated climate change workshops at two high schools in Vancouver to help teenagers feel empowered about the future of the planet, rather than frightened. By inspiring climate ambassadors, this pilot phase shows students that they can make a difference by taking action. "I realized how much power I held and how much power this generation holds. That could change the world," said 15-year-old BC Student.

After listening to the interview and investigating the initiative, could your class become climate ambassadors? While the partnership between a university/college would mimic the program in British Columbia, could your class do the same for elementary students perhaps? For younger students within the school? What research and support would be needed for this to happen?

*Link: **https://sustain.ubc.ca/stories/climate-change-workshops-offer-high-school-students-hope-future***

Group Knowledge Consolidation

After students have the opportunity to research and investigate the various ways youth are getting involved worldwide, create a class list of the top ways your class can get involved and make an impact. What did they like and not like about various action plans? Did some seem more practical than others? In a creative way, share this list with the rest of the school and school board. This could be either on the school website, teacher websites, in the front foyer of a school, or in the hallways. Even if each class or school makes a single change, that is a step in the right direction.

Making Connections & Moving on Beyond School & Community Integration

Resource: Video

The most important thing you can do to fight climate change: talk about it
To assist in inspiring students on the importance and benefits of talking about climate change and taking action, Katharine Hayhoe in her TedTalk discusses how the key to climate change is having a real discussion to connect over shared values like family, community and religion to prompt people to realize that they already care about a changing climate. "We can't give in to despair," she says. "We have to go out and look for the hope we need to inspire us to act—and that hope begins with a conversation, today."

Katherine Hayhoe addresses the media's effect on our ideologies and how it can make things confusing, and yet, why are we not talking about it? Invite students after the video to discuss ways they can simply bring up the conversation about climate change to those around them. What are we most afraid of in talking about it? Students can additionally brainstorm ways to bring up climate change with those who might have conflicting opinions.

*Link: **https://www.youtube.com/watch?time_continue=2&v=-BvcToPZCLI***

The best way to showcase activism and action is by getting directly involved. Based on the research conducted by students, take part in a local initiative. This can range from participating in community gardens, a river-clean up or protesting in front of the city hall for change. Afterwards, give students the opportunity to reflect in their journals on how this made them feel and if, by participating hands-on, this helped contribute to a feeling, with their small initiative, that they are doing their part in helping combat climate change.

Resource: Activity
Engaging Student in Sustainable Action Projects Guide We suggest referring to the Learning for a Sustainable Future's "Engaging Student in Sustainable Action Projects Guide". The Guide provides a detailed overview of an action process as well as activities to support each step in the design and implementation of your action projects. An 'action project' meaningfully engages students throughout the entire process—from deciding on the topic of the project to how it will be carried out. The graphic at the link below illustrates some of the distinguishing aspects of Action Projects. ***Link: http://lsf-lst.ca/en/projects/teacher-resources/essap-guide***

There is an opportunity to create a school-wide campaign. Based on issues that students find pressing in your local school community and the surrounding area, they can find an issue most relevant to them. Tying in inquiry 1, this can revolve around "what worries you most about climate change" and finding an initiative that can help combat whatever that worry may be. Some suggested campaigns could include:

- Meat-Free Mondays
- Walk to school campaigns
- Waste audit
- Eat your lunch - say no to food waste campaign
- Fundraise for Trillion Tree Campaign
- School tree planting
- Postcard writing to Prime Minister about strengthening climate actions
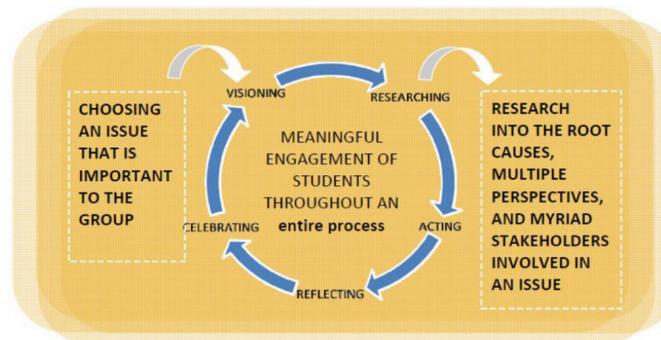- Letter writing to local MPs and MPP

Figure 13- Taking Action in the Classroom

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