

TEACHER'S GUIDE

TO WHAT DEGREE?

Telling Climate Change Stories Through Photos

A Lesson Plan for Grade 6 to 9

Preparing for climate-driven health impacts

A scientist examines E. Coli growing in a petri dish. Counting these colonies tells us about how much bacteria is present in the originating sample, of sewage overflow for example.

More intense weather like heavy rainfall and extreme temperatures put our health and well-being at risk. Weather like this may spread disease, pollute our waterways, and impact our environment and ecosystems. Canadian scientists are preparing for these changes by making advances through research, laboratory work, technology and monitoring that will help us address climate change impacts.

Préparation pour les effets sur la santé du climat

Une scientifique examine des bactéries E. coli qui poussent dans une boîte de Pétri. Le comptage de ces colonies permet de dénombrer les bactéries dans l'échantillon d'origine, comme celui provenant du débordement des eaux usées par exemple.

Les événements météorologiques plus extrêmes, comme les fortes pluies et températures extrêmes peuvent mettre en péril notre santé et notre bien-être. Ces phénomènes météorologiques peuvent propager des maladies, polluer nos cours d'eau et modifier notre environnement et nos écosystèmes. Des scientifiques canadiens se préparent à ces changements en faisant avancer les recherches, les travaux de laboratoire, la technologie et la surveillance qui nous aideront à faire face aux effets du changement climatique.

TEACHER BACKGROUND

INTRODUCTION

Welcome to a series of activities designed to engage you and your students in a discussion on climate change and energy in Canada. Using photographs from Ingenium Canada's new exhibition, **To What Degree? Canada in a Changing Climate**, your students will be exploring the power of photos to tell the story of how climate change is impacting Canada today.

CONTEXT

This unit plan is comprised of four lessons to develop critical thinking around climate change adaptation and mitigation. We hope they will help you engage with your students in discussions on the impacts of climate change through visual, digital, and critical literacy by using source material from the travelling exhibition. **To What Degree? Canada in a Changing Climate** tells stories of climate change impacts across sectors in Canada, from agriculture to transportation, biodiversity to wildfires, cool roofs to urban forests, and diseases to electric vehicles. Over the course of this unit, students will explore the power of photos to tell a compelling story on larger topics—such as climate change—that are often challenging to explain.

THEME AND GRADES

This unit is geared towards Grades 6 to 9 (Primary 6 to Secondary 3), with a focus on middle years and early high school. The activities and final project have connections not only to science, but to social science and language arts as well. Canadian National Standards for Geography and Natural Science Training Outcomes are provided, to connect the outcomes of the activities to your own respective curriculum.

Key themes of the activities and concepts include:

- Climate change adaptation and mitigation
- Science communication
- Photo and media literacy
- Community learning
- Environmental citizenship
- Visual design
- Geography

You may wish to use the lesson plans in order—as a mini-unit on climate change—or pick and choose activities or discussions from them to accompany your teaching plan. Each lesson begins with a shorter activity, then moves into extensive exercise building on climate change knowledge in an inquiry-based environment. There are suggestions for evaluation in each lesson plan, and an editable evaluation rubric for the final project.

LESSON OUTLINE

PART 1: How do we adapt to and prevent climate change? (1 class)

- Opens with a value line activity, to brainstorm and discuss prior knowledge of climate change
- Work in groups to categorize activities as either adaptation or mitigation
- Students connect actions and activities they see locally as examples of adaptation and/or mitigation

PART 2: A picture tells a thousand stories (2 classes)

- Opens with a *Family Feud* competition, to talk about how different actions have different impacts on mitigating climate change
- Explore how photos can effectively tell a story on the environment and climate change
- Analyze photos from the exhibit, then create word clouds and captions for one of the images
- Share their created captions and the real caption is revealed

PART 3: Researching climate change (2 classes)

- Delve deeper into one of the photos and conduct research to get a bigger picture of the story
- A 'first steps' list of news articles, infographics, and videos from government, news sources, etc. are provided as a starting point (as needed)
- Present back to others on the story, with more information in a Museum Walk format.

PART 4: Climate change in our words and photos (3 classes)

- Work together as a class on a climate change photo exhibition of their own
- Tell a local/global story with their own photos or research, or approach it as an art project
- Research background information and create captions
- Share and display with other classes, the school, and ideally the greater community

Unit length: 2 weeks

LOOKING FOR MORE CLIMATE CHANGE AND ENERGY LESSON PLANS?

For more information on other resources and lesson plans, visit our website at: www.letstalkenergy.ca Here you will find our climate change infographic and lesson plan series, geared towards grades 7 to 12, that focuses on urban life and biodiversity. You'll also discover online resources from Ingenium – Canada's Museums of Science and Innovation, literacy organization recommendations from across the country, our curated YouTube channel, Pinterest board, and other lesson plans and ideas on energy and climate change.

ABOUT THE EXHIBITION

Canada's changing climate is a deeply complex issue that presents us with both losses and opportunities. Adapting to it is challenging but necessary. **To What Degree? Canada in a Changing Climate** is a new, travelling photographic display sharing Canadian stories, some hopeful, some disheartening, all true, and all happening right now.

Created in partnership with the Government of Canada and Canadian Geographic, this travelling display tells of the unique ways that people and ecosystems within Canada are adapting to our changing climate. Through compelling photography and minimal text, these stories explore individual and community resilience in the face of extreme events. Even in the face of heat, storms, wildfires, and changes in livelihood due to habitat shifts, possibilities still exist for improved quality of life.

This unit highlights 10 photos from the exhibit. If your community is interested in booking a digital or physical copy to show, please contact Ingenium's Travelling Exhibits office at: outreach-rayonnement@IngeniumCanada.org

FEEDBACK

We welcome feedback on this and other lesson plans we have developed. Let us know how the lessons and share your class's climate change exhibit with us.

Tag us on social media [@enertweets](https://twitter.com/enertweets) on Twitter, [Facebook.com/talkenergy.parlonsenergie](https://facebook.com/talkenergy.parlonsenergie), or email us at: energy-energie@ingeniumcanada.org

ACKNOWLEDGEMENTS

To What Degree? Canada in a Changing Climate was produced by Let's Talk Energy, an energy and climate change initiative under Ingenium – Canada's Museums of Science and Innovation, along with the following Government of Canada departments:

- Transport Canada
- Environment and Climate Change Canada
- Natural Resources Canada
- Public Health Agency of Canada
- Health Canada
- Indigenous and Northern Affairs Canada
- Fisheries and Oceans Canada

Lead writing and creation of this unit was done by the team at Let's Talk Energy, along with testing and resource sharing feedback from the departments listed above. Thanks to Adam Young, Jason Armstrong, Shane Patey, Lucija Prelovec, Carolyn Holland, Steven Fabbro, and Katherine Dunster (Canada Science & Technology Museum) for testing and feedback, Raluca Ellis (Ontario Science Centre) for use of editing notes, Sonia Mendes (Ingenium) and Elizabeth Shepherd for text editing, and Gabriel Ruest for graphic design and layout. Finally, thanks to our group of student testers.

THE COMMON FRAMEWORK OF SCIENCE LEARNING OUTCOMES, GRADES 4-6 (1997)

Social and Environmental Contexts of Technology

- Describe applications of science and technology that have developed in response to human and environmental needs
- Describe positive and negative effects that result from applications of science and technology in their own lives, the lives of others, and the environment
- Describe how personal actions help conserve natural resources and care for living things and their habitats
- Describe how technological products and systems can be used to conserve natural resources
- Describe how personal actions help conserve natural resources and protect the environment in their region
- Identify their own and their family's impact on natural resources

Initiating and Planning

- Make observations and collect information that is relevant to a given question or problem

Analyzing and Interpreting

- Classify according to several attributes and create a chart or diagram that shows the method of classifying

Communication and Teamwork

- Work collaboratively to carry out science-related activities and communicate ideas, procedures, and results

Knowledge

- Describe and predict causes, effects, and patterns related to change in living and non-living things
- Describe natural phenomena that cause rapid and significant changes to the landscape
- Describe interactions within natural systems and the elements required to maintain these systems

Attitudes

- Appreciate the role and contribution of science and technology in their understanding of the world
- Be sensitive to and develop a sense of responsibility for the welfare of other people, other living things, and the environment

THE COMMON FRAMEWORK OF SCIENCE LEARNING OUTCOMES, GRADES 7-9 (1997)

Relationships between Science and Technology

- Explain how science and technology interact with and advance one another

Social and Environmental Contexts of Science and Technology

- Illustrate how the needs of individuals, society, and the environment influence and are influenced by scientific and technological endeavours
- Provide examples of how science and technology affect their lives and their community
- Analyze social issues related to the applications and limitations of science and technology, and explain decisions in terms of advantages and disadvantages for sustainability, considering a few perspectives
- Describe possible positive and negative effects of a particular scientific or technological development, and explain how different groups in society may have different needs and desires in relation to it
- Make informed decisions about applications of science and technology, taking into account personal and social advantages and disadvantages
- Propose a course of action on social issues related to science and technology, taking into account personal and community needs
- Propose a course of action on social issues related to science and technology, taking into account human and environmental needs

Analyzing and Interpreting

- Use or construct a classification key

Communication and Teamwork

- Work cooperatively with team members to develop and carry out a plan, and troubleshoot problems as they arise
- Evaluate individual and group processes used in planning, problem solving, decision making, and completing a task

Earth and Space Science

- Explain how Earth provides both a habitat for life and a resource for society
- Explain patterns of change and their effects on Earth

Attitudes

- Appreciate that the applications of science and technology can have advantages and disadvantages
- Confidently pursue further investigations and readings
- Consider observations and ideas from a variety of sources during investigations and before drawing conclusions
- Project, beyond the personal, consequences of proposed actions

CANADIAN NATIONAL STANDARDS FOR GEOGRAPHY, GRADES 6-8 (2001)

Places and Regions

- Analyze the physical and human characteristics of places
- Factors that influence people's perceptions of places and regions
- Explain how technology affects the ways in which cultural groups perceive and influence places

Physical Systems

- Explain the distribution of ecosystems from local to global scales

Human Systems

- Make some general conclusions about how innovation in transportation and communication affects patterns of economic interaction

Environment and Society

- Explain the critical importance of energy resources to the development of human societies
- Identify and explain the ways in which human-induced changes in the physical environment in one place can cause changes in other places
- Integrate multiple points of view to analyze and evaluate contemporary geographic issues

CANADIAN NATIONAL STANDARDS FOR GEOGRAPHY, GRADES 9-12 (2001)

Places and Regions

- Explain why places, nations, and regions are important to individual human identity and as symbols for unifying or fragmenting society
- Use regions to analyze geographic issues and answer geographic questions

Physical Systems

- Describe how physical processes affect different regions of Canada and the world

Environment and Society

- Explain the global impacts of human changes in the physical environment
- Analyze examples of changes in the physical environment that have reduced the capacity of the environment to support human activity
- Analyze and assess the global impacts of human changes in the physical environment

The Common Framework of Science Learning Outcomes:

<http://science.cmec.ca/index.en.htm>

Canadian National Standards for Geography:

http://www.cangeoeducation.ca/resources/learning_centre/docs/Canadian_Geography_Standards.pdf

PART I

How do we adapt to and prevent climate change?

Suggested classes: English Language Arts, Science, Social Studies

Length of time: 50-70 minutes

Objective

In this lesson, students will:

- Appraise their own feelings about and evaluate their understanding of climate change
- Distinguish actions as examples of climate change adaptation or mitigation strategies
- Examine local actions—both present and future—that adapt to or prevent the impacts of climate change

Materials

- Pens and pencils (or coloured markers)
- Adaptation/mitigation symbols page
- Flip chart paper
- Magnifying glass Venn diagram template (optional)
- Adaptation and Mitigation infographic (optional)

Evaluation

- Group evaluation of how many correct answers each group had in their Venn diagram (Summative)
- Communication during group conversation (Formative)
- Notes and ideas shared on the place-mat activity paper (Summative)

OPENING ACTIVITY: VALUE LINE

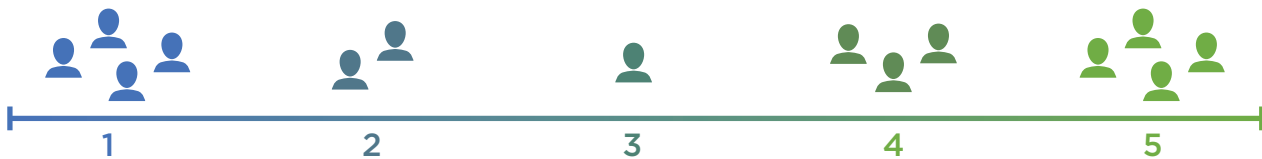
The purpose of this activity is to share students' perceptions of climate change: what they observe happening around them and the impacts their generation will face. It also provides a way to gauge your students' understanding around climate change and their interest in this topic.

A value line activity is flexible to location and questions. Just make sure you have enough space in the room for students to move around along a 'line' that you can form on the floor (or against a wall if there is space). You may want to make and display numbers one to five, to help guide students to where along the line they should stand.

To begin, you will read out different statements and ask students to place themselves on the line to indicate how strongly they agree or disagree with that statement. Students should be able to position themselves on the 'line' where they feel comfortable. You can then begin a whole class conversation by asking students to explain why they placed themselves there, either by a show of hands or by asking a student or two on each extreme end of the line to share their reasoning.

A value line is usually represented by taking a position between one and five, with scaling somewhere along:

- 1- Strongly disagree
- 2- Somewhat disagree
- 3- Unsure or neutral
- 4- Somewhat agree
- 5- Strongly agree



Choose to unpack the statement as you see fit, and go through as many as you would like. Some example statements to use might be:

- Climate change is an important issue in the world.
- Climate change will greatly affect our community.
- People are confused about climate change.
- Climate change will bring opportunities to Canada.
- I think my generation can do something about climate change.

The line is not as important as the conversation it creates. Let this activity be an opportunity to have students recall and share what they already know about climate change, different causes and effects, and their interest/engagement with the topic.

You may wish to write out some of their answers or responses in categories on the board, as a record of your discussion together. Put a checkmark if a sentiment expressed can be grouped with another list.

Tip: Keep the conversation constructive and solutions-based. We've ordered the suggested statements above in a way that begins small, and moves from informative to collaborative.

Hope in Climate Change:

Climate change is one of the greatest threats to humanity and planet Earth. Depending on how you look at it, climate change is worse than famine, disease, and war. Climate change will exacerbate conflict, tensions, and affect the overall quality of life for many people on the planet. Changing weather patterns and rising sea levels are not only affecting those facing extreme weather on Canada's coastlines, but inland as well.

Given the rhetoric around climate change supported by various groups, it should come as no surprise that many educators are reluctant to actively talk about climate change. Don't lose hope! Like many difficult topics in education, the fact that it is a complex issue that requires action beyond an individual's choices makes it even more important to be taught in your class.

Keep the tone of your conversations open and thoughtful. This unit tries to go beyond the usual discussions around scientific facts and figures, instead hoping you will encourage a more human perspective on how climate change is impacting the planet and our livelihoods. Remind your students that the actions we take in our local communities can make a difference—and we have the tools we need to fight climate change—we just need to implement them.

What actions can we take as citizens to influence laws and decisions that affect us all? Consider what bite-sized chunks of action and information you can discuss with your students throughout this unit and the lessons that follow. Think about ways in which these conversations can better connect your students to real-world problems, but also real-world solutions. It is our hope that this unit will build up not only a knowledge base for students, but also the capacity to take action and inform other students, their parents, and the public as they become more active citizens.

If time allows, you may want to show the class a video that provides a good overview of climate change.

We recommend Climate Change 101 with Bill Nye (National Geographic), or for a longer Canadian discussion, Climate Change: What to expect and are there really two sides? with Bob McDonald from Quirks and Quarks. Both are available on Let's Talk Energy's YouTube channel ([youtube.com/letstalkenergy](https://www.youtube.com/letstalkenergy))

VENN DIAGRAM ACTIVITY

Write down the words “Mitigation” and “Adaptation” on the board. First, ask students to try and define these words and their meaning. Then review the definitions and some examples of each.

Mitigation

Mitigation refers to those activities we can do to reduce greenhouse gas emissions (in other words, what we can do to reduce our carbon footprint). Examples include:

- Walking, biking, or using public transit to get around
- Eating less meat or a vegetarian diet
- Increase energy efficiency in our homes (ex. air condition and heating)

Adaptation

Adaptation refers to adjusting our lifestyle and activities to our already changing climate, and to prepare for the future. What are we doing now that the climate has already changed? Adaptation also examines how natural systems are changing in response to climate changes (e.g. species moving to warmer/cooler areas or to follow food). Examples include:

- Preparing for extreme weather
- Changing the plants we grow
- Storing water for emergencies

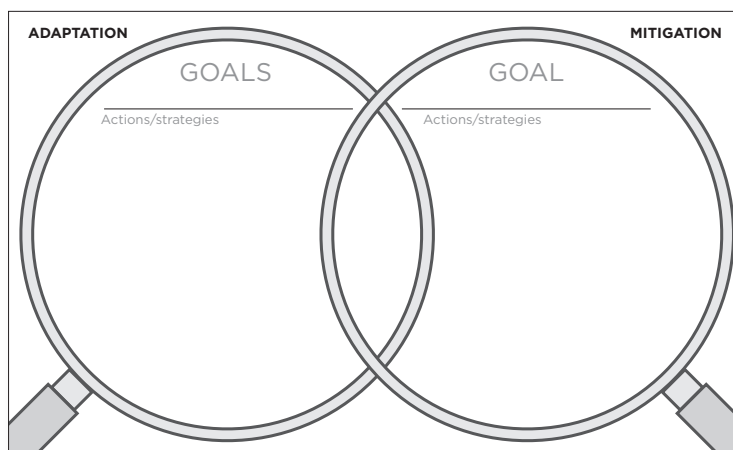
Climate change mitigation and adaptation

Society’s response to climate change includes two fundamental strategies: adaptation, where people and ecosystems respond to a changing environment; and mitigation, where efforts are made to reduce greenhouse gas (GHG) emissions. (<http://www.statcan.gc.ca/pub/16-201-x/2007000/10542-eng.htm>)

Adaptation is a necessary complement to mitigation in addressing climate change. Adaptation involves making adjustments in our decisions, activities, and thinking because of observed or expected changes in climate, with the goals of reducing harm and taking advantage of new opportunities.

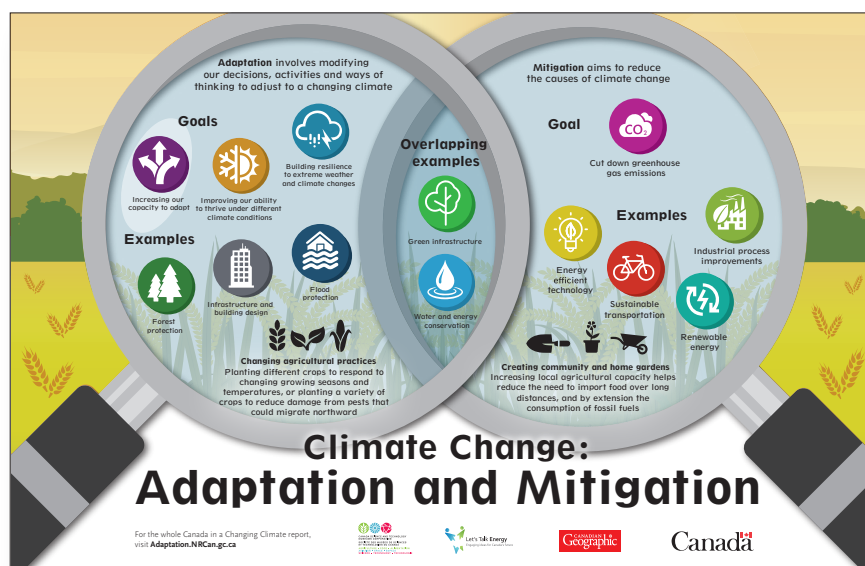
Adaptation or mitigation?

While neither adaptation nor mitigation actions alone can prevent significant climate change impacts, taken together they can significantly reduce risks. There is no optimal mix between adaptation and mitigation, and climate change policy is not about making choices between the two. Mitigation is necessary to reduce the rate and magnitude of climate change, while adaptation is essential to reduce the damages from climate change that cannot be avoided. (<http://www.nrcan.gc.ca/environment/impacts-adaptation/adaptation-101/10025>)



Next, hand out a sheet of chart paper to each group for a placemat activity, and a copy of the magnifying glass Venn diagram template (or have students sketch their own in the middle of the paper).

Have students start by working together to place the buttons found in the adaptation/mitigation symbols document into the appropriate spots of the Venn diagram. Remind students that some buttons are goals, and some are action strategies. There are two action strategies that overlap.



Give students 10-15 minutes to determine where the buttons go. Next, show the infographic, Adaptation and Mitigation, to correct the assignment. Discuss which buttons were challenging, and ask students if they are unclear on anything (see below for an outline of examples for each).

Tip: A copy of the Adaptation and Mitigation infographic can be found here:
<https://energy.techno-science.ca/doc/content/adaptation%20and%20mitigation.pdf>

CONNECTING TO COMMUNITY

If time allows, have students brainstorm on their own and write some ideas of their own on adaptation and mitigation actions that they can implement on the Venn diagram, using the rest of the space on the chart paper.

Ask the students to brainstorm some examples and actions (locally or elsewhere) they may have seen of a few action strategies, each using a different-coloured marker for their notes. If they can't think of examples, ask them to free write about how they think an action strategy will help with climate change. Assigning each student a few of the nine examples might work best.

After a few minutes, ask students to rotate around their group table and respond to what other students wrote. They can add in other ideas or examples—or use a checkmark or heart to symbolize a note they liked or really enjoyed—or a question mark if they are unsure of something.

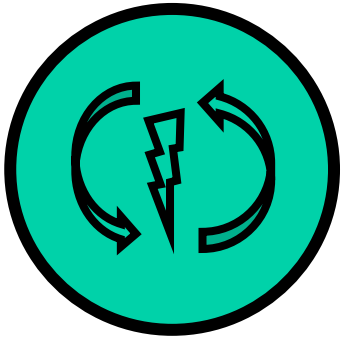
Close the activity by reviewing some of the examples students provided, and responding to some of the example ideas students were confused about. You may want to save some of these questions to answer in the next class, and review some local connections and actions using the chart below.

EXAMPLE (category it belongs to)	LOCAL CONNECTIONS AND ACTIONS
Forest protection (Adaptation)	As wildfires continue to grow in size and controlled burns occur near homes, putting in protected areas between forests helps to reduce risk of fires for homes and other areas.
Building design and infrastructure (Adaptation)	Extreme weather events will shape how and where our buildings can safely be built. Infrastructure needs to handle stronger winds, longer periods of droughts and downpours, and more frequent storms, for example. Buildings will have to be built in consideration of growing coastal erosion, and in the North in consideration of changing permafrost.
Flood Protection (Adaptation)	Whether coastal or inland, homes and businesses will be affected by rising waters around them. Climate change will increase flash flooding from storms, extend or shorten dry and wet seasonal changes, and increase sea level rise for coastal communities in particular. Flood protection actions share some similar preventive techniques from green infrastructure (in controlling precipitation), but also include carefully building according to floodplain mapping, raising buildings along lakes and river systems to protect them from flooding, building retaining walls, investing in sump pumps and back water valves, as well as landscaping and cleaning eaves troughs to keep water flowing away from the home.

Green infrastructure (Adaptation and mitigation)	Introducing urban solutions to increasing precipitation (water) from climate change helps to prevent future climate change by reducing energy and water use. Examples include rain barrels, water run-off wetlands, marshes, and lakes (both existing and restored), growing drought-tolerant plants for when flooding occurs, green roofs to reduce energy use, and urban heat islands.
Water and energy conservation (Adaptation and mitigation)	Canadians waste a lot of water, and the energy required to heat and cool the water we use is lost when we don't conserve it. Switching to low-flow or compostable toilets, washing laundry in cold water, drying clothes on a line, and eating and purchasing food/textiles that use less water are examples of some solutions.
Energy-efficient technology (Mitigation)	There are many options for energy-efficient technology now on the market. Examples of actions to reduce our GHG emissions include changing to more energy-efficient lighting (such as LED bulbs), buying Energy Star appliances, adjusting thermostats for home heating and cooling, and proper insulation of homes and buildings.
Sustainable transportation (Mitigation)	Choosing to commute and move around with the smallest carbon footprint includes walking or biking to work, using public transit, car sharing/carpooling, choosing rail over air travel, and using an electric vehicle.
Renewable energy (Mitigation)	Cutting down and reducing our dependence on fossil fuels will drastically reduce the amount of GHGs emitted. Renewable energy such as solar, wind, and hydro will help. This could be large-scale solar and wind farms, or rooftop solar on houses. Replacing diesel generators in Northern communities and closing coal-fired power plants are some challenges that will require renewable energy to make up for demand.
Industry improvements (Mitigation)	Factories and other industry make up a significant amount of emissions in Canada. Action strategies for them may include reducing toxic greenhouse gas emissions emitted in production, reusing products for electricity storage (e.g. car plants storing power in car batteries), better controlling heating and cooling, and adjusting workers' hours to times of the day/year to save on air conditioning and heating.

MORE RESOURCES

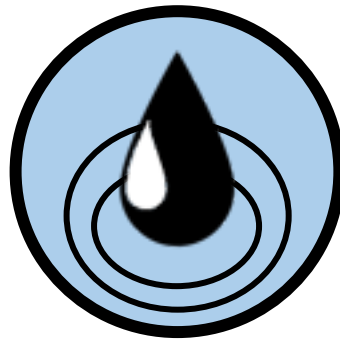
- Check out “Climate Change: The Basics” from The Climate Change Atlas of Canada (<https://climateatlas.ca/climate-change-basics>). This resource offers a brief introduction to adaptation and mitigation and an overview summary of the climate change science we know.
- Read a NASA article exploring the differences between adaptation and mitigation: <https://climate.nasa.gov/solutions/adaptation-mitigation/>



Renewable energy



Forest protection



Water and energy conservation



Energy-efficient technology



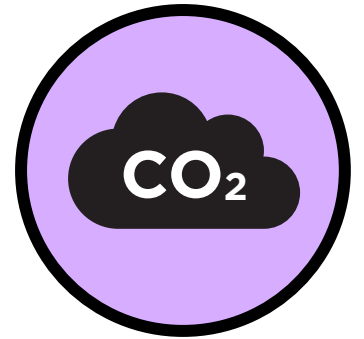
Green infrastructure



Flood mitigation



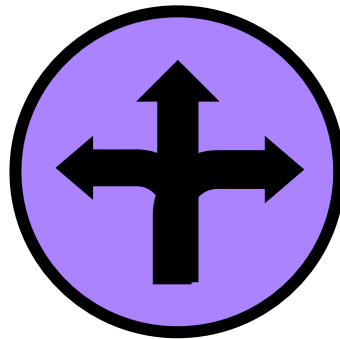
Industry improvements



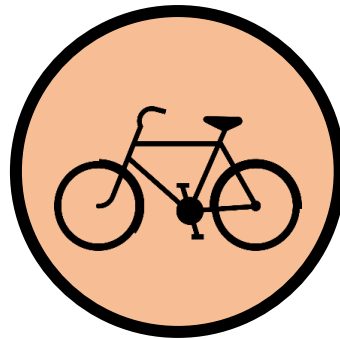
Cut down greenhouse gas emissions



Building design and infrastructure



Increasing our ability or capacity to adapt



Sustainable transportation



Improving our ability to thrive under different climate conditions



Building resilience to extreme weather and climate changes

ADAPTATION

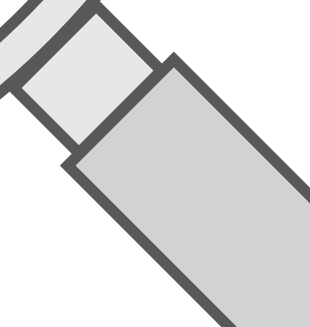
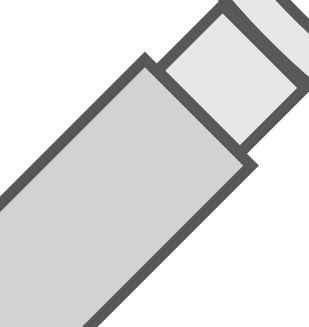
MITIGATION

GOALS

GOAL

Actions/strategies

Actions/strategies



PART II

A picture tells a thousand stories

Suggested classes: Geography, English Language Arts

Length of time: 50-70 minutes

Objective

In this lesson, students will:

- Appraise photos to work in different settings and contexts to tell a different story
- Interpret images using prior knowledge on climate change and the environment
- Select effective words and phrases to describe a photo
- Design and create photo captions using background knowledge on climate change

Materials

- Environment Photos (one copy per group)
- Captioned **To What Degree?** sample images (to display digitally or print)
- Uncaptioned **To What Degree?** environment photos to sort, (one copy per group, printed)
- Pen and paper

Evaluation

- Captions and word clouds created for photo panels (Summative)
- Communication and work as a group (Formative)

REVIEW OF PART I

Begin by recalling the discussion in the previous class. Ask some questions and, if time allows, write down students' answers on the board as a group brainstorming session. Some recommended questions include:

- What is the difference between adaptation and mitigation for climate change?
- What are some examples of actions we can take to adapt to climate change, and to mitigate (prevent/lessen) future climate change?
- What are some actions that both adapt to and mitigate climate change?

CATEGORIZING PHOTOS

Shift into today's activities. Today students will be discussing the use of photos to tell a story, in particular about climate change and the environment. Ask the students to think about what their top five criteria would be for an effective photo.

Give them time to think individually, and then share with a partner, or a group next to them, for a few minutes and see if they can find a common agreement on good criteria.

After a few minutes, have each group share their criteria and note on the board, providing a checkmark or star if something is repeated. (Think-Pair-Share)

Explain to the students that they will be looking closely at photographs to tell an environment and climate change story. Brainstorm with the class:

- What kinds of images do you think would be good at representing climate change?
- What kinds of images come to mind when you think of climate change?
- What kinds of images have you seen on book covers, news articles, and television shows that talk about climate change?

Write down student suggestions and examples on the board for a few minutes, and then begin the activity.

Divide the class into groups of four to five students and have them sit together. Hand out a copy of the sample photos for each group, cut out beforehand. These photos were compiled from from websites and can be used and distributed for free for educational purposes.

In groups, ask the students to decide together a way they wish to sort their images. Give them five to 10 minutes to do so.

Alternatively, you may want the students to sort the photos in a particular way, or assign one group each to sort them differently. Examples include:

- By tone of the photo (is it more upbeat and positive, more sad and pensive, or somewhere in between?)
- By categories of image types (e.g. animals, energy, weather, actions, colours, quality)
- By most compelling/least compelling story
- By how well they connect to the local community or not

Review how students decided to sort their images and see how it differs between groups. As a final task for these photos, ask the students to choose their top five to 10 images. In choosing them, do they want to tell a particular story? Allow time for the class to share their top selections. You may want to let each group put them up on the board and discuss them, or use the digital document projected to display them for analysis.

Access to photos

We have included photo examples for you in the appendix attached. Our photos are from Pexels and Unsplash (<http://pexels.com> ; unsplash.com), but you can also look for other photos across the internet. We used photos with Creative Commons Zero License, which allows the use of photos, images, audio, and video that the creators have licensed for certain uses (often non-profit and educational). If you choose to have your students look up their own examples of photos online—and they may be displayed outside of the classroom—teaching about Creative Commons licenses and citing work might be a useful tool. More info on the different types of Creative Commons licenses here: <https://creativecommons.org/>

CAPTIONING PHOTOS

For the next part of this lesson, students will be looking at a series of images that were chosen for a photo exhibition on climate change adaptation and mitigation across Canada.

Explain to the students they will be using source material from a climate change photo exhibition, **To What Degree? Canada in a changing climate**, from the Canada Science and Technology Museum. Over the next few classes, they will be exploring how stories can be curated for the public to tell a story on climate change and the environment. Taking on similar roles of museum exhibitors, curators, and interpreters, they will be asked to look at different visual representations to tell a story, delve deeper into some specific stories, and finally curate their own.

Exhibit planning for public spaces such as museums can be a challenge. Some important things the creators of this photo exhibit discussed were:

- Having photos that bring up a number of emotions and feelings at once
- Choosing photos that tell more than one story (i.e. cows in a field with wind turbines behind tells a story of methane and energy used by agriculture, but also renewable energy)
- Photos that reflect stories from throughout Canada that inform but also connect them to different regions (“I’ve been somewhere like that before!” or “This looks a lot like home.”)

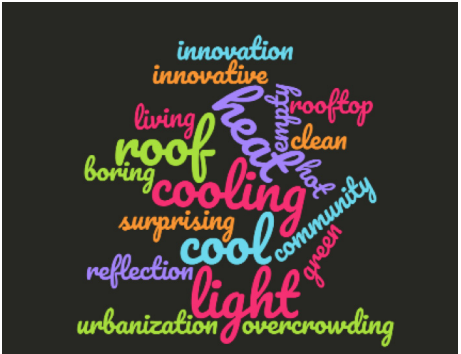
In groups of two to three students, give out one of the 10 uncaptioned photo panels from the uncaptioned **To What Degree?** sample images. You can either give these out at random, or have each group pick one.

Ask the students to take out a piece of paper and brainstorm as a group. Work through the following steps:

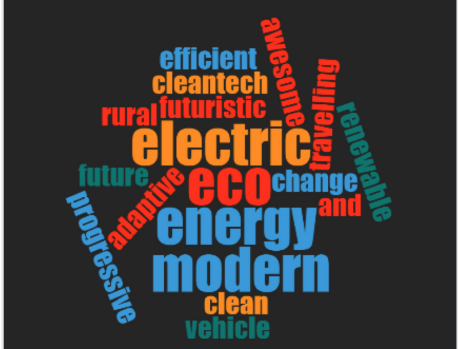



- 1- Take five minutes to mind map (in the form of a word cloud, for example) words and phrases you think of when you look at the photo. Knowing that the photos are from a climate change adaptation and mitigation exhibition, ask the students to try and think about other words and phrases they may have been introduced to last class—with the button Venn diagram activity—that may also apply. It may be helpful to have the button Venn diagram activity posted somewhere in the room to refer to, or on a digital screen.
- 2- After they have written some words down, give the students another 10-15 minutes to craft a made-up caption that captures what messages the image might be trying to convey. The group can decide what kind of tone they want to take with their caption (serious, goofy, educational, instructive, sombre, optimistic, etc.), but should keep it short and concise.


CLIMATE CAPTION WORDS

A team at the Canada Science and Technology Museum prepared the text and photo selections for the exhibition, **To What Degree?**. The following word clouds were created by the interpretive planner and writer of the captions, after asking people to brainstorm words they thought of when looking at the images. You may want to project these word clouds on a screen in the classroom. How many words do your students have in common?

Cool roofs	boring, innovation, light reflection, urbanization, green, cooling heat, rooftop, clean, overcrowding, hot, surprising, cooling, empty, living roof, cool roof, light, heat cool, community, innovative	
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Urban forests	average, solitary, fall, greenspace, open, park, trees, peaceful, landscaping, tranquil, urban, open space, dead, path, urban forests, calm, sad	
Wildland fire: friend and foe	teamwork, containment, wildfires, invasive species, firefighting strategies, wildfire, tragic, hot, controlled burn, destruction, control, controlled burning regeneration, destruction, disaster, determination, urgent, dangerous	
What's the beef?	landscape, spring, arid, melting, warming, change, unpredictable weather, arctic, brisk, Canada, warmth, peaceful, north, prairie, desert bare, vast	
Spreading tick habitat	microscopic, yuck Lyme, tick Lyme, disgusting, bedbug, yikes, terror, bedbug, ew, yuck, gross, tick gross Lyme disease, eerie, pests, tick, scary	

<p>Electric vehicles</p>	<p>eco, futuristic, clean, renewable, energy efficient, rural and modern, eco vehicle, progressive, awesome, electric, adaptive, clean technology, change, future, electric, energy, modern, travelling</p>	 <p>A word cloud on a black background featuring terms like 'electric', 'eco', 'energy', 'modern', 'clean', 'vehicle', 'future', 'adaptive', 'progressive', 'rural', 'futuristic', 'efficient', 'cleantech', 'awesome', 'travelling', 'renewable', 'change', and 'and'.</p>
<p>Heavy-duty aerodynamics</p>	<p>what is this, research, innovation, reduce, air resistance energy, testing facility, funny, testing, wind tunnel, awesome, unusual, testing research wind tunnel, trucking, research, museum, technology</p>	 <p>A word cloud on a white background featuring terms like 'research', 'testing', 'innovation', 'tunnel', 'wind', 'technology', 'air', 'facility', 'funny', 'resistance', 'awesome', 'unusual', 'trucking', 'reduce', 'museum', and 'energy'.</p>
<p>All-season Arctic highway</p>	<p>construction, dry, industry, develop, pipeline infrastructure permafrost, construction, bare, barren, desolate, contrasting, transport, dig, permafrost, vast, digging, exploration, new, desert</p>	 <p>A word cloud on a tan background featuring terms like 'construction', 'permafrost', 'infrastructure', 'contrasting', 'desert', 'bare', 'vast', 'dry', 'transport', 'industry', 'dig', 'new', 'pipeline', 'digging', 'barren', 'develop', 'desolate', and 'exploration'.</p>
<p>Preparing for climate-driven health impacts</p>	<p>Hands, investigate, explore, scientist, researcher, bacteria, sample, glass Petri dish, disease, observe, growth, gross, spreading</p>	 <p>A word cloud on a black background featuring terms like 'bacteria', 'explore', 'scientist', 'disease', 'researcher', 'sample', 'glass', 'Petri', 'dish', 'spreading', 'investigate', 'growth', 'observe', 'gross', and 'hands'.</p>

<p>Top predators adapt</p>	<p>wild, tourism, whales, whaling harvest, one world, protecting wildlife, whale migration, beautiful, photography, orcas, whales, newcomers, saviour, clash, ocean, eco, nature, dangerous</p>	
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If time allows, have each group share their caption with the class. Then, end the class by revealing the real captions. Have students discuss how accurate they were in their own messaging versus the real messaging. Inform the students that for the next class, they will be digging deeper into the climate change story behind the image. You may wish to ask them to think about choosing a few of the images that stood out for them – as they will be choosing one for their research project next class.

MORE RESOURCES

- Check out Everyday Climate Change on Instagram for a global collection of photographers documenting climate change, or a summary piece by the Guardian here: <https://www.theguardian.com/environment/gallery/2015/jan/20/everyday-climate-change-in-pictures>
- Similarly, check out CNN's photo gallery This is What Climate Change Looks Like: <https://www.cnn.com/2016/11/16/world/gallery/cop22-photo-award/index.html>



Abben S - Unsplash



Rawpixel.com - Pexels



Monica Silva- Unsplash



Aaron Burden- Unsplash



Stijn-Te Strake- Unsplash



Chris Liverani- Unsplash



Jay Mantri- Pixels



Ken Treloar - Unsplash



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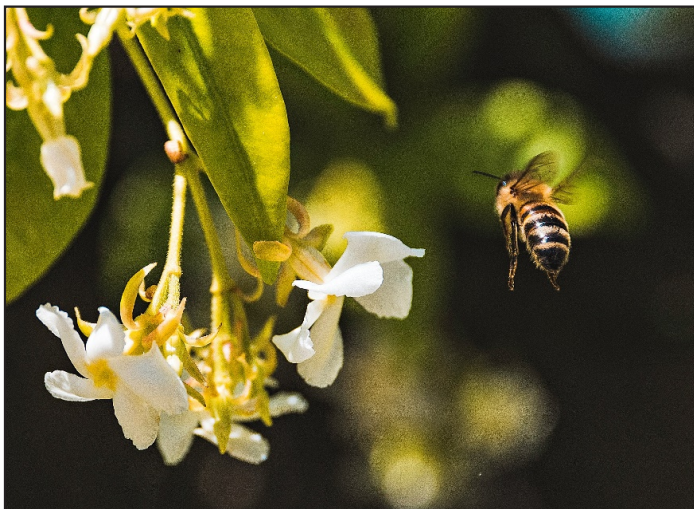
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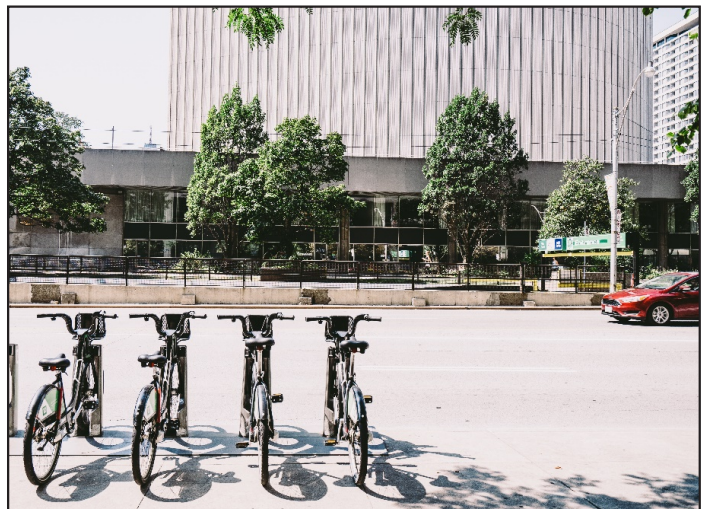
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Warren Wong- Unsplash



Andrea Sonda- Unsplash



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Andy Brunner- Unsplash



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Alex Bagirov- Pexels



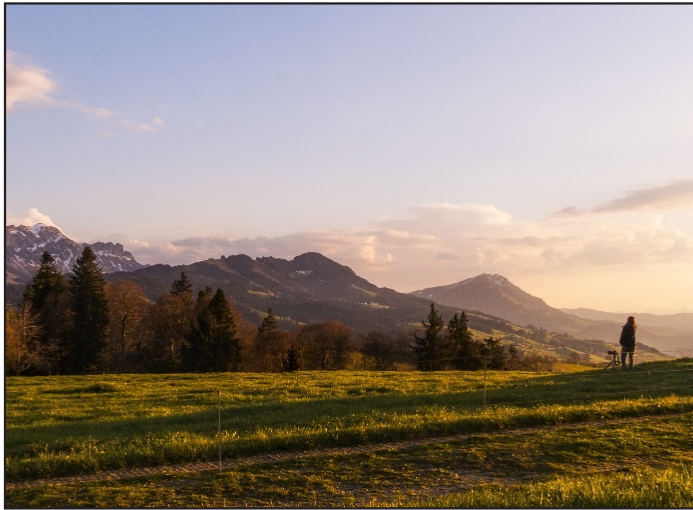
American Public Power Association- Pexels



George Desipris- Pexels



Mikes Photos -Pexels



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Tadeusz Lakota- Unsplash



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Priscilla Du Preez- Unsplash



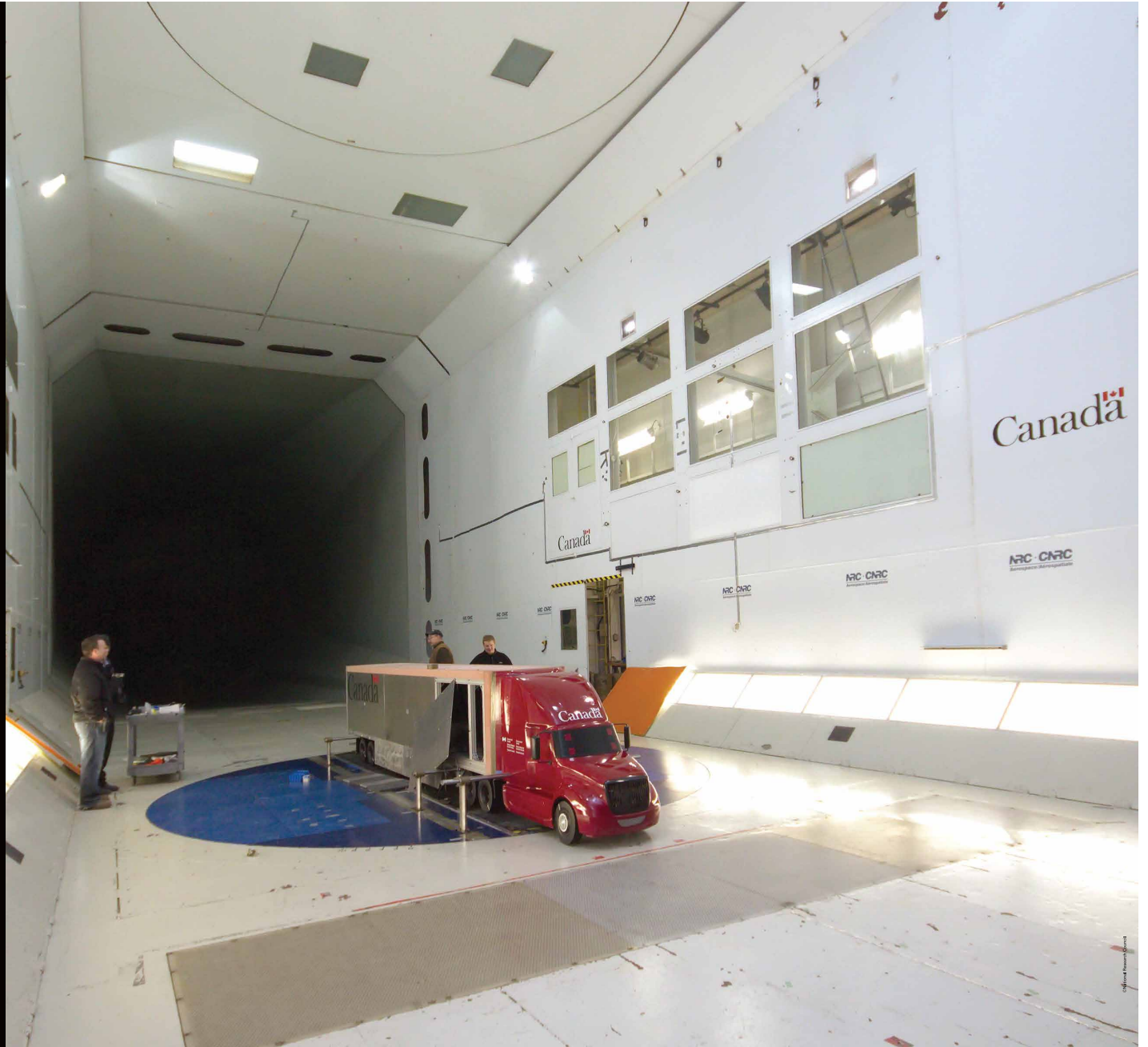
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What's the beef?

Black Angus beef cattle graze in a field with wind turbines in Rosenholf, Saskatchewan.

Climate change is a threat to cattle farming and meat production because it impacts the quality of food crops and animal feed, and contributes to water shortage and livestock disease. Livestock, especially cattle, also contribute to climate change. In terms of reducing the carbon footprint, switching from beef to veggies just one day per week is like driving 1860 km LESS per year.

L'effet du changement climatique sur l'élevage bovin

Des vaches Black Angus mangent de l'herbe dans un champ à éoliennes situé à Rosenholf en Saskatchewan.

Le changement climatique est une menace pour l'élevage bovin et la production de viande, car il a un effet néfaste sur la qualité des cultures alimentaires et des aliments pour animaux et contribue aux pénuries d'eau et aux maladies du bétail. Le bétail, notamment les bovins, contribue également au changement climatique. Pour réduire l'empreinte de carbone, il suffirait de ne consommer que des légumes un seul jour par semaine, ce qui équivaldrait à une réduction d'émission carbone égale à l'émission carbone d'une voiture roulant 1 860 km par an.



Top predators adapt

A group of killer whales is spotted in Nunavut's Admiralty Inlet in the Canadian Arctic.

With ice melting earlier in the year, killer whales are expanding their hunting range, and competing with polar bears as the top Arctic predator. They target narwhal, beluga, and bowhead whales during the summer, which are traditional Inuit hunting prey. Interviews with Inuit community members have revealed important Arctic changes including this story about more predatory killer whales in the region.

Les grands prédateurs s'adaptent

Un groupe d'épaulards (orques) dans l'anse de l'Amirauté du Nunavut dans l'Arctique canadien.

La saison de fonte des glaces arrive plus tôt dans l'année qu'auparavant, et en conséquence, les orques bénéficient d'une période de chasse allongée et sont désormais en concurrence avec les ours blancs pour le titre du plus grand prédateur de la zone Arctique. Ils chassent les narvals, bélugas et baleines boréales durant l'été, mammifères marins qui entrent aussi dans la chasse traditionnelle inuite. Des entrevues avec des membres de la communauté inuite ont révélé d'importants changements dans la zone arctique comme le prolongement de la période de chasse des épaulards dans cette zone.



Heavy-duty aerodynamics

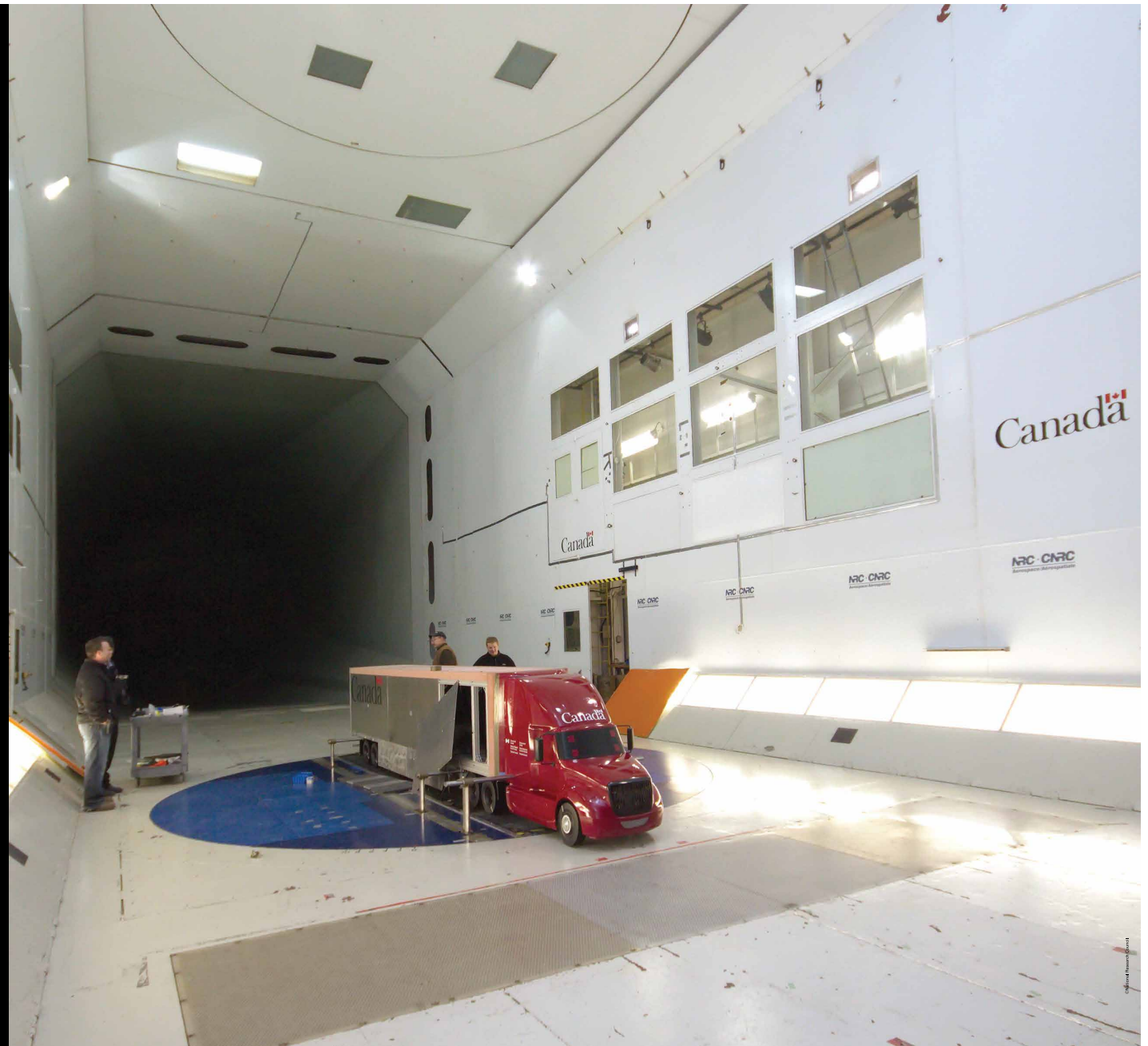
Researchers in Ottawa test a 30% scale model of a transport truck in the National Research Council Canada's 9-metre wind tunnel, for a Transport Canada project to assess aerodynamic retrofits for trucks and trailers.

While cars are getting more fuel efficient, emissions of heat-trapping carbon dioxide from heavy-duty trucks are growing rapidly because of the increase in the movement of goods. Electric trucks might be the future, but equipping trucks with aerodynamic technologies, such as side skirts, boat-tails, and gap and roof fairings, can help reduce emissions today.

Transport aérodynamique

Des chercheurs d'Ottawa testent une maquette à échelle 30 % d'un camion de transport dans la soufflerie de 9 mètres du Conseil National de recherches du Canada, pour un projet de Transports Canada visant à améliorer l'aérodynamique des camions et remorques.

Alors que les voitures sont de plus en plus efficaces en consommation de carburant, les émissions de dioxyde de carbone retenant la chaleur et provenant des poids lourds augmentent rapidement en raison de l'augmentation du transport de marchandises. Les camions électriques pourraient être développés à l'avenir, mais l'amélioration de la technologie aérodynamique dans les camions, tels que des jupes latérales, rétrofits et carénages, permettrait de réduire les émissions dès maintenant.



All-season Arctic highway

Completed in November 2017, the 137 km long Inuvik-Tuktoyaktuk Highway winds through the tundra of the Northwest Territories.

Ice roads are winter lifelines that move goods and people in Canada's North. Climate change is thawing the ice and permafrost, making these roads less reliable and more costly to build and maintain. A new all-season Arctic highway now snakes from Inuvik to Tuktoyaktuk in the Northwest Territories. Its design and engineering help protect the permafrost and give the road additional strength.

Route arctique en toutes saisons

Achevée en novembre 2017, la route Inuvik-Tuktoyaktuk de 137 km de long traverse la toundra dans les Territoires du Nord-Ouest.

Les routes de glace sont vitales en hiver, car elles permettent le transport des biens et personnes dans le Nord canadien. Le changement climatique fait fondre la glace et le pergélisol, ce qui rend ces routes moins fiables et plus coûteuses à construire et à entretenir. Une nouvelle route arctique toutes saisons relie désormais Inuvik à Tuktoyaktuk dans les Territoires du Nord-Ouest. Sa conception et sa construction aident à la protéger du pergélisol et renforcent la route.



Preparing for climate-driven health impacts

A scientist examines E. Coli growing in a petri dish. Counting these colonies tells us about how much bacteria is present in the originating sample, of sewage overflow for example.

More intense weather like heavy rainfall and extreme temperatures put our health and well-being at risk. Weather like this may spread disease, pollute our waterways, and impact our environment and ecosystems. Canadian scientists are preparing for these changes by making advances through research, laboratory work, technology and monitoring that will help us address climate change impacts.

Préparation pour les effets sur la santé du climat

Une scientifique examine des bactéries E. coli qui poussent dans une boîte de Pétri. Le comptage de ces colonies permet de dénombrer les bactéries dans l'échantillon d'origine, comme celui provenant du débordement des eaux usées par exemple.

Les événements météorologiques plus extrêmes, comme les fortes pluies et températures extrêmes peuvent mettre en péril notre santé et notre bien-être. Ces phénomènes météorologiques peuvent propager des maladies, polluer nos cours d'eau et modifier notre environnement et nos écosystèmes. Des scientifiques canadiens se préparent à ces changements en faisant avancer les recherches, les travaux de laboratoire, la technologie et la surveillance qui nous aideront à faire face aux effets du changement climatique.



Wildland fire: friend and foe

Life returns to a valley as charred trees are covered over by wildflowers, in the Sawback Range, Alberta.

Climate change is already causing more severe and catastrophic wildland fires. With the expansion of communities into forested areas, fires are more frequently threatening homes and livelihoods. Wildland fire is a natural part of forest ecosystems and important for forest health. Fire smart education, outreach and vegetation management are valuable wildfire prevention tools to protect homes and communities.

Feux de forêt : amis et ennemis

La vie reprend dans une vallée où des arbres carbonisés sont recouverts de fleurs sauvages, dans le chaînon Sawback en Alberta.

Le changement climatique est déjà à l'origine des feux de forêt plus graves et catastrophiques. Avec l'expansion des villes dans les zones forestières, les incendies menacent plus fréquemment les habitations et moyens de subsistance. Les feux de forêt sont un élément naturel des écosystèmes forestiers et sont importants pour la santé des forêts. La sensibilisation sur les feux et la gestion de la flore sont d'importants outils de prévention de feux pour protéger les habitations et les villes.



Cool roofs

A six acre green roof extends on top of the west building of the Vancouver Convention Centre.

Built surfaces like roofs, paved roads, and parking lots absorb heat from the sun, making cities hotter than surrounding greener areas. One way to cool down cities and the people in them, is to create reflective or vegetative surfaces. Many cities across North America like the city of Vancouver now encourage the installation of cool roofs (reflective white roofs or vegetative green roofs) when replacing existing roofs or constructing new buildings.

Toits frais

Un toit vert de six acres sur le bâtiment ouest du Centre des congrès (Convention Centre) de Vancouver.

Les surfaces construites comme les toits, routes et parcs de stationnement absorbent la chaleur du soleil, ce qui réchauffe les villes par rapport aux régions rurales avoisinantes. Une façon de refroidir les villes et les gens dans les villes consiste à créer des surfaces réfléchissantes ou végétalisées. De nombreuses villes d'Amérique du Nord comme la ville de Vancouver encouragent l'installation de toits frais (toits blancs réfléchissants ou toits verts végétalisés) pour remplacer les toits existants ou pour les nouvelles constructions.



Spreading tick habitat

A close up of a deer tick on human skin can help with identifying this kind of tick in the environment.

As our climate warms, ticks are spreading in Canada and may bring infectious diseases like Lyme disease. Adapt to our changing climate: stay healthy and enjoy the outdoors by taking steps to protect yourself, your family and your pets. Use insect repellent, wear long-sleeve shirts and pants, and be sure to check for ticks. If you find a tick, remove it immediately.

Agrandissement de la zone d'habitat des tiques

Un gros plan sur une tique à pattes noires posée sur la peau d'un humain peut aider à identifier ce type de tique dans la nature.

À mesure que notre climat se réchauffe, les tiques se propagent au Canada et peuvent transmettre des maladies infectieuses comme la borréliose (ou maladie de Lyme). Adaptez-vous au changement climatique : restez en bonne santé et profitez du plein air en prenant des mesures pour vous protéger, ainsi que votre famille et vos animaux de compagnie. Utilisez un insecticide, portez des pantalons longs et des chemises à manches longues et vérifiez que vous n'avez pas de tiques sur vous. Si vous trouvez une tique, enlevez-le immédiatement.



Urban forests

Evergreen Brick Works environmental centre situated within the Don Valley urban forest in Toronto.

In a changing climate, cities face higher temperatures and declining air quality. Trees help solve these problems and improve community well-being. Urban trees reduce heat by adding moisture to the air and creating shade. The soil they grow in absorbs storm water. Each year, urban trees absorb nearly 2.5 million metric tonnes of carbon dioxide – the weight of 21 CN Towers!

Forêts urbaines

Le centre de l'environnement Evergreen Brick Works situé dans la forêt urbaine de Don Valley à Toronto.

À cause du changement climatique, les villes font face à des températures plus élevées et à une qualité de l'air en déclin. Les arbres aident à mitiger ces problèmes et à améliorer le bien-être de la communauté. Les arbres urbains permettent de réduire la température en humidifiant l'air et en créant de l'ombre. Le sol dans lequel ils poussent absorbe les eaux pluviales. Chaque année, les arbres urbains absorbent presque 2,5 millions de tonnes de dioxyde de carbone – le poids de 21 tours CN!



Electric vehicles

EV charging at a Fast Charger unit operated by Hydro-Québec's Electric Circuit network in Lévis, Quebec.

Using electricity to power your car produces zero tailpipe pollution or heat-trapping gases like carbon dioxide. With the increase in popularity of electric vehicles, one question arises: where can people charge their cars, especially in rural areas? Fast-charging stations are being built along highways across Canada to facilitate travelling from coast to coast.

Véhicules électriques

Recharge d'un véhicule électrique à une borne de recharge rapide opérée par le réseau Circuit électrique d'Hydro-Québec, à Lévis, Québec.

L'utilisation de l'électricité pour alimenter votre voiture ne produit aucune pollution atmosphérique ni de gaz qui retiennent la chaleur comme le dioxyde de carbone. Avec l'augmentation de la popularité des véhicules électriques, une question se pose : où peut-on charger son véhicule, en particulier en zone rurale? Des stations de recharge rapide sont construites le long des autoroutes à travers le Canada pour faciliter les déplacements d'un océan à l'autre.



PART III

Researching climate change

Suggested classes: Science, English Language Arts

Length of time: Two 50-70 minute blocks

Objective

In this lesson, students will:

- Argue the best actions to take to mitigate future climate change and reduce one's carbon footprint
- Evaluate appropriate source material for an informative and argumentative text
- Develop critical thinking and media literacy skills through research
- Explain a climate change topic to their classmates using effective communication

Materials

- Computer access (with internet)
- Headphones
- Pen and paper
- Peer evaluation sheet
- Research notes template (optional)
- Captioned **To What Degree?** sample images
- Climate actions scorecard

Evaluation

- Group discussion arguing for the best climate change strategies (Formative)
- Research notes and primary source interpretation (Formative)
- Presentation and write up on a climate change topic: peer, self, teacher (Summative)

OPENING ACTIVITY: TOP CLIMATE ACTIONS GAME

As an opening activity, students will go into groups to play a *Family Feud* style game to decide with their team the best actions people can take to mitigate climate change.

Determine the class teams and seat the students appropriately (two to four teams works best). Decide the order of the groups and keep track of scoring.

Like *Family Feud*, the students will gain points by deciding on one group answer to provide during each round. Inform students that there will, of course, be lots of other actions that might not necessarily be on the list (see top climate actions scorecard below). You, as judge, could feel free to either accept some of these answers and estimate an impact rating (points), or go only with the actions listed and check for any that repeat.

Points are determined based on the measured impact rating of the action, from one—meaning little impact—to five, meaning a high-impact action.

Explain to students that greenhouse gas emission calculations were estimated for each action on the list from three sources that have measured and/or estimated the impact of each action.

Students should be given enough time to form a consensus as to what answer they want to give for their group. They can either do this by having a spokesperson for the game, or rotate a spokesperson for each round. Remind the students that the answers are primarily focused on *individual* or household actions, and not necessarily as broad as the entire community or country.

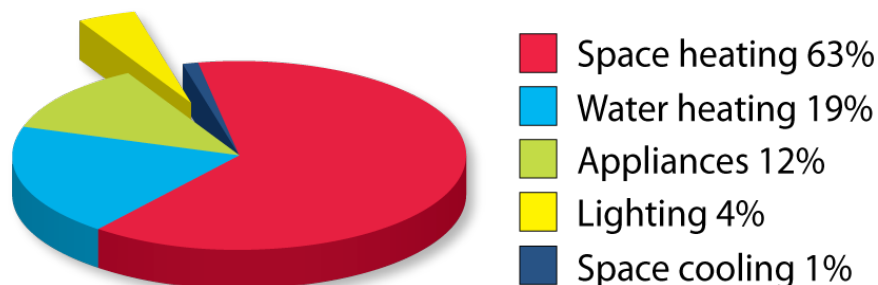
Play a couple of rounds until students have guessed most of them—or as time allows—and do a quick run-through of the rest of the examples they may not have thought about. On the board, you may also wish to list the four categories of energy use (residential, commercial, industrial, transportation) so they can make the connection between each of these actions to the four areas.



After the game is done, ask students what they noticed. How much effort would some of these strategies take, and how much impact did different actions have? Were they surprised?

Impact of our actions

It may come as a surprise that some of the most common actions we tell students to do in order to be more energy efficient and pollute less do not have as large of an impact as we think. The ‘low-hanging fruit’ of shutting off lights or switching to LED bulbs is a beginning action. However, if lighting in the average Canadian home only makes up for 4% of energy use, the impact this switch has is minimal in comparison to larger changes to efficiency in heating and cooling water and air inside of your house.¹



The higher-impact items on our list may need to be unpacked more with your students as they are often bigger picture than individual students can accomplish themselves. For example, if you live in a province that has more non-renewable resources used in the power grid, making the switch to clean energy sources—either by a power utility or generating your own electricity with solar panels—will make a much bigger difference. Preventing heat loss through basement and roof insulation will help prevent energy-intensive winter heating from being wasted.

The climate change mitigation action of having fewer children may be a controversial idea with your students. It can also be a reminder to them that each person’s total carbon footprint is substantial when added up. Students may not feel like it is a reasonable or viable solution. The author of the originating study factored in the total emissions emissions per person living to an average of 80 years, divided in half as they are one parent, and accounting for a smaller ratio of all of a child’s descendants (e.g. a quarter for the grandchild, and an eighth of a great-grandchild).²

By the end of this activity, students should begin to connect to the most important actions they can take to reduce greenhouse gas emissions and their carbon footprint, at home and at school. While smaller steps—such as shutting off lights when not in use—are still important to take and good habits to form, students should be reminded of the larger impact actions they can work towards and advocate for.

(The data for this activity has been adapted and collaborated from actions outlined from Change Habits for Climate: Your Guide to a Sustainable Lifestyle (The City of Edmonton), Drawdown—The Most Comprehensive Plan Ever Proposed to Reverse Global Warming (Paul Hawken), and “The Climate Mitigation Gap: Education and Government Recommendations Miss the Most Effective Individual Actions” (Seth Wynes & Kimberly A. Nicholas)

¹ <https://www.nrcan.gc.ca/energy/products/categories/lighting/13730>

² <http://iopscience.iop.org/article/10.1088/1748-9326/aa7541>

RESEARCHING A CLIMATE CHANGE STORY

Students will now be asked to do some further research on some of the stories that have been showcased in the excerpts of the photo exhibition, **To What Degree? Canada in a Changing Climate**.

In the last class, they had to think of captions and words to associate with images from the photo exhibit. In this class, students will delve deeper into the climate change stories and issues behind these photos. Explain to the students that by the end of their research, they will be asked to present to their peers on what they learned and will interpret the picture for their classmates.

Challenge your students to think beyond the image to explain the greater story of adaptation and/or mitigation that the story is referring to.

Decide on evaluation criteria as you see fit, in consultation with your students. Some example criteria to use might be:

- Topic is clearly connected and engaging
- Clearly shows they researched more about the topic
- Provides connections to climate change
- Teaches their classmates about individual or group actions to adapt to or mitigate climate change, as applicable
- Connects the topic to actions mentioned in the Venn diagram discussed earlier

Presentations to their classmates in the groups should take three to four minutes each, with some questions and discussion afterwards.

In the development of the original photo exhibition, research was done by museum interpreters to lay out the larger story first, and then source pictures that connect visually to that broader story. You may want your students to hone their research skills at first by conducting some primary research without extra support. However, we have also curated some examples of source material from media sites, government agencies and departments, and other organizations.

Randomly assign students one of the 10 images from the photo exhibition. Or, ask them to further research the image they created a caption for in the last class.

STARTING POINTS FOR CLIMATE CHANGE RESEARCH

The following table is a list of online articles, interviews, and videos to help students begin exploring the topics related to the photo panels.

We have included a mix of videos and articles, and most of the videos can be found on our YouTube playlist at: <https://www.youtube.com/user/LetsTalkEnergy>

ELECTRIC VEHICLES	COOL ROOFS
<p>“Myths busted!” (Energy Exchange): http://www.energy-exchange.net/myths-busted/</p> <p>“Global village” (Energy Exchange): http://www.energy-exchange.net/lesson-low-emissions-transportation/</p> <p>“Why buy an electric vehicle?” (Natural Resources Canada): https://www.nrcan.gc.ca/energy/efficiency/transportation/19198</p> <p>“Electric cars will come of age in 2018” (The Economist): https://www.youtube.com/watch?v=zGFb6CcG0DA</p>	<p>“Up on the roof, green takes root” (The Globe and Mail): https://www.theglobeandmail.com/report-on-business/industry-news/property-report/up-on-the-roof-green-takes-root/article4435768/</p> <p>“Urban heat islands: Consumer, killer” (White Roof Project): http://www.whiteroofproject.org/how-we-can-curb-climate-change</p> <p>“Five of Canada’s most innovative green roofs” (Canadian Geographic): https://www.canadiangeographic.ca/article/five-canadas-most-innovative-green-roofs</p> <p>“Exploring biodiversity on Canada’s largest green roof” (University of British Columbia): https://www.youtube.com/watch?v=vNsTf_c9Vpc</p> <p>“Green Roof Growth” (CBC): https://www.youtube.com/watch?v=2HxSvjMDOgl</p> <p>“Weighing the Benefits of Green Roofs” (The Wall Street Journal): https://www.youtube.com/watch?v=mMjxvw5bOhk</p> <p>“One Drop: Why We Need Green Infrastructure” (American Rivers): https://www.youtube.com/watch?v=vMalfLsfOc</p>
HEAVY-DUTY AERODYNAMICS	URBAN FORESTS
<p>“Wind tunnel shows big rigs should be shaped like boats” (The Ottawa Citizen): http://ottawacitizen.com/news/local-news/wind-tunnel-shows-big-rigs-should-be-shaped-like-boats</p> <p>“Big Rigs, Big Oil Savings” (Union of Concerned Scientists): https://www.ucsusa.org/sites/default/files/legacy/assets/documents/clean_vehicles/Truck-Technology-Factsheet.pdf</p> <p>“Driving down freight emissions” (Pembina Institute): http://www.pembina.org/blog/driving-down-freight-emissions</p> <p>“NASA Wind Tunnel Used to Test Truck Fuel Efficiency” (Space Library): https://www.youtube.com/watch?v=uE_OVUL6B08</p> <p>“NRC Wind Tunnel” (CTV Ottawa): https://www.youtube.com/watch?v=4-YWGuL3hKU</p>	<p>“What is Green Infrastructure?” (Environmental Protection Agency): https://www.epa.gov/green-infrastructure/what-green-infrastructure</p>

“Four Challenges We Must Overcome to Preserve Canada’s Urban Forests” (Huffington Post): https://www.huffingtonpost.ca/michael-rosen2/4-challenges-we-must-overcome-to-preserve-canadas-urban-forests_a_23223313/

“International Day of Forests 2018: Forests and sustainable cities” (Food and Agriculture Organization of the United Nations): <https://www.youtube.com/watch?v=ucXz3EqzRLo>

TOP PREDATORS ADAPT

“Killer whales hunting seals on ice – behind the scenes in Antarctica” (BBC Earth): <https://www.youtube.com/watch?v=g1VEwsl4SIY>

“Polar bears scavenging more orca-killed bowhead whales: study” (CTV): <https://www.ctvnews.ca/sci-tech/polar-bears-scavenging-more-orca-killed-bowhead-whales-study-1.3194560>

“Polar bears face yet another threat to their survival: sharks” (International Business Times): <https://www.ibtimes.co.uk/polar-bears-face-yet-another-threat-their-survival-sharks-1597095>

“Killer whales moving in in polar bears territory” (Winnipeg Free Press): <https://www.winnipegfreepress.com/canada/killer-whales-moving-in-on-polar-bears-territory-138382094.html>

WHAT’S THE BEEF?

“Eating Less Meat Will Reduce Earth’s Heat” (Huffington Post): https://www.huffingtonpost.ca/david-suzuki/eating-less-meat-climate-change_b_10012978.html

“Vegetarian vs. carnivore: What’s better for the environment?” (Weather Network): <https://www.theweathernetwork.com/news/articles/vegetarian-or-carnivore-whats-better-for-the-environment/87869>

“Is a vegetarian diet really more environmentally friendly than eating meat?” (CNN): <https://www.cnn.com/2017/02/06/health/vegetarian-diet-conversation/index.html>

“The other inconvenient truth” (TedTalk): https://www.ted.com/talks/jonathan_foley_the_other_inconvenient_truth

WILDLAND FIRE: FRIEND AND FOE

“Climate change” (Natural Resources Canada): <http://www.nrcan.gc.ca/forests/video/13557>

“Forests – Climate change: Adaptation” (Natural Resources Canada): <http://www.nrcan.gc.ca/forests/climate-change/adaptation/13099>

ALL-SEASON ARCTIC HIGHWAY

“The road to Tuktoyaktuk” (CBC): https://www.youtube.com/watch?v=vbj_IQaDvyA

“Melting permafrost: A sign of climate change?” (Australian Broadcasting Corporation): <http://education.abc.net.au/home#!/media/524675/melting-permafrost-a-sign-of-climate-change->

“Inuvik to Tuktoyaktuk road finally connects Canada from sea to sea to sea” (Toronto Star): <https://www.thestar.com/news/insight/2017/11/18/inuvik-to-tuktoyaktuk-road-finally-connects-canada-from-sea-to-sea-to-sea.html>

SPREADING TICK HABITAT

“Climate Watch Shorts: Why ticks are moving north” (TVO): <https://tvo.org/video/programs/climate-watch-shorts/climate-watch-shorts-why-ticks-are-moving-north>

“More ticks means an increase of Lyme disease across Canada – thanks to climate change” (Global News): <https://globalnews.ca/news/3472203/more-ticks-means-an-increase-of-lyme-disease-across-canada-thanks-to-climate-change/>

JIGSAW SHARING

Group students with different exhibition photos so everyone will be learning about something different (four to six students recommended). Hand out copies of the peer evaluation sheets and review together as a class.

On the sheet for each presenter, the last question should be done as a group. You may want students to complete the peer evaluation part after they have done the last question together. Ask students to try and see if the topic can connect to any of the climate change adaptation or mitigation actions/strategies they went over using the Venn diagram a few classes before. Bring up to display as necessary, or the original infographic from *Canadian Geographic* (available at: <https://energy.techno-science.ca/doc/content/adaptation%20and%20mitigation.pdf>)

Evaluate group discussions as needed.

Allow the class to go through their presentations, and then debrief. Were there any questions the presenter was unable to answer? (You may want to write them down and do some searching for the next class.) If time allows, you may also want to review what climate change adaptation/mitigation strategies they think their topic may connect to. Remember to collect peer evaluation forms.

WEATHER-PROOF WINDOWS AND DOORS 1	SET THERMOSTAT LOWER 1	COLLECT RAIN WATER FROM BARRELS FOR YARD WATERING 1	DRY CLOTHES NATURALLY ON A CLOTHESLINE 1	REPLACE SHOWER HEAD OR INSTALL A LOW-FLOW TOILET 1
OPEN AND CLOSE YOUR BLINDS SEASONALLY 1	SWITCH TO LED LIGHTBULBS 1	CARPPOOL TO WORK AND SCHOOL 1	SWITCH TO A TANKLESS WATER HEATER 1	USE FANS INSTEAD OF AIR CONDITIONING 1
CUT THE LAWN WITH AN ELECTRIC OR PUSH MOWER 1	WASH CLOTHES IN COLD WATER 1	BRING A REUSABLE BAG TO THE STORE 1	USE A TOASTER OVEN FOR SMALL MEALS 1	TAKE SHORTER SHOWERS AND FEWER BATHS 1
BUY SECOND-HAND THINGS INSTEAD OF NEW 1	UNPLUG ELECTRONICS WHEN NOT IN USE 2	INSULATE YOUR BASEMENT 2	EAT LOCAL FOOD 2	RECYCLE PAPER, METAL, AND PLASTICS 2
EAT LESS MEAT 2	INSTALL ENERGY-EFFICIENT WINDOWS 2	BUY AN ENERGY EFFICIENT STOVE OR FRIDGE 2	PURCHASE AN ENERGY EFFICIENT WASHER AND DRYER 2	CHOOSE CLEAN ENERGY SOURCES FOR POWER 2
LIVE CLOSE TO WHERE YOU WORK AND PLAY 3	DRIVE AN ELECTRIC VEHICLE 3	FLY LESS 3	BE CAR-FREE: ONLY USE PUBLIC TRANSIT 3	INSTALL SOLAR PANELS ON YOUR HOME 4
INSTALL GEOTHERMAL IN YOUR HOME 4	INSTALL A HIGH-EFFICIENCY FURNACE 4	DON'T WASTE FOOD 4	UPGRADE YOUR ROOF INSULATION 5	HAVE FEWER CHILDREN 5

Peer Evaluation: Researching Climate Change

Listen closely to each presenter and fill in an evaluation for each of them:

_____ 's presentation.....
(name of presenter)

Name: _____
(your name)

	Not at all	Very little	Somewhat	Mostly	Definitely
- Was communicated clearly and was engaging.	1	2	3	4	5
- Showed they researched the topic.	1	2	3	4	5
- Connected the picture to climate change.	1	2	3	4	5
- Gave me ideas and strategies for adapting to and mitigating climate change	1	2	3	4	5
- Taught me the following thing I found interesting:	_____				

- Made me think of the following question:	_____ ?				
	_____ ?				
- Could be connected to the following climate change adaptation and mitigation action(s): (see Venn Diagram)	Action/Strategy: _____				
	Reason: _____				

Peer Evaluation: Researching Climate Change

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_____ 's presentation.....
(name of presenter)

Name: _____
(your name)

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- Connected the picture to climate change.	1	2	3	4	5
- Gave me ideas and strategies for adapting to and mitigating climate change	1	2	3	4	5
- Taught me the following thing I found interesting:	_____				

- Made me think of the following question:	_____ ?				
	_____ ?				
- Could be connected to the following climate change adaptation and mitigation action(s): (see Venn Diagram)	Action/Strategy: _____				
	Reason: _____				

KEY POINTS

DETAILS

SUMMARY

PART IV

Climate change in our words and photos

Suggested classes: English Language Arts, Geography, Science, Visual Arts

Length of time: Three to four blocks of 50-70 minutes

Objective

In this lesson, students will:

- Curate and create content for a class-led climate change exhibition
- Collectively decide on a common guiding question, then build a series of photos or artworks
- Connect to local community and climate change issues using their creations and captions
- Communicate work during an event/opening to other classrooms, the school, or others in the community

Materials

- Cameras (phone or digital)
- Art supplies (optional)
- Paper for photo captions
- Computer access (optional)
- Pens and pencils
- Sample interpretive plan
- Exhibition evaluation rubric (optional)

Evaluation

- Development of art/photo development, along with caption editing, researching, and revising (Formative)
- Art/photo submission and accompanying captions (Summative)

OPENING ACTIVITY: COMMUNITY AND CLIMATE – WHY CARE?

Begin today’s class with a discussion about the community connections to climate change topics presented last class. After researching and thinking of some personal actions for climate change adaptation and mitigation, ask your students how they see this topic connecting to their own community.

You may wish to have your students try to discuss one climate story and community connections in pairs, and then come together as a class to continue brainstorming and share ideas. Note the conversations on the board.

Ask students to begin by discussing any climate actions they suggested from their research presentations; then try to broaden the discussion to connect to community issues.

The goal of this conversation is to connect a series of impacts that climate change is having across Canada and make a local connection to it. For example, while your community may not have to worry about building a highway over permafrost, urban planners everywhere have to think about how floods and storms will affect transportation routes and infrastructure. There is also a discussion to be had about the impacts of shorter and less cold winters affecting recreation and transportation, in both positive and negative ways. Challenge your students to think about what are the bigger stories in these topics.

After your discussion, you may want to display the chart of Community and climate questions (provided below). You may want to familiarize yourself with potential links here to help prompt groups that may be struggling to make links to the community.

Community and climate questions

ELECTRIC VEHICLES

Are there any electric vehicle charging stations near our school? In our community? Is the electricity we would need for one in our community coming from a renewable or non-renewable energy source? Are there any other benefits or rebates to purchasing one where we live? Does our local climate affect how people feel about driving an electric vehicle?

COOL ROOFS

Do we have any of these in our community? What do they look like? Could our school and community spaces install one? How would it help the environment as well as insulating the building? What kinds of plants would work best for a cool roof in our community?

HEAVY-DUTY AERODYNAMICS

How do goods get to our community now? By road? Rail? Air? What goods and services do we send out to other places? How are these different modes of transportation becoming more efficient? What percentage of our local energy is used in transportation?

URBAN FORESTS

How much green space does our community have compared to built-up concrete and asphalt? Can we explore this further on Google Maps or by asking our local government? Are there laws or goals to have a certain percentage of green space where we live? How much green space do we have on our school grounds and in the area?

TOP PREDATORS ADAPT

What kinds of animals move through our community? Are there any we notice arriving earlier, staying later, or who are becoming more uncommon or common? How do you think they are adapting to, and being influenced by, climate change?

WHAT'S THE BEEF?

What kinds of food do we eat (at home and at school) that consume more energy and produce more greenhouse gas emissions than others? If we had a 100-mile diet for our community, what would we eat? Could we do it? What are some ways we can eat meat while being conscious of our carbon footprint?

WILDLAND FIRE: FRIEND AND FOE

How at risk is our community to local wildfires, or the effects of fires far away (i.e. smoke)? How does our community use prescribed burns (planned fires), and where? What plants do we have around us that are influenced by extreme heat and cold that fires and other climate change weather impacts might stress/thrive in? Are there other insects or bugs that will affect us with climate change?

ALL-SEASON ARCTIC HIGHWAY

How are our community transportation arteries being affected by a changing climate? Does our community have any risk of flooding? How could shorter—and less cold—winters affect our daily work and recreation activities?

SPREADING TICK HABITAT

As tick populations migrate, will they impact our community? How does our location fare for ticks? In what months are they most active? What should we do to prevent ticks and Lyme disease in our activities? What happens if you get a tick, and are the impacts always the same?

PREPARING FOR CLIMATE-DRIVEN HEALTH IMPACTS

Where do we get our water from? Where does our waste go? Do both of these processes involve the same body of water (e.g. river, lake)? Where does water go down a sewer vs. a storm drain? What diseases in these systems will increase with a warming climate? How does our sanitation system work to prevent this?

MAKING A CLIMATE CHANGE EXHIBITION

Following a brainstorm on community connections, introduce the final project: your students will be creating their own photo or art exhibition on climate change and/or the environment. They will work together as a class; first, to determine a guiding question and key messages for the exhibition, then to create and curate a photo or art exhibition to be shared with others.

This project can take a few paths depending on the resources you have available. You might ask students to:

- Go out in the community—in groups or individually—to gather different photos or other materials they think would help tell a story (graphs, posters, brochures, etc.), produced by them or by others
- Create artwork instead of taking photos, in a medium determined by you or the students, potentially using environmentally friendly and/or recycled materials

- Use online sources to search for photos or images relevant to the theme, citing the owner to the best of their ability and crediting them
- Mix all of the above

Regardless of the plan you approach, this project will ask your students to use their climate change and photo literacy knowledge to discuss, choose, edit, and write captions for the featured photos or artifacts that make up the exhibition. Just like a curator helps to gather stories and express research and knowledge on a subject to the exhibition design team, your students will have to use a number of complementary skills to effectively display an exhibition for their school, and if possible, their community.

Photos and participation

Students today are not only bombarded with images, but have constant opportunities to take their own photos, and edit and curate their lives. Social media platforms such as Facebook, Instagram, and Snapchat remind us of how powerful photos and images can evoke emotions in people, especially youth.

As museums continue to move towards engagement that connects people to their physical and digital lives, make your exhibition fun and participatory. Ask your students how they will welcome people to interact with and share their experiences—beyond looking at the images and walking away.

Do you want to create a hashtag or meme for your exhibition—or make a digital copy of the exhibition—that you can send to other actors in the community, such as your local politicians, climate change-connected companies and non-profits, the school board, or the Prime Minister of Canada?

Will you take in feedback from the public by signing a climate change action pledge, or by asking visitors to fill a postcard with drawings or sentences to answer a question about climate change? What will you do with the feedback you collect? Can you find a way to communicate it back to visitors and other interested stakeholders?

Engaging outsiders with your exhibition will help your students to feel empowered. Knowing that they are producing something not just as a school project, encourage them to celebrate their collaboration and think of different ways people can share their own stories by looking at the stories from the exhibit materials (photos, artwork, etc.) they have curated.

The process and procedure you undertake to produce your exhibition will vary, depending on what you or your class choose to produce. When preparing an exhibition at a museum, staff use an interpretive plan to help guide the key messages and ideas they want to convey. An example interpretive plan is included in the Appendix (Interpretive plan template) for you to go over with your class.

Review the Interpretive plan with the students, either displayed on a screen or print out copies.

Have a class discussion to determine context, key audiences, and principal messages you want to convey. Ask each student (or if you choose, student groups) creating a piece for the exhibition to work on their line submission for the Interpretive plan. This includes filling out the following information in advance so that students have a rough idea of what the key messages and goal of their contribution will be.

Their list of considerations includes the following:

- Key ideas
- Visitor outcome (i.e. what do you expect visitors to get out of your piece, either when in front of it, or afterwards?)
- Photo/graphics/illustration description (what are they creating?)
- Text strategy (What will their caption say and in what format: a summary of the work, themes, and/or ideas? What questions do they want to pose for visitors to think about?)

An example outline of this is provided on the Sample interpretive plan template.

A few other considerations for you and your students to determine include:

- Installation: Where do you hope to put up your exhibition first, and for how long? Where else would you like it to go? What is required to display your pieces? How can you make it look official?
- Title of the exhibition: What do you want to call the exhibition?
- More information: Do you want visitors to have a pamphlet or a short summary of the exhibition?
- Timeline: When should the final exhibition project be completed by?
- Vernissage/opening: Do you want to have an official opening of your exhibit? Who at the school and in your community would you like to invite?

Tip: You may want to leave some of the coordination of this to small groups of students who may finish the project earlier than others. With your guidance, you might want to invite them to work on certain areas (e.g. determine who to invite and create an invitation, or make an exhibition title poster or heading).

At this point, let the development begin! You may want to expand this project across a few subject areas, as applicable, to also allow your students ample class time to complete some of the major pieces of this final project in an efficient manner.

PRESENTATION

Determine who to invite for the opening, and decide if you'd like students to be evaluated with an oral presentation format during or before the opening. Then, enjoy the communal work of your students and celebrate.

Share your exhibition and your experiences in this project with us! Email us at: energy-energie@ingeniumcanada.org with photos and your feedback, or tweet us at @enertweets.

Interpretive Plan

Context:

Audience:

Primary audience: (ex. youth, peers, etc.)

Secondary audience: (ex. general public, political figures, etc.)

Principal message: (ex. big idea)

Principal objective: (ex. what should people take away?)

Rubric

Development Process	Communication of Ideas	Impact	Process & Form
<p>1- Little to no sketching out of the art exhibit submission took place. Class time was not used and time was poorly managed. The exhibit submission seemed rushed with little thought into its development.</p>	<p>1- The exhibit submission shows no connection to the larger exhibit theme. No captions are provided to give visitors context.</p>	<p>1- The exhibit submission is not yet prepared to connect with the exhibit theme. Greater attention to how visitors will see and be attracted to this piece is required.</p>	<p>1- The exhibit submission shows no development in the medium used (e.g. photograph, painting, sculpture). Working through the process and creating some drafts would have been helpful.</p>
<p>2- Very little attention was given of the process of sketching out the proposed exhibit submission first before developing it. Class time was generally not used well and time management was unclear.</p>	<p>2- The exhibit submission does not communicate the larger exhibit theme very much. Captions provide little detail or assistance for viewers to understand the submission. Major revisions required.</p>	<p>2- The exhibit submission has little impact on visitors to connect with the theme of the exhibit. The piece does not easily provide a way for visitors to pause, reflect, and think about the theme of the exhibit and connect it to the submission.</p>	<p>2- The exhibit submission shows little development in the medium used (e.g. photograph, painting, sculpture). Creating some drafts or experimenting more in the medium before would have been useful.</p>
<p>3- The process from sketch to development of the exhibit submission was somewhat thought out, but not completely clear. More class time used and better time management would help.</p>	<p>3- The exhibit submission communicates the larger exhibit theme somewhat but is somewhat unclear. Captions are unclear and need some revising for visitors to better understand the submission.</p>	<p>3- The exhibit submission has a moderate impact on visitors and will resonate with some of them. The piece is good, but needs to think more about how visitors will pause, reflect, and think about it when they see it.</p>	<p>1- The exhibit submission shows some development in the medium used (e.g. photograph, painting, sculpture). A general understanding of the medium and experience is demonstrated in the final product.</p>

Processus de développement	Communication des idées	Impact	Processus et forme
<p>4- The process from sketch to development of the submission was generally well done. For the most part you thoughtfully used time effectively and managed time wisely.</p>	<p>4- The exhibit submission communicates the larger exhibit theme quite well. Visitors can distinguish and connect mostly what the submission was trying to express. Minor revising of captions would be helpful.</p>	<p>4- The exhibit submission has an impact on visitors and resonates with them somewhat. The piece encourages visitors to think about the theme of the exhibit and they may pause, reflect, and think.</p>	<p>4- The exhibit submission shows good development in the medium used (e.g. photograph, painting, sculpture). A good understanding of the medium and experience is demonstrated in the final product.</p>
<p>5- The process from sketch to development of the exhibit submission was well done and showed mastery of this skill. You carefully used class time effectively and managed time wisely.</p>	<p>5- The exhibit submission communicates the larger exhibit theme very well. Visitors could easily understand what the submission was trying to express, using well-versed captions.</p>	<p>5- The exhibit submission has a high impact on visitors and resonates with them. It is an exemplary piece that gives visitors reason to pause, reflect, and think on the theme of the exhibit.</p>	<p>5- The exhibit submission shows high development in the medium used (e.g. photograph, painting, sculpture). A strong understanding of the medium and experience is demonstrated in the final project.</p>

Comments:

Total: