WHAT'S WEATHER & CLIMATE GOT TO DO WITH IT?

A Unit on Air Quality, Our Health & the Environment

TEACHER OVERVIEW & ACTIVITY GUIDE – GRADE 5 & 6 LEARNING PACKAGE

West Central Airshed Society

This learning package was designed by the West Central Airshed Society (WCAS), a not-for-profit community organization that collects and shares information about ambient air quality in West Central Alberta.

As Alberta's inaugural Airshed organization, WCAS is responsible for operating air quality monitoring stations that measure the level of pollutants in the outdoor air; providing credible science-based data and educational outreach to all stakeholders, including the public; and working collaboratively to better air quality in West Central Alberta.

We invite you to explore this teacher guide and the other learning package materials that are available on our website, and hope that you and your students enjoy the content and activities that follow.

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We hope you and your students enjoy these resources! To offer feedback or if you require further information please contact us at info@wcas.ca

OVERVIEW

This Teacher Guide is part of the larger Grade 5 & 6 Learning Package, *What's Weather & Climate Got to Do with It?*, which explores the relationship between climate, weather, and local air quality. The material addresses common air pollutants and their sources, how weather interacts with pollutants in our atmosphere to determine the quality of our air, and air pollution's impact on the health of humans and the environment. The learning package also focuses on current efforts to monitor and predict air quality in Alberta. Students will learn about the province's Airshed organizations, how they function, and the role they play in keeping our communities safe—including how these organizations provide data for the Air Quality Health Index (AQHI).

Learning Package Quick Facts

- Can be used for both in-class or online instruction
- Meets the needs of a variety of different learning styles
- Is flexible – use the whole curriculum or pick and choose activities according to your goals
- Access to the internet and equipment to display PowerPoint is required
- All materials are available on our website, including:
  - An inquiry-based PowerPoint lesson containing five activities and two videos
  - A teaching script (included in the lesson slideshow and available as a separate document)
  - A summative assessment tool, i.e., Air Quality Jeopardy

Curriculum Connections

This learning package aligns with Alberta's NEW Grade 5 and 6 Science curricula, specifically the topics of Energy and Earth Systems and helps teachers address the following Guiding Questions:

- How are energy resources understood?
- How are energy resources used?
- How can climate and its effects be understood?
- What relationship exists between climate and changes on Earth?

Learning Outcomes

At the end of this unit, students will be able to:

- List common local air pollutants and their sources
- Explain how human activities contribute to air pollution
- Reflect on how their daily routines contribute to local air quality and identify behavioral changes they can adopt to help improve conditions
- Identify ways in which weather impacts air quality and describe common weather phenomena that lead to poor air quality in their communities
- Discuss how air pollution contributes to our changing climate and how changes to our climate may impact air quality in the future.
- Describe how air pollution can affect the health of humans and the environment and explain why clean air is important for our wellbeing
- Locate and interpret air quality data and forecasts

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LESSON OUTLINE & INSTRUCTIONS

The *What's Weather & Climate Got to Do with It?* lesson is a PowerPoint presentation consisting of 40 slides. Appropriate software and computer equipment is required to teach this material. A secure internet connection is also necessary, as the lesson contains links to online videos.

When starting the PowerPoint, be sure to use "presenter view;" this will allow you to read the teaching script located in the "notes" section of the slideshow. Be aware notes written in *italics* are the suggested teaching script while CAPITALS LETTERS signify an action that is required (e.g., CLICK SLIDE to reveal animation) and any additional information is written in normal lettering.

The entire presentation will take roughly 45 minutes to 1 hour to cover (not including time spent on activities). We suggest pausing at Slide 20 - the start of Module 2, so that the lesson unfolds over two classes. Not only is this the middle of the slideshow, but it is also a logical place to stop given the content.

MODULE 1 (SLIDE 2 - SLIDE 19)

Introduces students to the sources of air pollution, the science and technology used to monitor and predict local air quality, and personal choices available to solve our air pollution problems.

- Two videos
- Two activities – additional 30 minutes

MODULE 2 (SLIDES 20 - 40)

Delves deeper into the ways in which weather conditions, how climatic patterns can help predict the type of air quality issues we can expect, and in turn impact local air quality and how poor air quality affects life on Earth as well as the planet's climate. It also introduces students to the Air Quality Health Index (AQHI), a system used for communicating levels of outdoor air pollution to Canadians.

- Three activities – additional 70 minutes

While we encourage you to cover all five activities in the lesson, if time is at a premium, you may pick and choose activities as needed. The teaching script is written such that if any activities are left out, the lesson still functions.

The following Teacher Guide provides an in-depth overview of the activities embedded in the *What's Weather & Climate Got to Do with It?* lesson. Teachers should review this information carefully. Where applicable, the outlines contain:

- Time required
- Summary
- Essential questions
- Preparation required
- Materials list
- Background information
- Activity instructions
- Teacher tips
- Ideas on how to modify the activity to suit different learning settings or styles
- Student worksheets

You'll note that the **Summative Assessment: Air Quality Jeopardy**, is an optional activity located in a separate PowerPoint document, but the activity outline and game instructions are found in this guide.

Time required: 10 minutes

ACTIVITY 1: A REAL PEASOUPER

SUMMARY

In this visual literacy activity, students will examine a primary historical source (i.e., Monet's painting, *The Thames below Westminster*) and make observations about London's past air quality. Students will learn that air pollution is not a new phenomenon, but that our attitude towards this problem has shifted, prompting more awareness of the issue and its implications for the health of humans and the environment.

ESSENTIAL QUESTIONS

- How did the Industrial Revolution (which brought about use of machines in factories to produce goods), and the increased burning of fossil fuels, lead to air pollution problems?
- How is the quality of outdoor air impacted by human activities and weather conditions?
- How did people in the past view air pollution?

MATERIALS

There are no specific materials nor preparation required for this activity, but it works best if students have access to paper and a pencil/pen to record their observations.

BACKGROUND INFORMATION

Air pollution is often thought of as a recent issue, however, laws seeking to control it began as early as 1306, when King Edward I banned the burning of sea-coal in London — a move that did little to stop the practice.

Oscar-Claude Monet (1840-1926) was a French Impressionist artist who painted outside, *en plein air* ("in open air"). When painting his romantic landscapes, Monet focused on using colour to reveal the ambiance of natural light. Monet painted *The Thames below Westminster* while living in London in 1871; it is believed to be based on actual observations and not from his imagination.

Monet's painting showcases London's infamous "peasoupers," thick smoky fogs known for their brownish-yellow colour. This type of air pollution is more formally called "industrial smog." With the advent of the Industrial Revolution, the shift from human labour to machinery meant that fossil fuel burning increased significantly. In the 1700s, coal became the main fuel source in England and was used in both factories and homes.

In Monet's time, industrial smog was common in London during the winter and resulted from a combination of coal smoke and natural fog. The coal that Londoners were burning contained sulphur, which when combined with fog transformed into sulphuric acid and made the outside air toxic. During the Great Smog of 1952, it is believed that 12,000 Londoners died on account of poor air quality, while an additional 100,000+ became ill.

Monet's painting has an appealing quality to it that differs from the harsh realities of air pollution. In fact, Monet once told art dealer, Rene Gimpel: "I only love London in winter… without its fog, London would not be a beautiful city." Clearly, Monet was not concerned with the health impacts of poor air quality, which were known but not widely understood at the time.

Nevertheless, this quote highlights the fact that in the 19th century, many Londoners viewed air pollution positively, while others considered it a normal part of living in the city. Sources of pollution (e.g., industry and transportation) created many jobs, in addition, burning coal to heat homes was a comfort that people wanted.

Peasoupers remained a concern for Londoners up until the mid-20th century, when the famous smogs of the 1950s and 60s prompted public inquiries and ultimately led to the UK's Clean Air Act, which posed strict rules on air pollution. Many other governments followed suit with actions that have helped to improve air quality around the world.

As a large city, London continues to struggle with poor air quality, but the main causes have changed. The increasing number of motor vehicles in the city is producing large amounts of nitrogen oxides and particles in the air (called particulate matter), which can make photochemical smog. This type of smog is occasionally a problem in Alberta and will be addressed in Slide 28 of the lesson.

INSTRUCTIONS

- Display Slide 3 to your class.
- Play the recording or follow the teaching script to set up the premise for this activity. Students will be tasked with writing down five things they notice about the painting and any questions they may have about what they see.
- Discuss student's observations, which may include:
  - The air appears foggy/smoky and has a yellowish-brown tinge
  - It is hard to see the buildings in the distance
  - Smoke/exhaust is coming out of boats
  - People are continuing their daily activities outside
  - The painting has a romantic quality to it
- After your discussion, ask the following questions:
  1. How does the painting make you feel?
  2. What do you think the artist was trying to communicate? – remember that Monet believed that smog was beautiful.
- Read aloud the remainder of the teaching script, which explains industrial smog, how this term came to be, and what eventually prompted the UK government to intervene and clean up London's air.

Time required: 20 minutes

ACTIVITY 2: LINE 'EM UP

SUMMARY

This value-line activity allows teachers to assess students' understanding of and interest in air quality issues. It is designed to activate students' prior knowledge of air quality and to provide them with an opportunity to share their perceptions of the subject with their peers.

ESSENTIAL QUESTIONS

- Why is breathing clean air important?
- How and why does air quality vary around the world?
- Are personal actions necessary and/or sufficient to help solve air pollution problems?

MATERIALS

- Five pieces of paper with the numbers 1-5 written on them
- Tape

PREPARATION

- Ensure you have enough space in your classroom (or other location) for students to move freely and safely along the value line.
- Establish the value line by evenly spacing out and taping paper with numbers 1-5 to your walls and/or floors.

BACKGROUND INFORMATION

Use the following points to guide your class discussion (these are included in the teaching script):

- Clean air is one of the basic requirements of human health and wellbeing. We breathe approximately 20,000 times a day, so clean air is essential to a good quality of life.
- Individuals react differently to air pollution. Some people are more sensitive to pollutants and are at greater risk of experiencing associated health problems, but air pollution can affect anyone, even healthy people. Teenagers, young adults, and athletes can suffer negative effects from high pollution levels, especially when exercising outdoors.
- Emissions of many air pollutants have decreased substantially throughout the world in recent decades. However, air pollutant concentrations are still too high, and air quality problems persist.
- Air pollution is a problem throughout the world but is often worse in developing and densely populated countries, such as China and India. These countries tend to have a higher reliance on fossil fuels and emit more pollutants because of their large populations.
- Alberta and its urban centres (such as Edmonton) benefit from relatively good air quality. But weather conditions, wildfires, and industrial accidents sometimes create dangerous air pollutant levels.

- Many everyday human activities result in air pollution, therefore, by changing our habits and behaviours, we can help improve local air quality. Laws and regulations are only one way to help solve air pollution problems. If we want to be successful in reducing emissions, a combination of approaches must be taken.
- Humanity has the necessary knowledge and tools to improve air quality, but we need to be invested in this topic and willing to make changes to our daily routines for progress to occur.

INSTRUCTIONS

- Display Slide 8, which contains the value line scale:
  - 1 – Strongly disagree
  - 2 – Somewhat disagree
  - 3 – Unsure or neutral
  - 4 – Somewhat agree
  - 5 – Strongly agree
- Explain that you will be reading aloud a series of statements. Note that you must click the slideshow to reveal the following statements one at time:
  - Clean air is important for a good quality of life
  - Air pollution affects everyone
  - Air quality is an important issue around the world
  - Air pollution is a problem in our community
  - I can play a role today in improving air quality in my community
  - I am hopeful that air quality conditions will improve in the future
- For each statement, have students determine which spot on the value line most closely represents their opinion. Then ask students to line up according to their stance.
- Encourage students to verbalize what they notice about the feelings of the group, e.g., "over half the class agrees with this statement."
- Invite students to partner with someone who disagrees with their stance and discuss their differing positions.
- Debrief the value line judgement with your entire class.
- You may also wish to build in the opportunity for students to change their stance on a statement, after hearing the insights of their peers.
- Proceed in this fashion for the remaining five statements.

MODIFICATIONS

This activity is flexible; it can be done in a variety of locations. If space is an issue, you may wish to conduct the activity outdoors, using numbered pylons. If students are learning online, have them write down and display the number that corresponds to their answer. Tally responses, so that students know how their opinion compares to the rest of the class. In this case, you can skip the partner discussions and instead proceed directly to a class discussion. In addition, feel free to modify the value-line scale and add or remove statements as you see fit.

TEACHER TIPS

Where students place themselves on the value line is not as important as the conversation it creates. Let this activity be an opportunity for students to recall and share what they already know about air quality, the causes and effects of air pollution, and their level of engagement with the topic.

Learning about pollution and air quality issues can be overwhelming for students; be sure to keep the tone of your conversation open, considerate, and hopeful. Remind students that the actions we take in our local communities can make a difference.

*This activity was inspired by a resource on climate change by Ingenium, Canada's Museum of Science & Innovation: https://energy.techno-science.ca/doc/resources/TWD_English.pdf

Time required: 20 minutes

ACTIVITY 3: INVERSION DIVERSION

SUMMARY

This experiment introduces students to the concept of temperature inversions. Students will first observe a demonstration of typical atmospheric conditions, then hypothesize what will happen when this pattern is disrupted by a temperature inversion. Students will test their hypotheses by observing a simulation of a temperature inversion and contemplate how this condition could influence local air quality.

ESSENTIAL QUESTIONS

- How does the vertical movement of air in the atmosphere impact outdoor air quality?
- How do temperature inversions disrupt the normal pattern of outdoor air movement?
- How can temperature inversions result in poor air quality?

BACKGROUND INFORMATION

Temperature inversions are natural phenomena that occur year-round but are most prevalent in the winter. They are neither caused by, nor the cause of, air pollution, but they often contribute to poor air quality episodes by preventing atmospheric circulation and trapping pollutants near the ground, where we live and breathe.

The outside air is constantly moving, and this movement is an important factor in keeping our air clean. Air temperature affects the movement of air and so too the movement of air pollution. Under normal atmospheric conditions, air temperature decreases with an increase in altitude. As such, the air near Earth's surface tends to be warmer than the air above it. When the temperature of air (or water - as is used in this experiment) changes, so too does its density. As the density of air changes, it begins to move: warmer, less dense air rises and cooler, more dense air sinks. This vertical movement is known as convection. Convection is good in terms of air quality because it moves pollutants from the ground to less-polluted areas higher up in the troposphere, where wind speeds are faster and can more easily disperse pollution.

During a temperature inversion, the normal atmospheric temperature pattern is reversed: cool air sits near the ground and warm air is found further up in the troposphere. Temperature inversions slow down and limit convection as the warmer layer of air higher up acts as a lid and prevents the cooler air at ground level from rising. This phenomenon causes pollutants to build up at ground level, where we live and breathe.

MATERIALS

- Four empty glass bottles of equal size (ensuring glass is safe for use with hot water)
- Food colouring (preferably yellow and blue)
- Two playing cards large enough to cover the mouth of the bottles (substitute: pieces of laminated cardstock)
- Plastic tablecloth
- Optional: methods to heat and cool water (e.g., kettle, microwave, ice, etc.) if tap water temperature does not vary significantly
- Optional: gloves with grips to handle hot water bottles
- Copies of the Inversion Diversion student worksheet (see pages 13 and 14)

PREPARATION

- Place a tablecloth on top of the surface you are using for this experiment.
- Carefully fill two bottles to the brim with hot water; add yellow food colouring to these containers, ensuring it is well mixed. Handle bottles of hot water carefully to prevent injury. You may want to wear gloves with grips.
- Fill the other two bottles to the brim with cold water; add blue food colouring to these containers, ensuring it is well mixed.

INSTRUCTIONS

- Distribute the Inversion Diversion worksheets to students.
- Display Slide 25.
- Follow the teaching script to set up for this activity. You will be conducting two demonstrations; one will act as a model for convection (vertical mixing) and the other will simulate a temperature inversion.
- Ask for one or two students to assist you with these demonstrations.

Demonstration #1 - Model of typical atmospheric conditions (convection)

- Your first demonstration will be what happens when the bottle filled with cold water is placed atop the bottle filled with hot water.
- To start, place the playing card over the mouth of the bottle containing cold water.
- Slowly and carefully tilt the bottle of cold water upside down, using the playing card as a lid to ensure no water escapes, and place it atop of the bottle of hot water.
- Keeping the top bottle fixed in place, ask the student you've identified as your assistant to remove the playing card slowly and gently, allowing the water from both bottles to touch. Be sure to hold both bottles steadily in place as your student assistant removes the playing card.
- Have students observe the interaction of the water in the two bottles and ask them to complete the first portion of the student worksheet by recording their observations and conclusions.

before

during

after

- Explain to students that they have just witnessed a model of convection. When the cold water bottle sits on top of the hot water bottle, the less dense hot water rises into the top bottle and the more dense cold water sinks into the bottom bottle. The movement of the water is clearly seen as the yellow and blue food colourings mix, creating a green liquid.
- Discuss with your students how the vertical movement and mixing of air impacts air quality.
- Before proceeding to the next demonstration, ask students to predict what will happen when the temperatures are inversed (or reversed – hot on top). Will the two liquids mix or remain separate? Have them write their hypothesis out in the area provided on the worksheet.

Demonstration #2 - Temperature inversion simulation

- Your second observation will be what happens when the bottle filled with hot water is placed atop the bottle filled with cold water.
- To start, place the playing card over the mouth of the bottle containing hot water.
- Slowly and carefully tilt the bottle of hot water upside down, using the playing card as a lid to ensure no water escapes, and place it atop of the bottle of cold water. You may want to wear gloves with grips for this portion.
- Keeping the top bottle fixed in place, ask the student assistant to remove the playing card slowly and gently, allowing the water from both bottles to touch.
- Have students observe the interaction of the water in the two bottles and ask them to complete the second portion of the worksheet by recording their observations and conclusions.
- In the case of this simulation, the hot and cold water will remain in separate bottles, no mixing occurs.
- Be sure that students reflect on what this means for air quality. Temperature inversions limit convection and stop air from circulating and mixing. This causes pollutants to build up at ground level, where we live and breathe, and creates poor air quality.
- Once students have completed their worksheet, proceed to the next slide (i.e., Slide 26) and use the slideshow notes to guide your explanation.

MODIFICATIONS

The instructions describe this experiment as a demonstration by the teacher, however, if you prefer a more hands-on approach, it can also be done individually by students or in small groups. To make the activity more challenging, you could conduct the experiment before introducing the concept of convection.

before

after

Student Worksheet: Inversion Diversion

DEMONSTRATION #1 – MODEL OF NORMAL ATMOSPHERIC CONDITIONS

Your first demonstration will be what happens when a bottle filled with cold water is placed on top of a bottle filled with hot water. This demonstration shows us what happens under normal atmospheric conditions (warm air near the ground and cooler air above). Remember: water acts as a substitute for air in this experiment.

During the demonstration #1, I observed that...
(Describe at least 2 observations from the experiment. What happened?)

1 _____

_____

_____

2 _____

_____

_____

Based on these observations, I learned...
(Explain the results of the demonstration and why it occurred this way).

_____

_____

_____

_____

_____

_____

_____

Student Worksheet: Inversion Diversion

DEMONSTRATION #2 – TEMPERATURE INVERSION SIMULATION

Your second demonstration will be what happens when a bottle filled with hot water is placed on top of a bottle filled with cold water. This demonstration shows us what happens during a temperature inversion. Remember: water acts as a substitute for air in this experiment.

Create your hypothesis (make an educated guess)...

Based on my observations from demonstration #1, I think that _____ _____**will happen when the temperatures are inversed (upside down).**

Test your hypothesis by observing demonstration #2!

My hypothesis was _____ **(right or wrong). What happened was** _____ _____

During demonstration #2, I observed that... (Describe at least 2 observations from the experiment. What happened?)

1 _____

_____

_____

2 _____

_____

_____

Based on these observations, I learned... (Explain the results of the demonstration and why it occurred this way).

_____

_____

_____

This experiment is related to weather and air quality because it shows us how... (What do these two demonstrations teach us about the vertical movement of air and its impact on air pollution? Hint: think about where air pollution comes from and what would happen if air pollutants are prevented from rising high into the atmosphere).

_____

_____

_____

_____

_____

_____

Time required: 30 minutes

ACTIVITY 4: CONNECTING CONCEPTS

SUMMARY

This two-part group activity challenges students to differentiate between weather and climate and how they can impact ambient air quality. A series of fill-in-the-blank statements highlight the most prominent weather conditions and climatic scenarios that can affect the quality of outdoor air in Alberta. After completing the statements with the appropriate term, students will determine whether these statements relate to weather or climate.

ESSENTIAL QUESTIONS

- What is the difference between weather and climate?
- How are weather and climate interconnected?
- How do weather conditions impact the quality of our air?
- How can knowledge of climate help us predict our risk for poor air quality events?
- How might the changing climate affect the air quality we can expect in the future?

PREPARATION REQUIRED

- Review definitions of weather and climate found in the PowerPoint slides (i.e., Slides 21 & 22)
- Print enough copies of the Connecting Concepts worksheet so that each group has one
- Divide students into groups of two to three

MATERIALS LIST

- Copies of the Connecting Concepts worksheet (one per group)
- Pencils (one per group)

BACKGROUND INFORMATION

While closely connected, weather and climate are not interchangeable concepts. Weather is the short-term conditions experienced in a specific place, including temperature, humidity, precipitation, wind speed and direction, and the amount of sunlight or cloud cover. Weather can change from day-to-day, hour-to-hour, or even minute-to-minute. On the other hand, climate is the long-term pattern of weather experienced in a larger region, usually tracked for at least 30 years. Climate is defined not only by things such as average temperatures and precipitation but also by the type, frequency, duration, and intensity of weather events.

While weather conditions impact real-time air quality, the climate of a given region helps to predict the types of poor air quality events its residents may encounter. Although Alberta benefits from relatively good air quality, its continental climate with hot and dry summers puts it at risk for wildfires that emit harmful smoke and chemicals. Likewise, its cold winters make the region prone to the accumulation of pollutants associated with temperature inversions.

Climate change and air quality also have a reciprocal relationship. Climate change can affect air quality and certain air pollutants can contribute to a changing

climate. For example, hot sunny days associated with a warming climate can lead to elevated levels of ground-level ozone. Ground-level ozone, in turn, is a greenhouse gas that contributes to climate change by trapping heat in the atmosphere.

INSTRUCTIONS

- Divide students into small groups.

Part 1:

- Have groups begin by filling in the blanks of each statement with the correct term. Be sure groups use pencil when writing their responses, so they have the option of erasing.
- Review answers with the class as a whole by asking groups to volunteer their responses. Student should read the entire statement aloud to reinforce learning. Groups should correct any mistakes on their worksheet before moving on to the second part of the activity.
- Have students discuss which statements were easiest and hardest to complete. Review any concepts that they may still find challenging by using the applicable PowerPoint slides or other materials you see fit.

Part 2:

- Have groups determine whether each phrase is discussing the weather or climate.
- Review the answers with the class by asking groups to volunteer their responses. Student should read the entire statement aloud to reinforce learning.
- Have students discuss which statements were easiest and hardest to categorize. Review any concepts that they may still find challenging by using the applicable PowerPoint slides or other materials you see fit.

Student Worksheet: Connecting Concepts

PART 1:

Use the terms below to complete the following statements correctly. For statements with two blanks, use the same term twice. Do not complete the statement with two different terms.

RAINSTORM	**HIGH-PRESSURE SYSTEM**	**HEAT WAVES**	**PRECIPITATION**
LIGHTNING	**SNOW**	**SUNSHINE**	**WILDFIRE**
WINDS		**COLD**	

☐ _____ sparked a wildfire this afternoon, which created smoke that was dangerous for seniors and young children.

☐ _____ are becoming longer and more frequent in Alberta, increasing the risk of droughts and wildfires.

☐ Alberta's winters are generally _____, with average temperatures in the Edmonton region ranging from -4°C to -13°C. These conditions can lead to temperature inversions that create harmful smog.

☐ Strong _____ this evening pushed pollutants from the city into the countryside.

☐ Annual total _____ in Alberta is greatest in the mountains and decreases at lower elevations. _____ can help scrub the air and rid it of pollutants.

☐ On Thursday morning, there was seven centimetres of _____ covering the ground. These conditions contributed to a temperature inversion which resulted in winter smog.

☐ At 3pm, a big _____ helped to clear smog from the air.

☐ On average, Alberta experiences 312 days of _____ per year. _____ reacts with chemicals in our air to create ground-level ozone (O_3), a pollutant that can make it hard to breathe.

☐ Due to increasingly warmer and dryer conditions in the winter, the start of Alberta's _____ season is shifting from April to March.

☐ This week, a _____ created stagnant (or unmoving) air that caused a build up of pollutants and created poor air quality.

PART 2:

Determine whether the completed statements describe how weather conditions or regional climate impacts the quality of our air. Label the statements accordingly: **W = Weather / C = Climate**

Answer Key: Connecting Concepts

PART 1:

Use the terms below to complete the following statements correctly. For statements with two blanks, use the same term twice. Do not complete the statement with two different terms.

RAINSTORM	**HIGH-PRESSURE SYSTEM**	**HEAT WAVES**	**PRECIPITATION**
LIGHTNING	**SNOW**	**SUNSHINE**	**WILDFIRE**
WINDS		**COLD**	

W	___LIGHTNING___ sparked a wildfire this afternoon, which created smoke that was dangerous for seniors and young children.
C	___HEAT WAVES___ are becoming longer and more frequent in Alberta, increasing the risk of droughts and wildfires.
C	Alberta's winters are generally ___COLD___, with average temperatures in the Edmonton region ranging from -4°C to -13°C. These conditions can lead to temperature inversions that create harmful smog.
W	Strong ___WINDS___ this evening pushed pollutants from the city into the countryside.
C	Annual total ___PRECIPITATION___ in Alberta is greatest in the mountains and decreases at lower elevations. ___PRECIPITATION___ can help scrub the air and rid it of pollutants.
W	On Thursday morning, there was seven centimetres of ___SNOW___ covering the ground. These conditions contributed to a temperature inversion which resulted in winter smog.
W	At 3pm, a big ___RAINSTORM___ helped to clear smog from the air.
C	On average, Alberta experiences 312 days of ___SUNSHINE___ per year. ___SUNSHINE___ reacts with chemicals in our air to create ground-level ozone (O_3), a pollutant that can make it hard to breathe.
C	Due to increasingly warmer and dryer conditions in the winter, the start of Alberta's ___WILDFIRE___ season is shifting from April to March.
W	This week, a ___HIGH-PRESSURE SYSTEM___ created stagnant (or unmoving) air that caused a build up of pollutants and created poor air quality.

PART 2:

Determine whether the completed statements describe how weather conditions or regional climate impacts the quality of our air. Label the statements accordingly: **W = Weather / C = Climate**

Time required: 20 minutes

ACTIVITY 5: GET YOUR MESSAGE STRAIGHT

SUMMARY

This matching activity is designed to familiarize students with the Air Quality Health Index (AQHI), a colour-coded numerical index used across Canada to communicate levels of outdoor air pollution to the public. Students will learn about the health implications of poor air quality and think about how they might change their own activities during times of high AQHI readings.

ESSENTIAL QUESTIONS

- What is the AQHI and how does it help keep Canadians safe?
- How does AQHI messaging vary depending on whether an individual is considered part of an at-risk group or the general public?
- Where can daily air quality information and forecasts be accessed?

BACKGROUND INFORMATION

The AQHI is a colour-coded numerical index used across Canada to communicate levels of outdoor air pollution to the public. The formula used to calculate the national AQHI is based on research conducted by Health Canada using health and air quality data collected in major cities throughout the country.

The AQHI reading communicates the relative risk of a mixture of common air pollutants that can harm human health. Three pollutants act as indicators of the overall outdoor air quality:

1. Ground level ozone
2. Fine particulate matter
3. Nitrogen dioxide

Alberta's AQHI is determined by comparing hourly pollutant concentrations against Alberta's Ambient Air Quality Objectives (AAQOs). Each pollutant is given an acceptable 1 hour, 24 hour, and annual average concentration range. Levels above these limits means the AQHI value will be High or Very High risk.

The number of the AQHI refers to the health risks associated with outside air quality in a specific region. The higher the AQHI number, the greater the health risk and need to modify our outdoor activities. Occasionally during extreme pollution events, AQHI levels may reach 10 or 10+, indicating Very High Health Risk. Real-time data can be accessed by visiting your local Airshed website (find links to all of Alberta's Airsheds at AlbertaAirshedsCouncil.ca). Airshed websites list AQHI forecasts for today, tonight, and tomorrow.

The Index also provides "health messages" for certain segments of the population. Messages vary depending on whether an individual fits into the "general population" or is considered part of the "at risk" group. These messages are intended to help people make informed decisions about their outdoor activities.

The general population typically does not need to change their outdoor plans because of poor air quality; however, some people should take precautions to reduce their exposure to air pollution. People with asthma, diabetes, lung or heart diseases are more sensitive to air pollution. Seniors are at higher risk because of an increased likelihood of health problems. Children are also more vulnerable to air pollution because they have a less-developed respiratory system and breathe much deeper and quicker than adults. Likewise, people participating in strenuous sports or work outdoors breathe more deeply and rapidly, allowing more pollution to enter their lungs.

MATERIALS

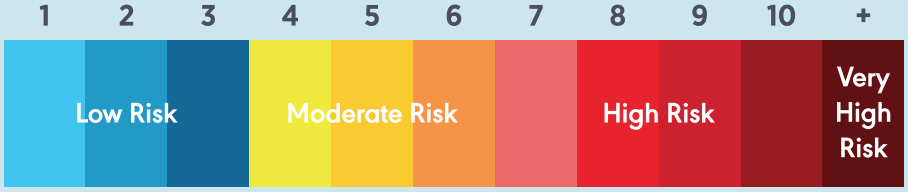
- Scissors and glue sticks
- Copies of the Get Your Message Straight worksheets (see pages 21 and 22):
  - AQHI Chart (preferably printed in colour)
  - Health Messages

INSTRUCTIONS

- Divide students into teams of three or four (depending on the amount of craft supplies available).
- Distribute the Get Your Message Straight worksheets to teams, making sure each group receives both the AQHI Chart and the Health Messages page.
- Display Slide 37 to the class; slide should begin with the blank AQHI Chart.
- Ask students to complete their AQHI Chart worksheet by cutting and gluing the health messages to their appropriate spots. Student should pay careful attention to the “at risk” and “general population” columns and consider how messages would vary depending on the type of person who is seeking advice.
- Once students have completed their worksheet, click the slide to reveal the answers. An answer key is also included in this document.
- We highly suggest visiting your local airshed website to find the AQHI forecasts for today, tonight, and tomorrow. Links to all of Alberta’s Airsheds at AlbertaAirshedsCouncil.ca.
- If learning online, have students complete this activity individually. If they do not have access to scissors and glue, they can write out the health messages in their appropriate spots on the AQHI Chart.

Student Worksheet: AQHI Chart

Health Risk	Air Quality Health Index	Health Messages	
		At Risk Population	General Population
Low Risk	1 – 3		
Moderate Risk	4 – 6		
High Risk	7 – 10		
Very High Risk	Above 10		

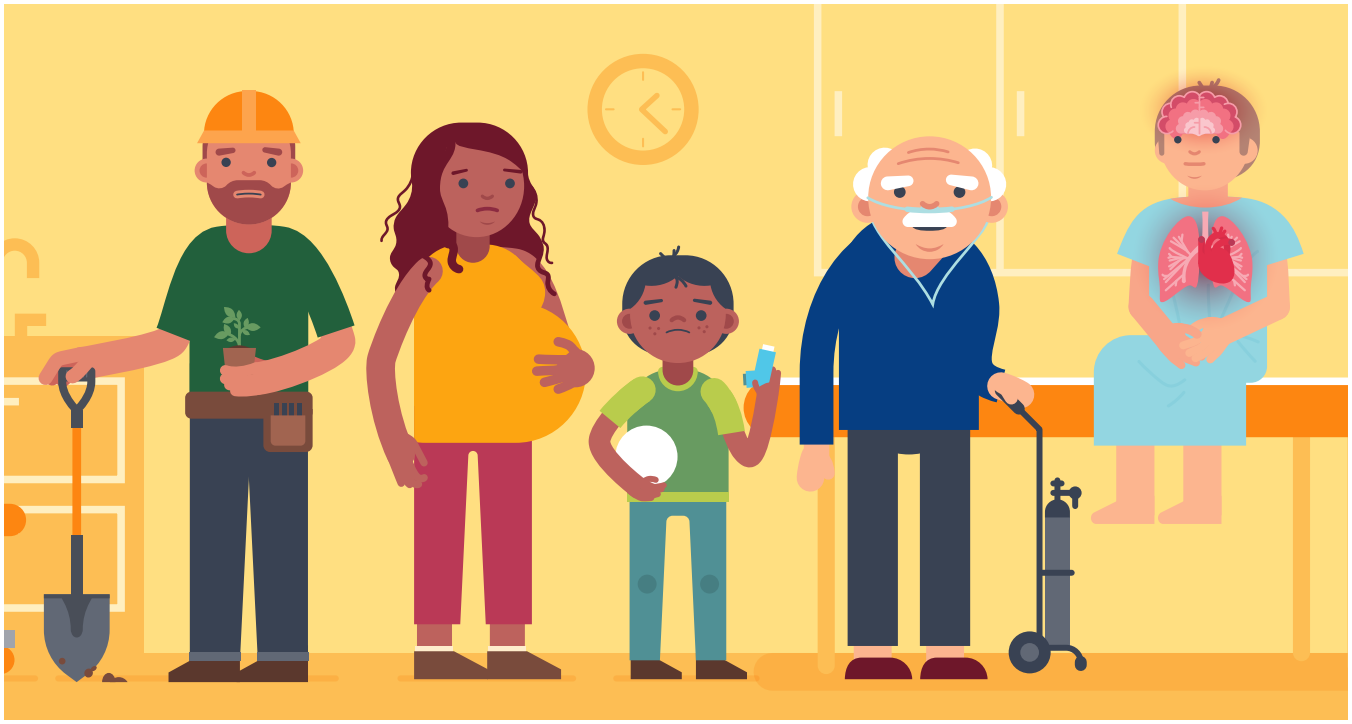


Student Worksheet: Health Messages

Below are health messages that are part of Canada's Air Quality Health Index (AQHI). With your team, determine where each message belongs on the AQHI chart. Cut out the messages individually and glue them to their proper spot. Remember that messages vary depending on whether someone is "at risk" or part of the "general population."

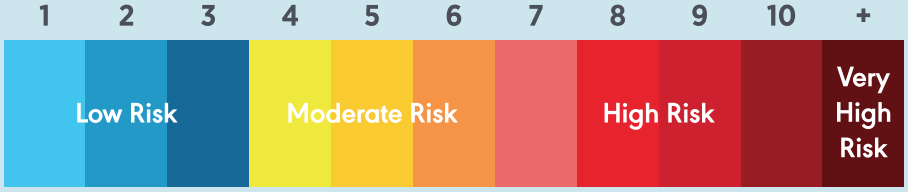
Avoid strenuous* activities outdoors. Children and the elderly should also avoid outdoor physical exertion.	**Consider** reducing or rescheduling strenuous* activities outdoors if you are experiencing symptoms.	**Ideal** air quality for outdoor activities.	**Reduce or reschedule** strenuous* activities outdoors. Children and the elderly should also take it easy.
Reduce or reschedule strenuous* activities outdoors, especially if you experience symptoms such as coughing and throat irritation.	**Enjoy** your usual outdoor activities.	**No need to modify** your usual outdoor activities unless you experience symptoms such as coughing and throat irritation.	**Consider** reducing or rescheduling strenuous* activities outdoors if you experience symptoms such as coughing and throat irritation.

*Strenuous activities are activities that require a lot of physical exertion or muscle power, like jogging, biking, and playing sports.



Answer Key: Get Your Message Straight

Health Risk	Air Quality Health Index	Health Messages	
		At Risk Population	General Population
Low Risk	**1 – 3**	**Enjoy** your usual outdoor activities.	**Ideal** air quality for outdoor activities.
Moderate Risk	**4 – 6**	**Consider** reducing or rescheduling strenuous activities outdoors if you are experiencing symptoms.	**No need to modify** your usual outdoor activities unless you experience symptoms such as coughing and throat irritation.
High Risk	**7 – 10**	**Reduce or reschedule** strenuous activities outdoors, especially if you experience symptoms such as coughing and throat irritation.	**Consider** reducing or rescheduling strenuous activities outdoors if you experience symptoms such as coughing and throat irritation.
Very High Risk	**Above 10**	**Avoid** strenuous activities outdoors. Children and the elderly should also avoid outdoor physical exertion.	**Reduce or reschedule** strenuous activities outdoors. Children and the elderly should also take it easy.



Time required: 35 minutes

SUMMATIVE ASSESSMENT: AIR QUALITY JEOPARDY

SUMMARY

Air Quality Jeopardy is an assessment tool that enables teachers to gauge how well students have absorbed the information communicated in *What's Weather & Climate Got to Do with It?* lesson. Be sure to review the lesson with your class before playing the game.

PREPARATION

- Download Air Quality Jeopardy game from our website.

MATERIALS

- One small whiteboard, marker, and eraser per team (alternative: one pad of paper and a pencil/pen per team).
- A method for keeping track of team scores – paper and a pencil/pen.

INSTRUCTIONS

You are probably familiar with the basics of Jeopardy. What follows is a suggested format for elementary students; these instructions can be modified to meet the needs of your class. Note that the instructions below allow for all teams to answer every question. Students may, but are not required to answer in question form, as per traditional Jeopardy rules.

- Divide students into groups of no more than five.
- Display main Jeopardy Board (i.e., Slide 2 of downloaded Air Quality Jeopardy game).
- Review the five Jeopardy categories with your class, noting that each category contains five questions of varying value (from 1-5 points). The higher the point value, the harder the question.
- Identify one student from each team to be the "point-counter," responsible for tallying their group's score at the end of every question.
- Explain to students that the goal is to answer questions correctly in order to accumulate more points than their opponents. If a group answers a question correctly, they receive points based on the difficulty of the question. (Optional rule: if they answer incorrectly that same number of points gets deducted from their overall score).
- Explain that teams will take turns choosing a category and point value. Use a random method (pick a number, rock paper scissors, etc.) to determine which team goes first.

- Depending on the selection, click the appropriate square on the Jeopardy board; this will redirect you to the corresponding clue. Read the clue aloud to the class.
- Give teams time to determine their answer. Teammates must collaborate before writing down the answer on their whiteboard. Encourage groups to discuss their thoughts quietly, so that other students do not overhear them.
- Click the arrow located in the bottom right-hand corner of the slide to reveal the correct answer and read it aloud. Allow the point-counters time to tally their scores.
- Click the home icon located in the bottom right-hand corner of the slide to return to the main Jeopardy board. You'll notice that any clues that have already been read are now highlighted on the board.
- Have a new team select a category and point value and repeat the steps above until all questions have been posed.
- Review each team's point total ahead of Final Jeopardy.

Final Jeopardy

- Announce the Final Jeopardy category: Pollution Solution.
- Based on the category, ask teams to discuss and agree on the amount of points they wish to risk. The points risked can range anywhere from 0 points to the total amount of points each team has accumulated throughout the game. Groups cannot risk more than the number of points they have earned.
- Have each team write down their wager on a slip of paper and present it to you.
- Reveal the Final Jeopardy question and provide students with enough time to think of and write down their response.
- Reveal the correct answer: "Carpooling."
- Have teams share their responses one-by-one; if groups answered the question correctly, add their points to their final total number of points. If groups answered incorrectly, their points should be deducted from their final score.

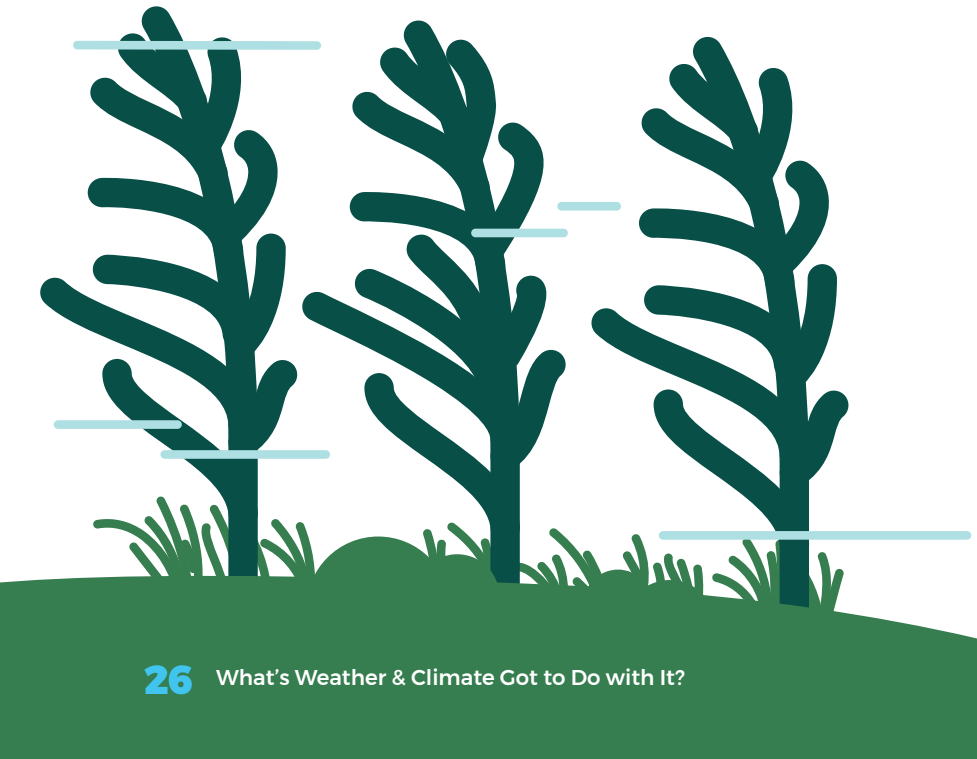
EXTENSION ACTIVITY & SUGGESTED RESOURCES

Optional Extension Activity – Data Analysis

As an extension, we suggest having students track the AQHI readings and weather reports for your school's community over the course of a week. Have them summarize the air quality for this period, explaining how weather conditions (such as temperature, precipitation, and wind) have affected the quality of the air. Daily AQHI readings can be found at your local Airshed's website. Links to all of Alberta's Airsheds can be accessed at AlbertaAirshedsCouncil.ca.

Suggested Resources

If you have enjoyed this learning package and want to investigate the topic of air quality further, see our website for a list of additional resources.



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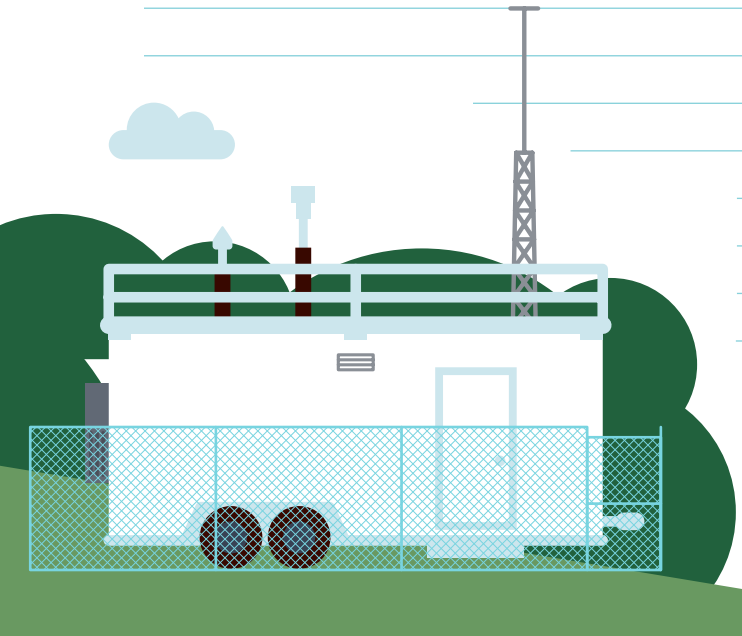

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