

CLIMATE CONVERSATIONS

Teacher's Guide to Climate
Adaptation and Resilience in
Edmonton

Junior & Senior High



Welcome to *Climate Conversations*

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Introduction: Using this Resource

Through thought-provoking questions and critical thinking activities, this resource will connect students to their city and provide them with enough information to begin preparing for a changing climate.

Why host Climate Conversations in your classroom?

- » It's relevant and current.
- » It's inspiring and promotes leadership.
- » It's meaningful and connects us to our city.
- » It's a way to be informed about a new climate future for the Edmonton region.

Who is this resource for?

The guide was designed for high school audiences but we know teachers are experts at adapting great resources to fit within their unique classroom situations. Junior high teachers may find it just as useful for facilitating thoughtful and informed conversations with a local context.

Numerous links can be made to science, social studies, CTS and math curricula, as well as leadership courses.

How do I use this resource?

The Climate Conversations Teacher's guide contains information and activities designed to support students in their learning by engaging them in meaningful and timely conversations about being resilient to climate change. It focuses primarily on Edmonton, although teachers across the province may find it useful for discussing municipal climate issues in their local context.

It contains nine unique modules focusing on real-world energy topics. Pick one, pick some or cover them all:

1. Edmonton Then and the World Now – Edmonton's energy history and local and global impacts of climate change.
2. Climate Change – how resilience, redundancy and innovation fit with climate adaptation
3. Changing Seasons and Ecosystems – projected impacts of climate change on the seasons and local ecosystems, and how that affects the City.
4. Vulnerabilities and Risks of Climate Change – the complexities involved in adapting a city—and a bit about potholes.
5. Resilience – applying the concept of resilience to a school environment.
6. Be Prepared: climate hazards and considerations for climate emergencies.
7. Air Quality and Climate Change: Is there a Connection? – sources of air pollution, interpreting the air quality health index and taking action to improve air quality.
8. Living in the Future, Today! – exploring sustainable buildings and sustainable communities, and the concept of "resilience hub".
9. Taking Action – pulling together learnings from the previous modules and formulating ideas for school, community or home action.

Each module provides background information, offers relevant connections and supports students in their learning experience. Topics are internalized by students through assigned presentations, facilitated discussions, website learning and case studies.

We hope you find this resource helpful and congratulate you in the pursuit of inspiring climate literacy among your students.

Overview: Edmonton's Plans and Strategies

What is climate change?

Climate Change is commonly defined as the long-term change in weather patterns, often tracked and averaged for thirty years or more, and characterized by extreme weather events such as floods, drought, hurricane-force winds, extreme cold, warming in winter and so on. The terms "climate change" and "global warming" are often used interchangeably. However, global warming pertains only to the average increase in the Earth's surface temperature, while climate change covers a wide range of potential changes in weather patterns—including changes in temperature and precipitation.

The average global temperature is rising and will continue to rise. Greenhouse gases produced by humans—mainly through the burning of fossil fuels (e.g., coal, oil and petroleum products like gasoline)—are a significant contributor to modern climate change. For definitions of more terms related to climate change, visit [Climate Change FAQs](#).

Responding to climate change

Climate mitigation plan

Cities around the world are rapidly developing plans that address climate change in various contexts, some of which are determined by geography, some by politics. Edmonton recognizes the need to reduce greenhouse gas emissions as an effort to mitigate or lessen the pace at which climate change is occurring, and as a response to finite oil and gas reserves. Edmonton is currently implementing its climate mitigation plan, The [Energy Transition Strategy](#), after it was endorsed by City Council in 2015. An updated, accelerated version of the strategy is being prepared for release in 2021.

Climate resilience plan

Edmonton recognizes that the climate is already changing. The [Climate Resilient Edmonton: Adaptation Strategy and Action Plan](#), commonly known as a climate adaptation plan, and sometimes Climate Resilient Edmonton, outlines risks and responses to a changing climate. The Action Plan addresses how the City should develop and redevelop itself so that the city will survive and thrive under changing conditions and challenges.

What is energy transition?

Energy transition is a long-term change that shifts us from relying on fossil fuels to relying more on energy sources that are sustainable and low or zero-carbon. Edmonton's Energy Transition Strategy outlines specific actions the City will implement to achieve these goals, including energy conservation, efficiency and renewable resource projects and how the broader community can support this transition. It also describes the current state of energy, climate challenges faced and important opportunities for the future.

[ConnectEdmonton](#), the City's strategic plan and vision for 2050, outlines four goals—one of which is **Climate Resilience**: *Edmonton is a city transitioning to a low carbon future, has clean air and water and is adapting to a changing climate.*

The Energy Transition Strategy targets:

- » reduce community greenhouse gas (GHG) emissions:
 - by 2025: by 35% (compared to 2009 levels);
 - by 2030: by 50% (compared to 2009 levels);
 - by 2050: achieve net zero per person GHG emissions
- » by 2030: a 35% reduction in energy use per person (compared to 2009 levels)
- » by 2030: locally generate 10% of electricity used in Edmonton

Climate mitigation goals

Various plans and strategies, including [Connect Edmonton](#), [The City Plan](#), [Edmonton's Community Energy Transition Strategy](#) and [Climate Resilient Edmonton: Adaptation Strategy and Action Plan](#), commit the City to taking action that will contribute to international efforts to limit the increase of global temperature to 1.5°C.

What is climate adaptation?

Whereas **climate mitigation** addresses the underlying causes of climate change by reducing greenhouse gas emissions, **climate adaptation** is about lowering the risks and negative impacts of a changing climate so that communities and ecosystems are prepared to cope with the new climate conditions. It also encourages us to embrace potential opportunities that may come with a changing climate.

Our lifestyles and infrastructure (roads, bridges, buildings) are designed for a particular climate. As the climate changes, we need to change, or adapt. As an example, the drainage system across the city is designed for a certain amount of snowmelt and rain.

Key Terms

Sustainable: enduring over a prolonged period as an integral part of Earth's natural systems.

Resilient: having the capacity to withstand environmental disturbances and bounce back from them intact.

View [Edmonton's Energy Transition Strategy](#).

Climate change will bring similar amounts of rainfall, but it is projected to fall as short-lived downpours that can cause flood conditions. Therefore, we need to rethink and redesign how to move a lot of water in a short period of time. That is just one example of what it means to adapt to a changing climate.

What does "Climate Resilient Edmonton" mean?

Through careful and thoughtful design and by taking measures that adapt Edmonton for a changing climate, we are making it more resilient. A **climate resilient** Edmonton is able to bounce back fairly quickly from major disturbances or shocks, and is able to maintain the functions and services it provides to its citizens. Resilient cities ensure redundancy so they can be flexible and adaptable when required.

In 2017, research from the International Institute for Sustainable Development shed additional light on what it means to be a resilient city. See [Building a Climate Resilient City](#) and [Climate Change Discussion Papers](#).

Module 1: Edmonton Then and Now

Learning Objectives

- Understand and reflect upon Edmonton's energy history.
- Recognize challenges associated with relying on fossil fuels as a primary energy source (i.e. air quality, climate change).
- Explore energy transitions of the past and how they impact the future.

Reflecting on the past: Edmonton's energy history

1798
Coal is found on the banks of the North Saskatchewan River and brought to Edmonton House to be used by blacksmiths

1841
Coal discovered on both sides of the river; brings workers and settlers to the area

1875-1880
Commercial coal mines open in Edmonton

1892 Population: 700

1904
Edmonton is designated a city

1908 Population: 18,500

1922
Edmonton area mines are producing 12,000 tonnes of coal each day and employing 3,600 men

1930s
The Great Depression slows coal production and population growth pressures the end of mining within Edmonton city limits

1947
The first major oil discover is made just south of Edmonton at Leduc #1

1950 Population: 148,861



Credit: City of Edmonton Archives EA-10-1430

1878 Population: 148

1891
Completion of the Calgary-Edmonton railway makes coal a significant part of the local economy

1905
Edmonton has its first six cars

1925 Population: 65,375

1928
Edmonton's first traffic light is installed

1939 Population: 90,419

1945
Coal mining is moved to areas outside the city limits

1950s
Edmonton is recognized as the "Oil Capital of Canada" and the city sees a huge population increase

1960 Population: 269,314

1966
Edmonton's first skyscraper, the CN Tower, opens

1970s
The increase in world oil prices starts a series of "boom and bust" cycles that have continued in Alberta ever since

1955
Edmonton's Rossdale power plant switches from using coal to natural gas



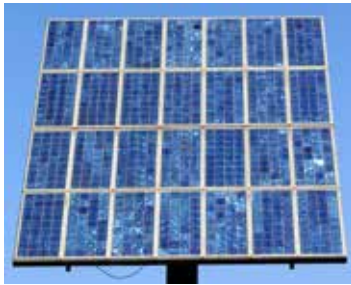
Rossdale Power Plant

1970
Edmonton's electrical generation and distribution merge to form Edmonton Power; construction begins in the Clover Bar generation station

1978
The LRT opens

1980 Population: 505,773

1986
Oil prices collapse; the city doesn't make a full economic recover until the late 1990s



Solar panel

Edmonton's Riverdale Net Zero project is one of the first net zero homes in Canada

2007

2006
City of Edmonton creates an Environmental Strategic Plan



Environmental plan

2012 Population: 817,498

2011
City updates its environmental strategy; *The Way We Green* is endorsed by City Council



Energy strategy

Edmonton's *Community Energy Transition Strategy* is endorsed by City Council

2015

2015-2016
World energy prices drop by over 50%

2019

City of Edmonton declares a Climate Emergency

2018
800 scientists converge in Edmonton for the inaugural CitiesIPCC Cities and Climate Change Science Conference

2019 Population: 972,223

2020
Global health pandemic, COVID-19 shuts much of the world down for three months starting in mid-March

Edmonton's Community Energy Transition Strategy is updated to reflect the accelerated action on climate change in order to keep the planet from warming more than 1.5 degrees Celsius (Pending: 2021)

Climate Resilient Edmonton: Adaptation Strategy and Action Plan is adopted City Council



Adaptation strategy

 zoomed in on timeline

Questions for reflection

1. What stands out for you in Edmonton's Energy History timeline?
2. Do you see any connections between energy and changes in the city's population?
3. What additional information would you need to better assess whether there are any correlations between energy production and changes in Edmonton's population? [e.g., population trends near and far from Edmonton, for context]
4. In 1947 with the discovery of oil, there was a major transition away from coal. Do you think it could be possible to transition away from oil toward a different source of energy?
5. What factors do you think promote change?
6. What do you predict for Edmonton's energy future? What makes you excited? What makes you discouraged?

A more detailed timeline for Alberta's energy history can be found at [Alberta Energy History up to 1999](#).

See **Edmonton's Climate Change Almanac Introductory pages** for another timeline of Edmonton's history. (Link to be provided in 2021.)

Energy in question: Beyond our boundaries

Classroom Conversations

Have students conduct an online search and browse science websites to help with understanding of what energy is. Focus the discussion on sources of energy, including fossil fuels (e.g., coal, oil, gasoline, natural gas), renewables (wind, solar, geothermal, biomass*) and how we use energy in our daily lives.

While we expect to be able to easily use energy when we want, like plugging in our tablets and phones at home and in public spaces, turning on lights when it's dark, fueling up vehicles when they're low on gas, not everyone in the world has access to energy in its various forms.

In many parts of the western world, we have organized society to take advantage of fossil fuels to power industries, fuel vehicles and provide electricity. Not everyone in the world has access to this supply of energy. It is estimated that one billion people (about 13% of the world's population) live without electricity, and three times that (about three billion) rely on cooking fuels like biomass that create very poor indoor and outdoor air quality conditions. The inequalities that exist around access to available and affordable energy is sometimes called "energy poverty".

Classroom Conversations (Teacher-led)

1. If you had no access to electricity, how would your time outside of school be different?
2. If you/your family/society had no access to fuel for vehicles, how would your life be different?
3. If you had no access to natural gas, what other sources of fuel might you have to access to heat your home?
4. If water were not pumped to your school or home, how would you access water for bathing or drinking?
5. Overall, how would a life without easy access to energy be different from what it is now?

Activity

1. Ask your teachers, parents or grandparents the following questions and bring answers back to class for a follow-up discussion:
 - » Ask, "When you were a teenager, what were the main sources of energy you used?"
 - » Ask, "Did you ever talk about energy when you were young?"
 - » Ask, "How do those conversations compare with the conversations of today?"
2. Based on the responses you receive, think about what makes the conversations they had when they were young similar or different to conversations you're having today.

Classroom Conversations

The discovery of oil in Leduc in 1947 was a turning point for the energy industry and for the rapid introduction of oil and gas-dependent industries and lifestyles. These discoveries have afforded us a terrific quality of life and have led to countless innovations. Nobody could have predicted that our use of fossil fuels would have led to concerns about global climate change.

So now that we understand the unintended consequences of these great discoveries, do we have the capacity and determination to transition away from our dependency on fossil fuels, and develop new and improved energy sources? Or do we continue to rely on fossil fuels—like coal and oil—with the ingenuity to use them in such a way that any (intended and unintended) consequences are avoided?

Further Reading: Energy transition in Edmonton

The City of Edmonton is committed to "energy transition" and has a number of programs in place and in progress to help homeowners, businesses, the City as an organization and the Edmonton community to reduce fossil fuel use. These efforts will reduce greenhouse gas emissions and mitigate Edmonton's contributions to climate change.

To find out how to get involved in energy transition in Edmonton, visit the City's interactive blog, changeformclimate.ca. The blog contains stories of Edmontonians making change in their lives, an interactive spectrum of Actions for Change and resources and programs to help reduce emissions.

Module 2: Climate Change

Learning Objectives

- Be informed about initiatives underway across the world to address climate change
- Become aware of the climate impacts expected for Edmonton
- Contemplate the concepts of resilience, redundancy and innovation and how these relate to climate adaptation.

Around the World and in Edmonton

Today, climate conversations are top of mind. Our planet's temperature is approximately 1°C warmer than preindustrial periods (halfway to the 2°C scientists are predicting will bring "dangerous" climate change). At the end of 2015, world leaders met at the UN Climate Change Conference to discuss hard hitting issues and make plans to rein in greenhouse gas emissions. In November, 2016, the "Paris Agreement" took effect, among 55 countries that account for about 55% of total global greenhouse gas emissions.

A website that might be of interest is: ipcc.ch/sr15. Other websites that may be of interest are the US-based National Oceanic and Atmospheric Administration (NOAA): noaa.gov/climate# which is linked to climate.gov.

In March, 2018, Edmonton hosted the inaugural [CitiesIPCC Cities and Climate Change Science Conference](#) to address research gaps that exist for cities wanting to address climate change. Besides the impressive line-up of presenters, posters and conference attendees, a community stage was scheduled for the public to learn more.

At the close of the 2018 CitiesIPCC Cities and Climate Change Science Conference, the Edmonton Declaration was created. It is a call-to-action for all cities to lead on climate change action and to ensure their climate action plans are grounded in scientific research and to reinforce targets set in the Paris Agreement. As of 2019, 4500 cities have committed to the principles of the Declaration.

Learn more at:

edmonton.ca/edmontondeclaration

Why are climate change discussions happening now?

Concentrations of greenhouse gases in the atmosphere have reached an all-time high and temperature changes cannot be ignored.

Figure 1: Edmonton's average annual temperature: 1880–2020

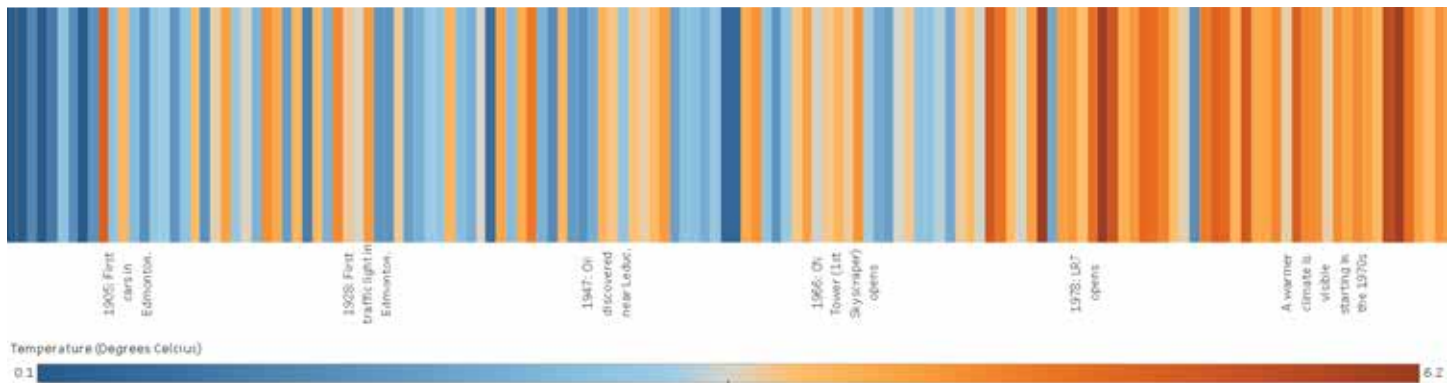


Image Source: [Public Tableau: Edmonton's Changing Climate - Temperature Over Time](#)

Effects of climate change

Glaciers are receding, ice is freezing later in winter and melting sooner in spring, habitat ranges have shifted and plants are flowering earlier. These observations may not seem significant but they are forecasting the start of more dramatic changes. Even if all greenhouse gas emissions were to be eliminated immediately, we are actually locked into this warming period for at least another 20 years.

Climate change is like a very large ship in the ocean: it takes much skill and forethought from the captain and crew to not only stop the ship, but to turn it; dropping the anchor does not result in a hard stop!

Because global climate systems are so highly complex, it can be many years before we see the results of our actions. Human-caused climate change has been occurring since the late 1800s and the greatest warming trend has occurred over the past 35 years [NASA 2018].

How will Edmonton be affected by climate change?

Edmonton will not be immune to the effects of climate change. Some of the direct impacts we feel today are expected to increase in intensity as time goes on:

- » extreme weather patterns that bring severe storms, flooding, droughts, heat stress. Fire is also a result of extreme weather and can lead to poor air quality
- » changes to local ecosystems and urban forests, invasive species and a loss of current native species
- » effects on industries that we depend on such as agriculture and forestry
- » impacts on infrastructure such as drainage system, roads and bridges

Edmonton is part of a much larger global social, environmental and economic system, all of which will be impacted by worldwide natural disasters, conflicts and resource disruptions. For example, consider how freezing rain in Florida will impact the supply of citrus fruits to Edmonton; or a drought in California could impact the supply of almonds and almond milk. Could Edmonton become attractive to people from other parts of the world as they face direct conflicts and food shortages? We're all connected to climate change in some way, and Edmonton has the ability and opportunity to help to shape a better global system.

To learn more about Edmonton's changing climate, visit edmonton.ca/climateresilience.

Climate resilience as an opportunity

Edmonton considers energy transition and climate adaptation as opportunities to address climate change, air quality and economic challenges. Like other municipalities, provinces and countries, Edmonton had a choice to make: ignore climate change and carry on as if things will always be the same or, listen to what the scientists are saying and what we and other parts of Canada and parts of the world are already experiencing. Communities that respond with innovative ideas will prosper; Edmonton is positioned to be a leader in these areas.

Climate adaptation

Have students view this short video from a [Pecha Kucha presentation](#) in Edmonton, featuring Danielle Koleyak, City of Edmonton.

Classroom Conversations

Prior to viewing the video, prepare the students to listen for the following concepts that are shared in the video. After viewing, review these ideas with the class.

1. **Survive and thrive amidst change.** How might you relate to this? Have you been affected by any changes (at home, school or at part-time work)? How were you able to handle change?
2. **Most people live in cities.** Therefore the impact of cities on climate change is even bigger than the impact of rural areas. How can we turn negative impacts into positive contributions?
3. **Changing seasons.** If the climate becomes warmer in winter, how might this affect you? If summer becomes hotter and drier, how might that affect you?
4. **Waiting for change.** We could wait until the impacts from climate change are felt more, say in 2050, to make changes. Or, we could begin to adapt now. What could we do now to adapt?
5. **Being redundant.** What does that mean?
6. **"Edmonton is a City of Innovators."** How could this be useful for adapting to climate change?

Module 3: Changing Seasons and Ecosystems

Learning Objectives

- Understand the seasonal climate changes expected for Edmonton and region
- Explore changes expected for the region's Aspen Parkland ecosystem
- Consider how changes in the natural environment can impact trees and natural areas the City maintains

Seasonal signs of change

Teacher Information: Climate models

Staff at the City of Edmonton worked with local, national and international scientists to develop climate models for Edmonton. While the models are not perfect, and lacking some of the inputs required for perfect predictions of the climate future, the models are still quite sophisticated and able to provide a widely accepted climate model for the Edmonton area.

Katharine Hayhoe is a respected scientist who came to Edmonton to participate in the 2018 IPCC Cities and Climate Change Science conference and speaks about the [complexities of climate models](#).

Seasonal changes projected for Edmonton and area

Spring: wetter, with a longer growing season and spring coming earlier

Summer: hotter and drier, and rainfall will evaporate quickly

Autumn: warmer and wetter, extending the growing season and delaying the first snowfall

Winter: warmer and wetter with fewer nights with temperatures dropping below -20°C .

Activity (Teacher-led)

1. Refer students to the seasonal posters, at edmonton.ca/climate-resilience.
2. Divide the class into groups, and assign one seasonal poster to each group. Each group should answer questions 3 to 5, below, and prepare a creative presentation to share with the class, perhaps a poem or rap to write and perform; a short video (2–3 minutes maximum); a skit; a display or simply a report-style presentation with visuals.
3. Student "reports" (of whatever style is chosen) should include the following information:
 - a. Identify the season
 - b. Describe your current experience with that season in Edmonton
 - c. Identify changes that are expected for the season
 - d. Share how the predicted changes will—positively, negatively or neutral—impact some or all of the following:
 - i. your walk or commute to school, including footwear and clothing choices
 - ii. your experience inside the school

- iii. the school yard and parking area
 - iv. extra-curricular activities that students participate in
 - v. after-school and weekend activities that students are involved in
 - vi. road and sidewalk conditions in Edmonton
 - vii. parks and natural areas in Edmonton
 - viii. facilities such as indoor recreation centres and outdoor recreation facilities and provisions
4. What do you suspect will be some of the more challenging aspects that the new conditions for this season will present for a) citizens; b) entrepreneurs and business owners and c) the City of Edmonton?
 5. What, if anything, makes you feel optimistic about the climatic changes that are projected for Edmonton?

Classroom Conversations (Teacher-led): Myth Busters

Have students act as *Myth Busters*. Present the following questions or statements about climate change. Encourage students to respond with evidence that supports their thinking. The bullet points provide you (the teacher) with more information.

1. If the Earth is getting warmer, why is it so cold today?
 - There's a big difference between long term climate trends and short term weather variability
 - Even as the climate warms, Edmonton will see cold days
2. The climate has changed before so why is everyone getting worked up this time?
 - Natural factors did alter climate in the past
 - Today, human activities that produce GHGs are accelerating change
 - The amount of carbon dioxide in our atmosphere is at its highest point in human history (climate.nasa.gov/evidence)
 - The climate has been warming most rapidly since the 1950s
3. Climate change might not be so bad in Edmonton.
 - We may see longer growing seasons and more temperate winters
 - Overall, the negatives like drought and flooding far outweigh any positives
 - Other places around the world could experience more serious consequences
4. Scientists do not agree on the reason for climate change.
 - The vast majority of scientists (97%) agree that human activities are contributing to global climate change
 - Some uncertainty arises around how significant the changes will be and how places around the globe will be affected.
 - View this website for further confirmation: climate.nasa.gov/scientific-consensus

What can we expect for the weather in Edmonton?

Residents of Edmonton can expect to see more variable weather, including extreme weather events. It is projected that we will see more rain on snow events, and early and quick snow melts. Edmonton should also expect high intensity rainfalls that cause higher overland water flows. Torrential rain is not ideal for replenishing water tables and groundwater because it tends to flow rapidly and result in flood conditions instead of gently seeping into the ground. In surrounding rural areas, it is bad for crops and agriculture.

The City has developed a website with animations that highlight local climate changes. Visit edmonton.ca/climatealmanac to learn more about a changing climate in Edmonton.

Heat island: Like most cities, Edmonton's downtown is concrete, pavement and glass, all of which can increase the city's temperature by absorbing heat as well as reflecting the sun's rays onto surfaces. This concentration of heat resulting from infrastructure is known as the Urban Heat Island Effect. Some cities have been mitigating the temperature rise using "green infrastructure" such as green roofs, enhanced tree canopy and shade trees.

Stories by Canadians about how climate change is affecting them can be viewed at cbc.ca/news2/interactives/inourbackyard as part of the CBC series, *In Our Backyard: What Climate Change in Canada Looks Like*.

Teacher Information: Ecosystem changes

Edmonton is situated in the Aspen Parkland, one of the six Natural Regions of the province. Over the years, "Natural Regions" have been called Ecoregions and even Ecoprovinces. The Aspen Parkland (sometimes shortened to Parkland) is generally known to be an area of transition between the hotter and drier grasslands to the south, and the wetter and cooler boreal forest to the North.

It is expected that in time, the Grassland Region will extend further north and Edmonton will eventually be part of this hot, dry Natural Region.

A warming climate is expected to change our ecosystems in a number of ways:

- » attract disease-causing microorganisms to warmer regions that would (prior to climate change) be uncommon to colder, more northerly regions like Edmonton.
- » warm waters have impacted our recreational waters and lakes with such events as blue green algae blooms that produce toxins that are harmful to humans and animals.
- » Canada, and Alberta, is experiencing a rise in Lyme disease, resulting from bites by infected ticks that are increasingly expanding their habitat to more northerly regions.

Find maps of the province's Natural Regions by visiting [Alberta Biodiversity Monitoring Institute \(ABMI\)](#) for a map and links to brief descriptions. Also, check out a more [interactive website](#).

While we often think about more immediate, weather-like impacts of climate change, such as extreme winds, or a summer heat wave, or freezing rain in winter—commonly called climate shocks or climate hazards—there are also slow-onset stresses that we should expect, too. See [definitions](#).

Classroom Conversations

Ecosystem Shift

View the "Ecosystem Shift" poster that was developed by the ABMI. Find it on [Climate Change Frequently Asked Questions](#), under Climate Change Adaptation.

As a class, discuss, "what does a changing ecosystem mean for Edmonton?"

When citizens are asked what they value about Edmonton, the words "nature" and "river valley" often come to mind.

Trees

The City of Edmonton's Root for Trees program (edmonton.ca/rootfortrees), contributes to the City's goal for a 20% canopy cover.

1. Do you remember being handed an evergreen tree seedling in grade one to take home to plant?
2. Will coniferous trees survive in grassland-type conditions?
3. Do you think a new tree species should be introduced for grade one planting? Why or why not?
4. What information would you need in order to determine what species of trees to plant as part of the Root for Trees or other naturalization programs in Edmonton?

Note: Some parts of the city, such as cooler, deep, north-facing ravines in the river valley may be able to support current vegetation types longer into the future.

Module 4: Vulnerabilities and Risks of Climate Change

Learning Objectives

- Understand the following terms: vulnerability; risks; climate hazard; slow-onset impact; assets; services
- Recognize the complexities of adapting a community for a changing climate
- Explore the relationship between potholes and climate change
- Relate how freeze-thaw cycles can impact more than roads; buildings and bridges, too!

Background information

Vulnerabilities to climate change means being sensitive or susceptible to harm and not having the capacity to cope with the harmful impacts.

For Edmonton, we might look at a specific community and consider if it is vulnerable to flooding. Parts of the Whitemud Freeway are known to flood during intense rains. Since climate change will likely bring more intense and frequent rainstorms, the places in Edmonton that are already known to flood are therefore vulnerable to climate change.

We might also look at a community and determine if there are language barriers for people who live there, and they may not be able to receive information as readily as others. Or, another community may experience low income levels and, as a result, inhabit spaces that they cannot afford to retrofit to be more energy efficient or adapted to a changing climate.

Classroom Conversations

What factors could create vulnerabilities for citizens?

Who in society might be most affected by a changing climate?

Risks of climate change refers to the **chances** of something happening (probability), combined with the **consequences** of an event. Usually it involves a calculation of the probability of a climate event occurring, and then discussing vulnerabilities to that climate event.

In January, 2018, climate experts and local stakeholders attended one or more of ten climate Vulnerability and Risk Assessment workshops. At these sessions, participants discussed the effects of **climate hazards** (e.g., extreme heat or cold, hail, freeze-thaw) on **assets** such as roads, buildings and bridges, and **services** such as communications, culture and public health.

Each of the asset and service areas were discussed according to the vulnerabilities of each and the risk associated with climate hazards. The discussions were lengthy and wide-ranging. An artist was present for each workshop and captured the essence of these conversations using graphics and words. To view the work of the graphic artist, visit edmonton.ca/climateresilience, scroll to Background and click on Setting Direction: 2017 to 2018.

The poster highlighting Economy + Community and Culture captures each of the "Assets and Service Areas" (Public Health & Safety; Urban Agriculture & Food; Storm Water; etc) and the "Climate Hazards" (extreme heat; urban flooding; timing of frost-free period; etc.) that were discussed at every workshop session, see them listed across the top of this [poster](#) (also found on Page 25 of this Guide).

Activity (Teacher-led)

There are ten “vulnerability and risk” posters. Divide the class so that small groups of two to four students are each responsible for reviewing one poster in more detail. Each group of students should prepare a short presentation (10 minutes maximum) for the class, where they provide responses to questions 2 to 5, below. If possible, project the applicable poster while each group presents.

1. Review definitions for **climate hazard**, **slow-onset impacts** and **adaptation**. You can find them on [Climate Change Frequently Asked Questions](#), under Climate Change Adaptation.
2. Study the poster you were asked to review. Name three climate hazards that stand out for you and describe how these relate to the poster topic.
3. Name three slow-onset impacts for your topic that you feel are most significant to consider.
 - » Why did you choose these three slow-onset impacts?
4. Review the adaptations recorded for your topic.
 - a. Which two or three might be the most challenging to address in terms of difficulty and/or cost?
 - b. Which two or three may not need much effort to implement or were captured more as something to be aware of?
 - c. Which adaptation action is of most interest to you and why?
5. Relate the information from your poster to how your school and/or home might be affected by climate change.
 - a. What are some risks or vulnerabilities your school should be aware of?
 - b. What are some risks or vulnerabilities that might apply to your home environment?

Adapting your home to climate change

A number of municipalities in the Edmonton region developed an online resource, [Climate Resilient Home](#), to provide homeowners with information about renovations, upgrades and actions to make their homes more resilient to climate hazards.

View the site and discuss if any of these actions might apply to your school.

Walking through your home neighbourhood, what do you see that demonstrates adaptation to climate change? Do you notice anything that could be changed to make it more resilient to extreme weather events?

Case Study: Potholes...and more potholes?

Is there a connection between climate change and potholes?

Recall the graphic poster, "[Roads and Active Transportation + Rail](#)" (Figure 4) where potholes were mentioned as a climate hazard. The following information and experiment illustrates the science of potholes and how and why they form.

If you've driven on Edmonton roads in the spring, you've likely experienced a pothole (or two). But have you ever considered there may be a connection between potholes and a changing climate? Variability in seasonal temperatures (-15°C one day and $+5^{\circ}\text{C}$ the next) increases the chance of structural failure on road surfaces. It's the freeze-thaw cycles that impact Edmonton's pavement; climate change means these cycles are becoming more frequent.

How does a pothole form?

1. As snow melts, water seeps through cracks in the pavement and softens the road base.
2. When it freezes again, the ice expands* and pushes the pavement up.
3. During a thaw, the ice melts and a hole is left under the roadway.
4. When vehicles drive over this weak pavement, it cracks and creates a pothole.

Figure 2: How a pothole is formed

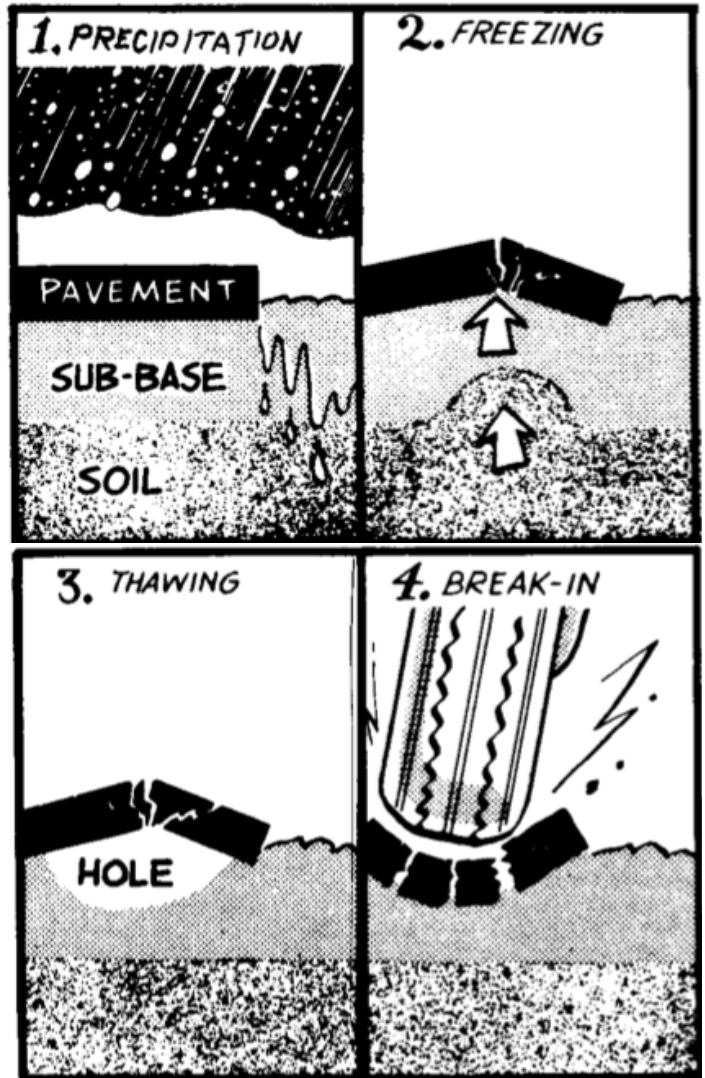


Image source: en.wikipedia.org/wiki/Pothole

Figure 3: Climate change hazards on transportation

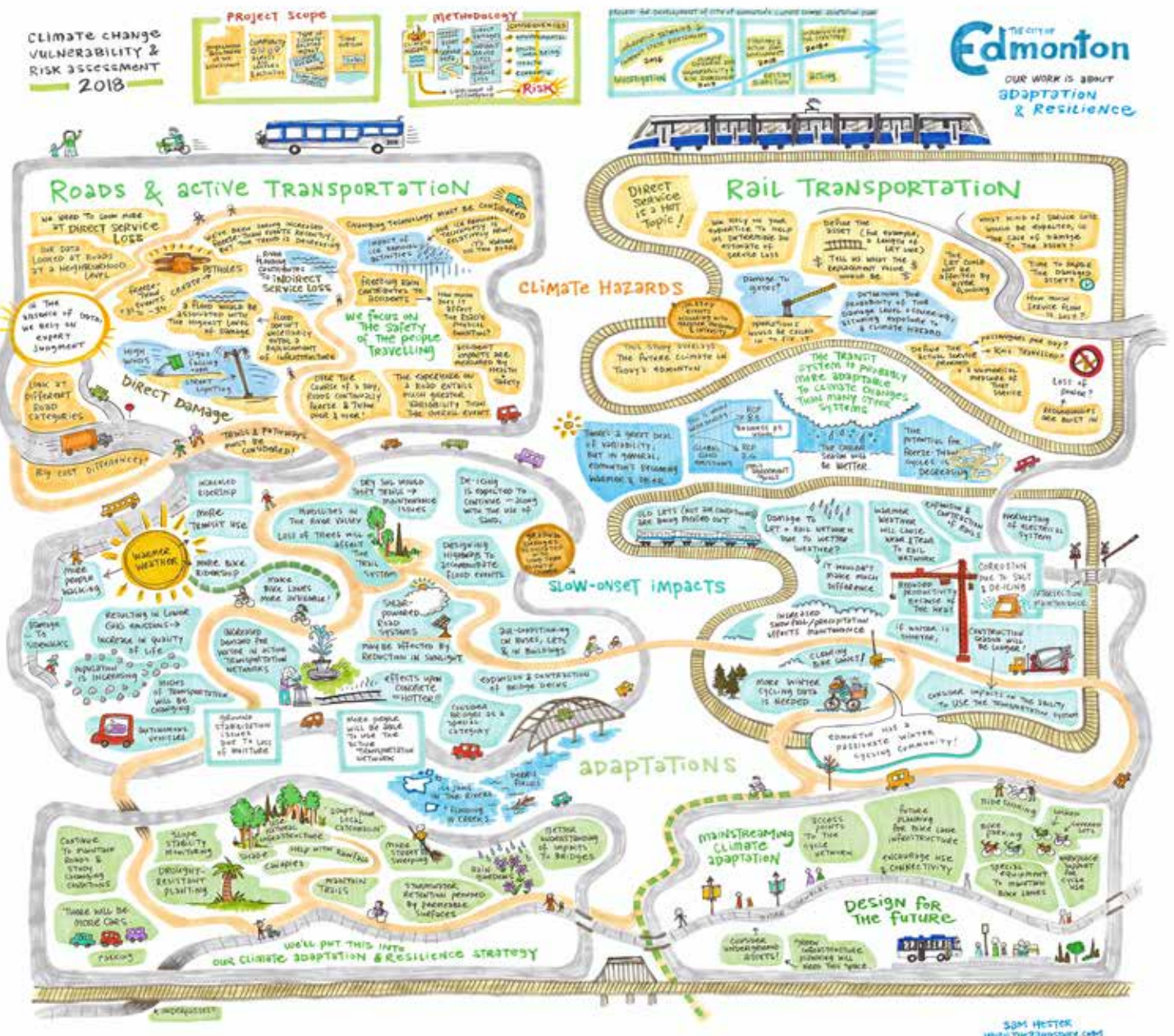


Image Source: [City of Edmonton](http://www.cityofedmonton.ca)

In a conversation with Green Energy Futures, Mayor Don Iveson agreed we have a climate challenge on our hands. The Mayor noted, "We don't have to look much further than the growing legions of potholes caused by Edmonton's more frequent freeze and thaw cycles. Like it or not, the problem is at our doorstep."

For more: Listen to the [full interview with Mayor Iveson](#).

As part of its climate adaptation planning, the City is researching and testing different concrete mixes to determine which responds best to variability in temperatures.

Activity

Partially fill a small plastic container with water and place it in the freezer. When the water is frozen, notice if the ice is concave (i.e. slightly heaved; rounded outwards) on the surface.

Classroom Conversations (Teacher-led)

How can a freeze-thaw cycle impact roads, bridges and buildings? Can freeze-thaw impact pipes underground?

Optional student discussion questions:

1. What sort of ideas or thinking might be required for solving this problem?
2. Should we consider paving roads with a different type of pavement?
3. How do other regions with a similar climate handle road repair, road maintenance, road building and emergency response?
4. Is there a way we could balance our need for roads for motorized vehicles with a need for active transportation routes (bike lanes, sidewalks, etc.)
5. How do first responders attend to situations without a good road system?

Module 5: Resilience

Learning Objectives

- Understand what the term "resilient" means
- Identify features of the school that are adapted for climate change (and are resilient)
- Identify features of the school that could be adapted to be resilient to climate change
- Explore what is meant by "redundancy" and how that fits with their school and for the larger city

Background information

Resilience is often described using words and phrases such as "ability to bounce back", "withstand shocks and disturbances", "maintain functions", "ensure redundancy", and "building on existing assets".

We often think about our built infrastructure being resilient, but these phrases also refer to people.

Classroom Conversations

In order to help students better understand the concept of resilience, ask students to reflect on a time when they may have shown their resilience. Have they ever had a bicycle stolen? Or, perhaps as a child, a favourite toy broken? Or a stay in hospital or a broken bone?

Most currently, how did students feel when they endured being kept indoors for several months with no personal contact with their friends during the COVID-19 pandemic? The pandemic highlighted different needs for families: doing school work from home, did everyone in the house have access to the Internet? to use a computer? Were parents or guardians still able to work, either from home or at a job site? What were the concerns about bringing the virus into the home?

As we grow older, life events will impact us differently. A broken toy for an adult will not be as devastating as it is to a child. Or, if a home floods, it is the homeowner /adult who will need to "make things right" by ensuring all occupants are safe and dry, clean up any damage, make insurance arrangements and so on. In some examples, a child may not feel the full force of the impacts, as long as they are safe. Instead, the responsible adult will need to show resilience. In other examples, like the COVID-19 pandemic, responsibilities were placed on many individuals, adults and children alike, to make sacrifices and make things work for everyone's health.

Figure 4: Climate change hazards, impacts and adaptations



Image Source: [City of Edmonton](https://www.edmonton.ca)

Classroom Conversations

By adding the word "climate" you can shift the discussion to focus on climate resilience.

Choose a climate hazard and consider how that hazard might impact your school. Lead a discussion that includes some of the following considerations. Students may find it useful to draw on their experiences through the COVID-19 pandemic, with schools being closed:

- » Is the school prepared for the disturbance created by the climate hazard?
- » Would staff or students have to stay at the school? If yes, is the school prepared for "overnight guests" with sleeping bags and water and food?
- » How, or could, the school maintain its functions?
- » Is there a part of the school that might survive the impact, or a nearby school or building to accommodate students and lessons? Or is all learning available online so students can continue their studies from home (if students can go home) during the disruption?
- » Are there assets in the community that may be able to provide some assistance?
- » Is the school prepared to assist others in the community? Should the school be prepared to assist others?

Going further: Making a plan

What could the school do now to prepare for a climate hazard like this in the future? Is the school already prepared? If not, the school might develop its own climate adaptation plan in order to make the school resilient to climate change.

Case Study: Hurricane Maria

In September 2017, Hurricane Maria arrived on the small island of Puerto Rico, leaving the majority of people without electricity. The hurricane wreaked havoc on infrastructure (roads, buildings, power systems, etc.) and was known to be a humanitarian disaster long after, with many still suffering from the initial impact. More than half a year later, it was reported that thousands of customers still had no power, even leading into the next hurricane season that typically begins there in early June. The island was also hit by a huge "nor'easter storm" in March, 2018, adding more damage and necessitating road and school closures and some evacuations.

This [Wired article](#) speaks to the importance of redundancy in the power grid.

Redundancy means to build in duplication so that if one part of a system fails, another part can take over. As an example, bed-side clock radios are designed to plug into a power outlet, but many are also designed with "battery back-up" so that if there is a power failure, the clock will automatically switch to run off batteries. That way, the alarm clock will always be reliable, even during a power outage. The same is true for laptops that many of us use every day.

Classroom Conversations

Consider if a storm were to impact the entire city of Edmonton.

1. Would Edmonton's power grid survive the storm? How much time might it take to restore power to everyone?
2. Would Edmonton's communications system (including Internet provisions) remain intact?
3. Would Edmonton's water and drainage system be able to handle the impact?
4. Are individuals and communities prepared for potential impacts?

These are the types of questions that were being asked and discussed when developing *Climate Resilient Edmonton: Adaptation Strategy and Action Plan*. Review the Strategy to learn more about what is already in place for Edmonton (the Strategy) and what more needs to be done (the Action Plan) to create a climate resilient city.

edmonton.ca/climateresilience

Module 6: Be Prepared

Learning Objectives

- Identify climate hazards for Edmonton
- Know the difference between "shelter-in-place" and a "grab-and-go" emergency kits
- Identify actions to prepare for climate hazards before they appear
- Explain why "knowing your neighbours" is a recommended for emergency planning

Background information

Emergency preparedness looks much the same as climate preparedness. If someone is prepared for an emergency, they are likely partially prepared for climate hazards. With climate change, we can expect the frequency and intensity of events (also called climate shocks or climate hazards) such as flooding, extreme heat, severe winds, storms that cause power outages and so on, to increase due to climate change.

Being climate prepared includes an understanding of what climate hazards to expect, how to mitigate any hazards before they become an emergency, and how to respond in the event of an emergency. Preparing one's home to be resilient to these hazards is a good starting point. Preparing oneself and family to stay at home for many hours or days in the event of an emergency is another good practice. This is commonly called "shelter in place".

In the event you are required to leave your premises, it is important to have a "grab-and-go" kit that will help you to survive outside of your home for an extended period.

Another recommendation that can be critical for survival is to know your neighbours. It is said that during an emergency situation, the first responder is not a trained First Responder; rather the first to respond is usually a friend or neighbour. Most of us experienced the importance of "community" during COVID-19 when we were asked to stay in our homes.

Emergencies really only become emergencies when one is not prepared. So, as an example, while it would be next to impossible for an individual to prevent a water main break in their neighbourhood, every individual should be prepared for this by having a bottled supply of at least 4 litres of water per person, per day, for at least three days. Valuable items should be stored in waterproof containers, and elevated from any floors that might be prone to flooding, such as the basement.

These preparedness actions make sense, regardless of the cause of the water main break. As mentioned, being climate prepared is about assessing the various hazards we might expect from a changing climate and ensuring we understand that the frequency and severity of these hazards are expected to intensify over time. Taking time to think through what may happen is a good starting place for planning for an emergency of any type.

A [2014 study by Stats Canada](#) reports that fewer than half of all Albertans have engaged in a high number of emergency planning activities. Yet, 69% of Albertans reported having emergency supply kits for their vehicles.

Classroom Conversations (Teacher-led)

Lead a discussion with the class to help students understand the importance of preparing for climate change.

1. Ask students to describe some typical emergencies that currently occur in Edmonton resulting from severe weather. Responses might include fire from tinder-dry conditions in the River Valley or a grassy area; downed trees from severe winds; road closure due to icy roads or heavy snowfall; roads impassable due to heavy rain and overland flooding; power outage from icy electrical wires or fallen power lines; extreme heat making it unbearable to be outdoors or too warm indoors without air conditioning.
2. Discuss how to prepare for climate change so extreme weather events do not become an emergency. Following are some climate hazards that we should prepare for.
 - » **fire** – Avoid area unless you/your neighbourhood is affected, in which case you may be asked to evacuate. Do you have electronic copies of important documents stored safely? Do you have an evacuation plan in place at your house? At your school? Do you have extra copies of important contact numbers, identification and so on packed in your “grab-and-go” kit, in case you are told to evacuate? There are many things we can do to minimize the potential for fire at home, but also to prepare for a more widespread community or neighbourhood fire. To fireproof the outside of your home, learn more at: wildfire.alberta.ca/firesmart
 - » **severe wind** – Ensure anything “moveable” in your yard or on your balcony is secured or sheltered from the wind. Climate models indicate we should be prepared for higher winds than usual, as well as strong wind gusts. You might identify old, weak trees in your yard or community that would be prone to being blown down. For private property, homeowners could call an arborist, skilled at thinning tree crowns and reducing the opportunity for trees to become top-heavy and prone to blow-down.
 - » **flooded streets** – Ensure you have an adequate supply of water that is safe to drink (potable), in case water is shut off. If there is a chance of home/basement flooding, it is recommended to store valuable materials, like photos or important documents, in waterproof bins and keep them elevated off the floor.
 - » **power outage** – If affected, do you have an emergency number handy to report the outage? Important items to help individuals to “weather” this event include: back-up power (charged batteries, generator, portable solar charger), flashlights, extra blankets if during winter, portable phone charger, crank-up flashlight and radio; manual can opener and supply of high-protein foods that can be eaten cold. Limit the number of times that fridges and freezers are opened to keep food from spoiling.
 - » **heat wave** – In July, 2018, a large number of deaths (some reports say more than 65) resulted from a heat wave in Montreal and area. How do you prepare and how would you cope? Do you know your neighbours well enough to check on them? If your home is not equipped with air conditioning or a cool basement, is there a nearby public space your family could go to, to escape the heat? How do COVID-19 protocols impact the choices you have for where to escape the heat?
 - » **fire smoke** – Experts suggest we should expect the worst from every fire season into the future. Smoke knows no boundaries and, as we have witnessed in the recent past,

smoky air can settle into Edmonton from fires burning hundreds of kilometres away, sometimes in a different province. Inhaling smoke can be very hard on the respiratory system of those already suffering health issues, as well as the very young and the very old. Keep an eye on the [Air Quality Health Index](#) (AQHI) and learn how to protect yourself from poor air quality. Find Edmonton's AQHI on this [map](#).

- » **pet safety** – How would you keep your pets comfortable during an extreme weather event? Having a pet emergency kit is a good idea, both for sheltering in place for an extended period and in the event you must vacate your home.

Evacuation order

What if you and your family were forced to evacuate for an unknown period of time? What if you had little time to prepare? To make a bad situation bearable, it is suggested that everyone has a "grab-and-go" kit already prepared.

Personal preparedness

It is suggested that individuals have passports, insurance documents, bank information, and other pertinent documents in one place and ready to take in the event of an evacuation.

And don't forget about your pets! Pet supplies, food, water, identification and vaccination papers should all be ready to "grab-and-go".

Students should become familiar with how to prepare for short-term disruptions, as well as longer-term evacuations resulting from climate hazards, or emergencies in general. For information, visit edmonton.ca/emergencypreparedness for more in-depth information.

The Province of British Columbia is another source of information, with materials translated into Chinese, Vietnamese, French, Punjabi and Spanish. Visit their [Emergency Preparedness site](#) and click on "explore within" PreparedBC.

Another great source of information is the [Calgary Emergency Management Agency](#). Click on "Learn how" under Get Ready.

See "Taking Action" activity at the end of this guide (page 41) to become more familiar with climate hazards that we might expect in Edmonton.

Module 7: Air Quality and Climate Change: Is There a Connection?

Learning Objectives

- Understand sources of air pollution impacting Edmonton and region
- Understand what an airshed is
- Recognize the regional boundaries of the Alberta Capital Airshed
- Describe the difference between point source and non-point source pollution
- Interpret the meaning of the Air Quality Health Index (AQHI)
- Explore ways for individuals to reduce air pollution

Background information

Although air permeates large areas, it is still localized to regions based on physical geography and weather patterns. Limited dispersion means air quality concerns tend to be concentrated within a local airshed.

Airshed: a geographical area that shares a common flow of air; the atmosphere of that region is subject to similar conditions such as air pollutants and is managed at a local level.

Edmonton is part of the [Alberta Capital Airshed](#).

In the Edmonton region, the majority of air quality concerns are the result of **point source** industrial emissions (for example, from refineries and power plants) or **non-point (diffuse) source** emissions (for example, from vehicles). The Edmonton region is particularly vulnerable to air pollution because Edmonton is in a low-lying area, where the air seems to settle rather than be dispersed by prevailing westerly winds. This makes the area more susceptible to poor air quality, and provides

reason to be extra careful to minimize activities that contribute to poor air quality.

Point source emissions: can be traced back to their original source.

Non-point source or diffuse emissions: cannot be traced to a particular, single origin.

Air contaminants in the capital region

Nitrogen dioxide: from the combustion of fossil fuels (vehicles, home heating or industrial processes).

Sulphur dioxide: from natural sources like decaying organic matter and from human activities including burning coal, refining petroleum and producing chemicals.

Fine particulate matter: (2.5 micrometers or less in diameter) from primary sources like dust, dirt and smoke and from secondary sources when oxides of nitrogen, sulphur dioxide and volatile organic compounds (VOCs) react in the atmosphere.

Ground level ozone: formed through complex chemical reactions between VOCs and nitrogen oxides in the presence of heat and sunlight. It can be a significant component of smog.

To learn more about these contaminants and others, visit the [Alberta Capital Airshed](#) and follow the links under "Monitoring Data".

Activity

Have students research the health impacts of the air contaminants listed above. They will find that these contaminants impact the respiratory system (nose, throat, airways, lungs, etc.) in various ways. If available, borrow one of the City's [AirBeam kits](#) to learn more about the air quality in your neighbourhood.

Teacher Information: A breath of fresh air

The air quality in our city impacts personal health, well-being and the environment. For current information on local air quality, we look to the Alberta Capital Airshed. This organization supplies measurements from several monitoring stations in the Edmonton region and reports concentrations of carbon monoxide, particulate matter, nitrogen oxides, ground level ozone, sulphur dioxide, hydrogen sulphide, methane and total hydrocarbons.

To help navigate air quality and the associated risks, we use the province's Air Quality Health Index (AQHI). The AQHI is a tool that rates local air quality on a scale from 1 to 10+. The lower the number, the lower the risk.

Figure 5: Air Quality Health Index



Recall May 30, 2019, when the AQHI peaked at 72 in Edmonton. Note: The scale goes only from 1 to 10+.

A quick Internet search will provide photos like this one. Some described that day as "apocalyptic".



Classroom Conversations

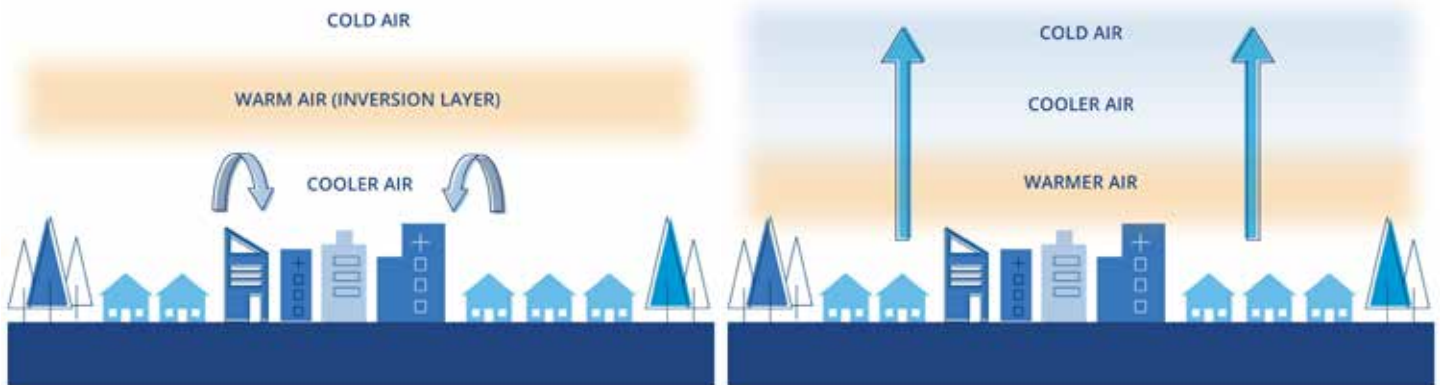
1. What do you think are the main contributors to poor air quality in Edmonton?
(Answer: point source emissions: refineries, industry, power plants; non-point source emissions: vehicles; natural sources: surrounding forest fires)
2. Observe today's AQHI rating by visiting capitalairshed.ca or airquality.alberta.ca/map. How might this air quality risk assessment impact your daily activities?
3. Generally speaking, most days in Edmonton range between 2 and 4 on the AQHI scale. However on July 11, 2015 AQHI ratings ranged from 8 to 10 (indicating a high to very high risk). Use your Internet search skills to determine why there was a sharp decline in air quality on this date. Suggested search terms include: July 11, 2015, air quality, Edmonton.
4. What other dates indicate a high risk? HINT: wildfire in Fort McMurray, May 2016; BC wildfires, July 2017, August 2018; Northern Alberta wildfires, May 2019. How high did the AQHI register during these smoke events?

Winter smog

Did you know, during the winter months air quality ratings in Edmonton are often higher, indicating a high health risk?

Wintertime smog occurs during a **temperature inversion**, when a layer of warm air traps a layer of cool air close to the ground. The upper layer acts like a lid, trapping in any air pollutants. Temperature inversions are most common in the winter and will break up when wind mixes air layers or the ground heats up and warm air rises.

Figure 6: Temperature inversion (left) and normal conditions (right)



Teacher Information: Air quality and climate change: Making the connection

Air pollution and climate change are closely related. The main sources of carbon emissions—the extraction and burning of fossil fuels—are not only key drivers of climate change, but also sources of air pollutants. Burning different fossil fuels results in higher and lower concentrations of GHGs.

For example, we often refer to natural gas as “clean burning” while coal produces more pollutants and releases more GHGs. Furthermore, many air pollutants that are harmful to human health and ecosystems also contribute to climate change by affecting the amount of incoming sunlight that is reflected or absorbed by the atmosphere, with some pollutants warming and others cooling the Earth.

Smog: smog contains ground-level ozone, which forms faster at higher temperatures. Read about [how climate change can cause more air pollution](#).

Forest fires: With rising temperatures and drier vegetation comes the increased risk of forest fires. Fire smoke can travel long distances and linger in the air. Pollutants that are released from burning wood can have adverse health effects. The [BC Centre for Disease Control](#) has developed a series of fact sheets about wildlife smoke..

Pollen: Climate change can lead to a longer pollen season, triggering more allergies. Plants tend to release more pollen with increased levels of carbon dioxide, too. (Source: [Live Science](#))

While air quality is by no means an indicator of climate change, atmospheric systems are connected. Air quality is impactful and immediate and therefore it is common for people to feel more connected to local air quality than to climate change.

To keep air quality in your sights, consider investing in a Wi-Fi enabled light bulb and downloading an app developed with support from the City of Edmonton. Once the app is linked to the light bulb via wi-fi, the bulb will change colour according to the Air Quality Health Index (AQHI) and update itself hourly with the AQHI. Some schools and agencies have [designed and built their own lamps](#).

For more information about air quality, visit edmonton.ca/airquality and to hook up your own lamp, visit smartcities.edmonton.ca/resources/#iftt.

Module 8: Living in the Future, Today!

Learning Objectives

- Appreciate how urban density and transportation mode shift contribute to sustainable cities.
- Consider how infill projects contribute to resilience
- Be introduced to the concept of "resilience hubs" and what this means for Edmonton
- Explore sustainable building design of the Jasper Place Branch of the Edmonton Public Library
- Explore sustainable community design through the Blatchford redevelopment project and other resources

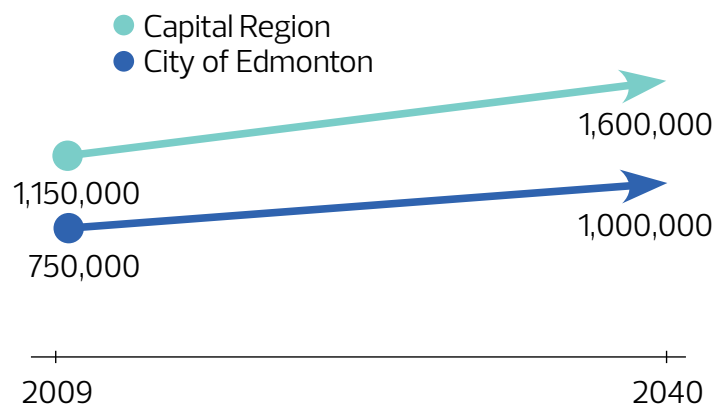
Teacher Information: Auto-dependency and transportation mode-shift

Edmonton is a dynamic, innovative city! The City is planning for a sustainable future by encouraging urban development that brings people closer to the services they use, and gives them access to different modes of transportation. Like most Canadian cities, much of Edmonton was built around vehicle traffic rather than foot or bicycle traffic. The City is working on mode shift (i.e., providing options for active and public modes of transportation, in addition to personal vehicles), but given the design of our streets and neighbourhoods, this is much easier said than done. Creative thinking and a willingness among residents to be part of this transformation is required to lead us to a future that is not so dependent on large, single-occupant vehicles.

A growing city

In two years (between 2012–2014), Edmonton's population grew by 7.4%. Think of it as if the city welcomed 82 additional people every day. Edmonton's current strategic plan, Connect Edmonton (edmonton.ca/connectedmton), suggests that Edmonton could see as many as 2 million people by 2050. This ten-year plan takes us from 2019 to 2028, and is intended to put us on a path to design our city for double the population we have now.

Figure 7: Edmonton's projected population



City Plan

The City Plan combines a Municipal Development Plan and a Transportation Master Plan into one that sets direction for the way Edmonton grows, its mobility systems, open spaces, employment and social networks. Approved by City Council in late 2020, it will track progress around five Big City Moves: (1) Greener as we Grow, (2) a Rebuildable City, (3) a Community of Communities, (4) Inclusive and Compassionate and (5) Catalyze and Converge.

Learn more about The City Plan at edmonton.ca/cityplan.

As our population increases, our city's footprint changes. Urban sprawl is a term used to describe the expansion of the population away from the city's core, often into vehicle-dependent communities.

The City is responding to this concern with plans to build up, in and out.

Up – by constructing new low, mid and high-rise condos and office towers.

In – by accommodating more people in existing neighbourhoods and encouraging infill.

Out – by committing to thoughtful new development projects on the edges of our city that require higher density neighbourhoods.

Residential infill is the development of new houses in mature neighbourhoods. These are neighbourhoods that are older, well-established, often with tree-lined streets. Infill might include secondary suites (a self-contained living space within a house, with its own entrance, kitchen bathroom and living area) or a "garden suite". These developments use land and resources more efficiently and make use of existing roads, sidewalks, alleys, streetlights, utilities (power, water, stormwater and sewage lines) and community spaces. Learn more at:

edmonton.ca/evolvinginfill

Case Study: Sustainable public spaces

The Jasper Place Branch of the Edmonton Public Library (EPL) demonstrates the City's commitment to meeting higher standards for building construction and energy efficiency.

Originally built in 1961, the Jasper Place Library has been a community cornerstone in west Edmonton. The library was renovated in 2013 with sustainability as a central focus. Some of the more notable



features include: charging stations for electric vehicles, bicycle storage and change rooms.

Care was taken in the design and construction so no mature trees were damaged. Architects considered water and lighting when they designed this family-oriented space. The use of low-flow and electric water fixtures reduce water use by 52% and many large windows allow 75% of the building to receive natural light.

Finally the building itself was built using recycled materials and 75% of all construction waste, including concrete and wood, was diverted from landfill and either reused or recycled. Jasper Place Library has shown that reducing energy and building with the environment in mind does not mean compromising on function or aesthetics.

Classroom Conversations (Teacher-led): Being green

1. Why is it important for the City of Edmonton to build energy efficient buildings? (set a standard of excellence, show leadership, good stewards of taxpayer's money; it costs less to operate an energy efficient building)
2. Can you think of any barriers to building "green" in Edmonton? (up front costs, availability of materials, changing technology, cold weather, expertise required)

3. Why do you think people want to live and work in “green” spaces?
4. Does your school show any examples of green building practices? Describe them. If not, is this something you feel you could change?

If students are interested to learn about energy efficient design, they could research [features of the Lois Hole Branch](#) of the Edmonton Public Library.

Another building that may be of interest to research is the [Mosaic Centre](#). A source of pride for Edmonton, it is Alberta’s first net-zero, LEED Platinum Certified commercial building.

Classroom Conversations (Teacher-led): Resilience hubs

Resilience Hubs are considered to be well-used, trusted facilities that serve the community. Successful Resilience Hubs are able to not only support citizens, but also coordinate communication and supplies before, during, and after a disruption. Ideally, they serve citizens year-round as centres for building a sense of community and stand out as an effort to revitalize the community. In the strategy [Climate Resilient Edmonton: ASAP](#) the City identifies that a Resilience Hub network may be necessary for Edmonton (see Action #8, Page 37 of the Strategy).

While no Resilience Hubs have been identified to date (January 2021), what role might a public space like the Jasper Place Branch of the EPL play in the event of a climate hazard event? Ask students to list some of the attributes of this library that would lend itself well to become a resilience hub.

These features that were mentioned in the case study:

- » Energy efficient
- » Community cornerstone
- » Charging stations for electric vehicles
- » Bicycle storage

- » Change rooms
- » Family-oriented space
- » Reduced water demand
- » Natural lighting via large windows
- » Recycled and reused building materials (likely contribute to excellent indoor air quality)

Could your school become a resilience hub? Would this make better sense while school is in or when students are on break, or a combination of both?

Note: Some studies show that during times of disruption, it is important that schools be up and running as soon as possible in order to maintain some “normalcy” for the student body. Otherwise, mental health challenges may begin to set in—for those increasingly concerned about their grades and losing school time, as well as those suffering the loss of personal connection among friends and classmates. Other studies show that schools are natural community resilience hubs due to the amenities built into them.

Question for class discussion: After your experience with school closures for COVID-19, what are your thoughts about schools becoming resilience hubs?

Case Study

Teacher Information: Mobile-friendly communities

Blatchford is a community being built in central Edmonton that will create new opportunities for people to connect with each other, their city and the environment. Blatchford will set a new standard for livable and healthy communities.

The City of Edmonton is designing Blatchford to provide residents with transportation options other than driving. The community will be walkable, bike-friendly and transit-oriented. Pedestrian comfort and safety will be provided by custom-designed streets, sidewalks and boulevards. Important destinations and activity centres, such as schools, parks, restaurants and stores, will be within walking distance of residential areas and linked by walking and cycling routes.

Public transportation will be accessible throughout the community. With numerous transit stops and two planned LRT stops in the community, using public transit will be easy for residents and visitors of Blatchford.

By designing the community for pedestrians, cyclists and public transit first, many residents may choose to drive less and may even choose to own fewer vehicles, if any. This means reduced greenhouse gas emissions, safer streets and healthier people.

Explore [BlatchfordEdmonton.ca](https://blatchfordedmonton.ca) for a sense of how the community is shaping up.

Activity

Locate the Blatchford development site on a city of Edmonton map (old City Centre Airport). [This map](#) offers an aerial view of the city and includes services that can be toggled on and off.

Share or project images of the [Blatchford design](#) plan with students.

- » What do you see in the plan that might contribute to a sustainable community?
- » What do you think of the design plan? Is this a place you would like to live?
- » Blatchford is an infill development; what are the benefits of its location within the city?

Other Resources

[Blatchford: Building a Sustainable Community](#) (video)

[Blatchford: Our Purpose](#) (video)

[Blatchford Renewable Energy](#)

Mayor Don Iveson also has a vision for a sustainable neighbourhood and city, visit edmonton.ca/RenewableSeries and click on "Season Two: The Edmonton Declaration".

[Season One has seven videos related to climate action in Edmonton.]

Classroom Conversations

More than just mobile-friendly, Blatchford is intentionally designed to be a liveable, sustainable community. Imagine the Blatchford Development team has hired you to advise on how to become climate resilient. What are some features of a climate resilient neighbourhood that Blatchford should consider for its design (if it hasn't already done so)?

Responses might include the following:

- » Creating a complete community where retail (shopping), residential (living), institutional (schools), offices (work), green spaces (recreational) are combined. Complete communities mean people can meet almost all their daily needs in one place.
- » Use of renewable energy sources to provide energy (heating, cooling, hot water, power) to the community.
- » Highly insulated homes to ensure homes will stay cool in summer during extreme heat days and stay warm in winter, especially during deep freezes.
- » Energy efficient homes to ensure a minimal reliance on heating fuels and to minimize heating and cooling costs.
- » Other sustainability features in homes and buildings such as high performance windows, energy efficient appliances, water conserving fixtures (toilets, shower heads, etc).
- » Considering how to reduce construction waste
- » Designed for ease of walking, cycling, public transit and other environmentally friendly forms of transportation.
- » Installation of electric vehicle (EV) charging stations to minimize air pollution in the area. (Question: should EVs be mandatory choice for vehicle owners living in Blatchford?)
- » Low Impact Development (LID) designs to capture rainwater on site rather than creating run-off situations.
- » Rainwater capture and storage for watering gardens and green spaces.
- » Green roofs to keep buildings and homes cooler and to absorb water from excessive rainfalls, therefore reducing run-off. Green roofs can even reduce the need for air conditioning.
- » Planting of drought-tolerant species that can adapt to a warmer and drier climate.
- » Community gardens and edible landscaping to support local food production.
- » Planting shade trees to help with cooling during extreme heat events.
- » Prioritizing green spaces (parks, etc) and integrating them into the community (green spaces not only for people, but for birds, bees, etc).
- » Looking for new technologies that will continue to be a part of the search for sustainable solutions (look for partnerships with others to share knowledge and experience to meet ongoing sustainability challenges and opportunities).

Module 9: Taking Action

Learning Objectives

- Recall examples of climate hazards
- Identify adaptation responses for particular climate hazards
- Consider taking action to adapt to a changing climate, individually, as a class or as a school

Learning for the sake of learning is not good enough when it comes to climate change.

Lead a discussion with your students to explore individual, home, neighbourhood, community or school actions that would contribute to building a resilient Edmonton. Are there potential actions students might take on at home or in their community? What about as part of a school environment club?

Activity: Climate hazards and adaptation responses

On the next page you will find a table of climate hazards and possible responses. Review some of the hazard with the students and have them suggest responses. Discuss or assign students to research any concepts that may be new to them. Adaptation actions would occur in advance, in preparation of a climate hazard.

Explore the [Climate Atlas of Canada](#) for local information and climateresilienthome.ca for ideas.

CLIMATE HAZARD	POSSIBLE ADAPTATION RESPONSE
Flooding	<ul style="list-style-type: none"> » Low Impact Development, including permeable pavement: <ul style="list-style-type: none"> • Edmonton • Calgary » Know your neighbours and check on their safety » Prepare for flooding in advance » Floodproof your space
Drought	<ul style="list-style-type: none"> » Rain barrels, cisterns (collect during rainfall, use during dry periods) » Plant drought-tolerant plants and trees » Increase depth of topsoil in yards, to be able to hold more moisture » Cover planted areas with mulch and compost to retain moisture
Heat wave	<ul style="list-style-type: none"> » Shade trees/shade landscaping » Misting stations » Public water fountains » Access to cool buildings (basements of public buildings; air conditioned areas) » Know your neighbours and check on them to ensure they are safe » Understand "heat islands" » Understand the impacts of too much heat
Emergency due to extreme event	<ul style="list-style-type: none"> » Ensure emergency preparedness training (in advance) » Schools have stock of basic needs in the event that students or teachers become stranded at school » Home emergency plans are in place » Know your neighbours and check on them to ensure they are safe » Be more knowledgeable
Roads impassable; grocery store delivery is impacted	<ul style="list-style-type: none"> » Grow a garden » Support local farmers, eat local » Keep a supply of water handy » Know your neighbours and ensure adequate food for all » Have a "shelter-in-place" (or "ready-to-stay") kit available » Know where to find information

Explore some of the [green projects by Edmonton schools](#). Are these ideas you might bring to your school?

How else could you contribute to your school's environmental initiatives?

More ideas can be found in [Change Homes and Change Habits for Climate guides](#).

Funding your project

Here are some places you might find funding to help bring your project to life.

The Alberta Council for Environmental Education has put together a list of grants, contests and awards to help get your ideas off the ground and celebrate your environmental achievements.

abcee.org/grants-contests-awards

The City of Edmonton offers grants/sponsorships for energy and climate-related projects. Visit edmonton.ca/envirosponsorship to learn more.

Additional Resources for Information and Teaching

City of Edmonton Resources

The Way We Green: Classroom Conversations Teacher's Guide
edmonton.ca/greeneducation
(Under "Senior High")

Change Homes for Climate Guide (retrofits and landscaping)
edmonton.ca/ChangeForClimateGuides

Change Habits for Climate Guide (lifestyle)
edmonton.ca/ChangeForClimateGuides

Environmental Education Resources

Alberta Council for Environmental Education
www.abcee.org

Search through this Government of Alberta site for education resources, including Focus on Climate Change.
www.alberta.ca/listing-of-environmental-education-resources.aspx

ATCO Energy Sense
www.atcoenergysense.com/In-Your-Community/Teacher-Resources

Canadian Geographic – Energy IQ & Classroom Energy Diet

- » energyiq.canadiangeographic.ca
- » energydiet.canadiangeographic.ca

City of Edmonton – Environment-related programs and grants offered by the City and links to external providers
edmonton.ca/greeneducation

Green Learning – Energy & Climate Change Resources
www.greenlearning.ca

Inside Education – Energy, Climate Change & Stewardship Teacher Resources; professional development opportunities for teachers and students

- » insideeducation.ca
- » www.energydialogues.ca

Master of Disaster – Developed by Emergency Preparedness at the Government of British Columbia, it consists of teaching and learning materials to help young people learn about being prepared. Available in English and in French.

www2.gov.bc.ca/gov/content/safety/emergency-preparedness-response-recovery/preparedbc/public-education-programs/master-of-disaster

SEEDS Foundation – Energy Literacy Series
www.seedsfoundation.ca

Other Information Resources

CBC: In our Backyard–What Climate Change in Canada Looks Like

cbc.ca/news2/interactives/inourbackyard

Climate Atlas of Canada

climateatlas.ca

EPCOR

- » Flood prevention and maintenance
epcor.com/products-services/drainage/flooding-flood-prevention/flood-prevention-homeowner-programs
- » Water conservation
epcor.com/learn/efficiency-conservation

Government of Alberta

www.alberta.ca/climate-change.aspx

Government of Canada

www.canada.ca/en/services/environment.html

Institute for Advanced Sustainability Studies (IASS)

www.iass-potsdam.de/en/output/dossiers/air-pollution-and-climate-change

Intact Centre on Climate Adaptation

www.intactcentreclimateadaptation.ca

The Star: Undeniable–Canada’s Changing Climate (heat wave focus)

projects.thestar.com/climate-change-canada/quebec

Websites Referenced throughout this Guide

Overview

[Climate Change FAQs](#)

edmonton.ca/city_government/environmental_stewardship/energy-climate-change-faq.aspx

[Energy Transition Strategy](#)

edmonton.ca/city_government/city_vision_and_strategic_plan/energy-transition.aspx

[Climate Resilient Edmonton: Adaptation Strategy and Action Plan](#)

edmonton.ca/climateresilience

[ConnectEdmonton](#)

edmonton.ca/connectedmonton

[Building a Climate Resilient City](#)

www.iisd.org/project/building-climate-resilient-city

[Climate Change Discussion Papers](#)

edmonton.ca/city_government/city_vision_and_strategic_plan/climate-change-discussion-papers.aspx

Module 1

[Alberta Energy History up to 1999](#)

alberta.ca/alberta-energy-history-up-to-1999.aspx

Module 2

[CitiesIPCC Cities and Climate Change Science Conference](#)

ipcc.ch/event/cities-and-climate-change-science-conference

[Public Tableau: Edmonton's Changing Climate - Temperature Over Time](#)

public.tableau.com/profile/change.for.climate#!/vizhome/EdmontonsChangingClimateAvgTemperaturefrom1880-2019/TemperatureoverTime

[Pecha Kucha presentation](#)

pechakucha.org/presentations/transforming-to-a-resilient-city

Module 3

[Complexities of climate models](#)

youtube.com/watch?v=fAiWNQmgeqY

[Alberta Biodiversity Monitoring Institute](#)

abmi.ca/home/reports/2018/human-footprint/Natural-Regions

[Interactive website](#)

learnalberta.ca/content/sszi/en/index.html

[Definitions](#)

edmonton.ca/city_government/environmental_stewardship/energy-climate-change-faq.aspx

[Climate Change Frequently Asked Questions](#)

edmonton.ca/city_government/environmental_stewardship/energy-climate-change-faq.aspx

Module 4

[Poster](#)

edmonton.ca/city_government/documents/Images/EconomyCultureGraphicRecording.jpg

[Climate Change Frequently Asked Questions](#)

edmonton.ca/city_government/environmental_stewardship/energy-climate-change-faq.aspx

[Climate Resilient Home](#)

climateresilienthome.ca

["Roads and Active Transportation + Rail"](#)

edmonton.ca/city_government/documents/Images/Roads_Rail_small.jpg

[City of Edmonton](#) (Figure 3 image source)

edmonton.ca/city_government/documents/Images/Roads_Rail_small.jpg

[Full interview with Mayor Iveson](#)

greenenergyfutures.ca/episode/iveson-edmonton-energy-transition-strategy

Module 5

[City of Edmonton](https://www.edmonton.ca/city_government/documents/Images/EconomyCultureGraphicRecording.jpg) (Figure 4 image source)
edmonton.ca/city_government/documents/
Images/EconomyCultureGraphicRecording.jpg

[Wired article](https://www.wired.com/story/why-cant-we-fix-puerto-ricos-power-grid)

wired.com/story/why-cant-we-fix-puerto-ricos-
power-grid

Module 6

[2014 study by Stats Canada](https://www150.statcan.gc.ca/n1/en/pub/85-002-x/2015001/article/14234-eng.pdf?st%3D0G-BvuF9&sa=D&ust=1611170722437000&usg=AFQjCNGdLqECra7ir1vUOxCyCCOUmOI8og)

www150.statcan.gc.ca/n1/en/pub/85-
002-x/2015001/article/14234-eng.pdf?st%3D0G-
BvuF9&sa=D&ust=1611170722437000&usg=AFQjC
NGdLqECra7ir1vUOxCyCCOUmOI8og

[Air Quality Health Index](https://airquality.alberta.ca/air-quality-health-index.aspx)

alberta.ca/air-quality-health-index.aspx

[Map](https://airquality.alberta.ca/map)

airquality.alberta.ca/map

[BC Emergency Preparedness site](https://www2.gov.bc.ca/gov/content/safety/emergency-preparedness-response-recovery)

www2.gov.bc.ca/gov/content/safety/emergency-
preparedness-response-recovery

[Calgary Emergency Management Agency](https://calgary.ca/cema)

calgary.ca/cema

Module 7

[Alberta Capital Airshed](https://capitalairshed.ca)

capitalairshed.ca

[AirBeam kits](https://edmonton.ca/programs_services/environmental/airbeam-kit.aspx)

edmonton.ca/programs_services/environmental/
airbeam-kit.aspx

[How climate change can cause more air pollution](https://livescience.com/57913-climate-change-will-increase-air-pollution.html)

ivescience.com/57913-climate-change-will-
increase-air-pollution.html

[BC Centre for Disease Control](https://bccdc.ca/health-info/prevention-public-health/wildfire-smoke)

bccdc.ca/health-info/prevention-public-health/
wildfire-smoke

[Live Science](https://livescience.com/57913-climate-change-will-increase-air-pollution.html)

livescience.com/57913-climate-change-will-
increase-air-pollution.html

[Designed and built their own lamps](https://lica.ca/wp-content/uploads/2019/07/Website-AQHI-Poster.pdf)

lica.ca/wp-content/uploads/2019/07/Website-
AQHI-Poster.pdf

Module 8

[Features of the Lois Hole Branch](https://edmonton.ca/city_government/urban_planning_and_design/lois-hole-library.aspx)

edmonton.ca/city_government/urban_planning_
and_design/lois-hole-library.aspx

[Mosaic Centre](https://primedmosaiccentre.com)

primedmosaiccentre.com

[Climate Resilient Edmonton: ASAP](https://edmonton.ca/climateresilience)

edmonton.ca/climateresilience

[This map](https://edmonton.ca/residential_neighbourhoods/neighbourhoods/neighbourhood-maps.aspx) (aerial view of the city)

edmonton.ca/residential_neighbourhoods/
neighbourhoods/neighbourhood-maps.aspx

[Blatchford design](https://blatchfordedmonton.ca/community/#neighbourhood_plan)

blatchfordedmonton.ca/
community/#neighbourhood_plan

[Blatchford: Building a Sustainable Community](https://youtube.com/watch?v=EF94nrEiiGE)

youtube.com/watch?v=EF94nrEiiGE

[Blatchford: Our Purpose](https://youtu.be/Jxd703FEZcU)

youtu.be/Jxd703FEZcU

[Blatchford Renewable Energy](https://blatchfordutility.ca)

https://blatchfordutility.ca

Module 9

[Climate Atlas of Canada](#)

climateatlas.ca/city-reports

Low Impact Development

[Edmonton](#)

edmonton.ca/city_government/environmental_stewardship/low-impact-development.aspx

[Calgary](#)

calgary.ca/UEP/Water/Pages/Watersheds-and-rivers/Erosion-and-sediment-control/Low-Impact-Development.aspx

[Prepare for flooding in advance](#)

epcor.com/products-services/drainage/flooding-flood-prevention

[Floodproof your space](#)

intactcentreclimateadaptation.ca/programs/home_flood_protect/resources

["Heat islands"](#)

climateatlas.ca/urban-heat-island-effect

[Impacts of too much heat](#)

canada.ca/en/health-canada/services/sun-safety/extreme-heat-heat-waves.html

[Home emergency plans](#)

edmonton.ca/programs_services/emergency-preparedness.aspx

[Be more knowledgeable](#)

canada.ca/en/services/environment/weather.html

[Know where to find information](#)

edmonton.ca/programs_services/emergency-preparedness.aspx

[green projects by Edmonton schools](#)

enviomatters.epsb.ca/recognition/school

[Change Homes and Change Habits for Climate guides](#)

edmonton.ca/ChangeForClimateGuides

Glossary

Airshed: a geographical area that shares a common flow of air; the atmosphere of that region is subject to similar conditions such as air pollutants and is managed at a local level.

Climate adaptation: lowering the risks and negative impacts of a changing climate so that communities and ecosystems are prepared to cope with the new climate conditions.

Climate mitigation: addressing the underlying causes of climate change by reducing greenhouse gas emissions.

Climate resilient city: a city able to bounce back fairly quickly from major disturbances or shocks, while maintaining the functions and services it provides to its citizens. Resilient cities ensure redundancy so they can be flexible and adaptable when required.

Emission Neutral Building: An emission neutral building is one that is highly energy efficient and uses only renewable energy for its operations, OR produces and supplies onsite renewable energy in an amount sufficient to offset the annual greenhouse gas emissions associated with its operations.

Energy transition: a long-term change that shifts us from relying on fossil fuels to relying more on energy sources that are sustainable and low or zero-carbon.

Fine particulate matter: (2.5 micrometers or less in diameter) from primary sources like dust, dirt and smoke and from secondary sources when oxides of nitrogen, sulphur dioxide and volatile organic compounds (VOCs) react in the atmosphere.

Ground level ozone: formed through complex chemical reactions between VOCs and nitrogen oxides in the presence of heat and sunlight. It can be a significant component of smog.

Heat island: the concentration of heat resulting from infrastructure.

Low Carbon City: A city that has a minimal output of greenhouse gases into the environment biosphere.

Net Zero: Net zero emissions are achieved when emissions of greenhouse gases are balanced by removals. Emissions should be reduced as close to zero as possible, and remaining emissions would be balanced by an equivalent amount of carbon removal, through nature based solutions or technology.

Nitrogen dioxide: from the combustion of fossil fuels (vehicles, home heating or industrial processes).

Non-point source or diffuse emissions: emissions that cannot be traced to a particular, single origin.

Point source emissions: emissions that can be traced back to their original source.

Residential infill: the development of new houses in mature neighbourhoods. These are neighbourhoods that are older, well-established, often with tree-lined streets.

Resilient: having the capacity to withstand environmental disturbances and bounce back from them intact.

Risks: the chances of something happening (probability), combined with the consequences of an event. Usually it involves a calculation of the probability of a climate event occurring, and then discussing vulnerabilities to that climate event.

Sulphur dioxide: from natural sources like decaying organic matter and from human activities including burning coal, refining petroleum and producing chemicals.

Sustainable: enduring over a prolonged period as an integral part of Earth's natural systems.

Temperature inversion: when a layer of warm air traps a layer of cool air close to the ground.

Vulnerabilities: being sensitive or susceptible to harm and not having the capacity to cope with the harmful impacts.

Climate Conversations (Version 1, March 2021)

Questions or comments?

Contact change4climate@edmonton.ca

