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

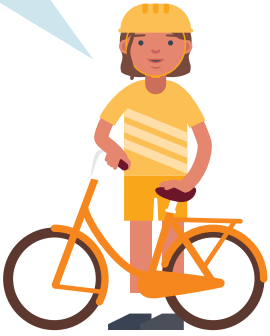
A Unit on Air Quality, Our Health & the Environment

West Central Airshed Society

TEACHING SCRIPT & NOTES – GRADE 5 & 6 LEARNING PACKAGE

GRADE 5/6 TEACHING SCRIPT & NOTES

FONT CODE: Writing in *italics* is the suggested teaching script. Writing in grey is additional information that may be of use to the lesson. Instructions for the PowerPoint are written in **GREEN**.



SLIDE 1 – TITLE PAGE

No notes

SLIDE 2 – MODULE 1 (SLIDES 2 – 19)

No notes

SLIDE 3 – ACTIVITY 1: A REAL PEASOUPER

*See activity instructions in the Teacher Overview & Activity Guide.

This is a painting by French artist, Claude Monet, who lived in London briefly in the late 1800s (more than 150 years ago). Spend a few minutes looking carefully at the artwork. Write down five things you notice about the painting and any questions you have about what you see.

*Discuss students' observations and questions, then ask:

- *How does the painting make you feel?*
- *What do you think the artist is trying to communicate?*

Monet's painting showcases London's "peasoupers," thick smoky fogs famous for their brownish yellow colour. This type of air pollution is also known as "industrial smog." With the Industrial Revolution, humans began to rely heavily on fossil fuels (i.e., coal, oil, and gas). These natural energy resources were (and still are) used to run factories, drive vehicles, generate electricity, and heat homes. When we burn fossil fuels to create energy, we release pollutants into the air that are harmful to humans and the environment.

CLICK SLIDE TO REVEAL ANIMATION.

The word smog was first used by a London doctor in 1905 to describe the city's dirty air that resulted from a combination of coal smoke and natural fog. The word "smog" comes from combining "smoke" and "fog." During the 19th and 20th centuries, thousands of Londoners died on account of bad smog episodes. One particularly bad event, the Great Smog of 1952, finally led the government to establish laws that would help clean up London's air.

ADDITIONAL INFORMATION

Fog is essentially a cloud at ground level; it consists of tiny water droplets or ice crystals floating in the air.

Figure 1. Claude Monet, The Thames below Westminster, London, 1871. From The Thames below Westminster by Claude Monet, 1871. https://commons.wikimedia.org/wiki/File:Monet_The_Thames_at_Westminster_1871_Westminster.jpg

SLIDE 4 – AIR QUALITY EQUATION

In the lesson that follows, we will learn how pollutants (the bad stuff in our air) interact with weather to determine our local air quality.

CLICK SLIDE TO REVEAL ANIMATION. *In the case of London's smog, smoke from factories and fireplaces combined with fog to create deadly results. London's smog made it hard to see outdoors (as shown in Monet's painting), but air pollution isn't always visible... What other senses can tell us if the air is polluted?* [Answers: smell and taste].

CLICK SLIDE TO REVEAL ANIMATION. *London's industrial smog was a triple whammy: not only did it look like pea soup, it also smelled and tasted like rotten eggs because coal smoke contains a chemical known as sulphur.*

SLIDE 5 – THE EARTH'S ATMOSPHERE

We live at the bottom of a large pool of air, known as the atmosphere. The atmosphere is made up of mostly colourless, odourless gases, like nitrogen (78%) and oxygen (21%), plus very small amounts of other chemicals such as argon, methane, and carbon dioxide. The atmosphere makes life on Earth possible by protecting us from the sun's harmful UV radiation and gives us warmth through the greenhouse effect.

There are several different regions (or layers) in the atmosphere, each with their own characteristics. The troposphere, or bottom layer, is where most of Earth's weather occurs. **POINT OUT THE IMAGE ON THE SLIDE.**

SLIDE 6 – WHAT IS WEATHER?

What are some examples or elements of weather? **CLICK SLIDE TO REVEAL THE ANSWER.**
[Answers: temperature, rain, snow, sun, clouds, wind, etc.].

Keeping this in mind, how can we define weather? **CLICK SLIDE TO REVEAL THE ANSWER.**
[Answer: the state of the air and atmosphere at a particular time and place].

These short-term conditions can change quickly, from minute to minute or hour to hour.

SLIDE 7 – AIR QUALITY

What do you think is meant by the term air quality? **CLICK SLIDE TO REVEAL THE ANSWER.**
[Answer: air quality is a measure of how clean (or dirty) the air is all around us]. *Clean air contains only the gases necessary to support a healthy environment.* **CLICK SLIDE TO REVEAL ANIMATION.** *Pollutants make our air dirty. We can define air pollutants as substances, either not found in the normal makeup of air or found at higher than normal levels, that can harm living things and other resources.*

Take a few deep breaths. Can you feel your rib cage moving in and out? Why is breathing so important?
[Answer: your lungs take in oxygen that is passed to your blood and moves around your body. It is the oxygen in the air that keeps you alive]. *When released into the atmosphere, pollutants change the characteristics of our air and can make it hard to breathe.*

Good air quality means that the air is relatively clean, clear, and free of pollutants. Poor (or bad) air quality means the air contains a high level of pollutants. **POINT OUT IMAGE OF FANHE, A TOWN IN CHINA, TO HIGHLIGHT THIS DIFFERENCE.** *These photos were taken 10 days apart.*

Figure 2. Fanhe, China. From Fanhe Town 10 day interval contrast by Tomskyhaha, 2019. https://commons.wikimedia.org/wiki/File:Fanhe_Town_10_day_interval_contrast.png. Public domain.

SLIDE 8 – ACTIVITY: LINE 'EM UP!

*See activity instructions in the Teacher Overview & Activity Guide.

*Where students place themselves on the value line is not as important as the conversation it creates...

KEY DISCUSSION POINTS

- Clean air is one of the basic requirements of human health and wellbeing. We breath 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 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 (as seen in the previous slide) 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 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 behaviors, 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.
- We have the necessary knowledge and tools to improve air quality, but we need to care about this topic and be willing to make changes to our daily routines for progress to occur.

SLIDE 9 – AIR QUALITY MONITORING IN ALBERTA

Alberta has a comprehensive air quality management system. In our province, there are ten regional Airshed organizations that monitor and report on the quality of the air in their communities. Airsheds share this information with the public, industries, and governments in order to come up with solutions to keep our air clean. **IDENTIFY THE AIRSHED THAT MONITORS AIR QUALITY IN YOUR REGION (IF OUTSIDE OF AN AIRSHED ZONE, IDENTIFY THE NEAREST ONE).**

CLICK SLIDE TO REVEAL ANIMATION. You should now see a blown-up version of the West Central Airshed Soceity's air monitoring zone.

SLIDE 10 – VIDEO: WHAT IS AN AIRSHED?

This video describes how Airsheds work. Pay close attention to the video and complete the sentence on the screen by filling in the blanks with the appropriate words.

WAIT FOR THE VIDEO TO LOAD BEFORE PLAYING. CLICK SLIDE TO PLAY VIDEO. Video will stop automatically when complete. Video Length: 1 minute 3 seconds. *If video is not responding, try this link: https://www.youtube.com/watch?v=psLtIm9Z_QU.

CLICK SLIDE TO REVEAL ANSWERS. [Answers: air pollutants, weather conditions].

SLIDE 11 – POLLUTANTS + WEATHER = AIR QUALITY

POLLUTANTS

There are two main categories of air pollutants: gases and particles. Airsheds monitor the air pollutants that are most harmful to human health.

CLICK SLIDE TO REVEAL ANIMATION:

- *Particulate matter*
- *Sulphur dioxide*
- *Ground-level ozone*
  *This should not be confused with the ozone layer in the stratosphere, which forms naturally and protects us from the sun's UV rays
- *Nitrogen oxides*

WEATHER

Once pollutants are released into the atmosphere, weather plays a big role in how they behave and how much danger they pose to humans and ecosystems. To help evaluate and forecast air quality, Airsheds measure…

CLICK SLIDE TO REVEAL ANIMATION:

- *temperature*
- *wind speed and direction*
- *relative humidity (how much water is in the air)*
- *precipitation (rain, snow)*

*You may wish to review (or introduce) the above weather terminology with your class. Here are some helpful definitions:

Temperature: is a measure of how hot or cold something is; meteorologists (weather forecasters) measure air temperature in degrees Celsius (C).

Wind: is air in motion. Changes in the temperature of air, land, and water cause wind. Two factors are necessary for reporting on wind conditions: speed and direction. Wind speed is measured in kilometers per hour (km/h). Wind direction is described using the direction that the wind comes from and not the direction towards which it blows. This means that an "easterly wind" will blow air (and air pollutants) from the east to the west.

Relative humidity: the amount of water vapour (or moisture) in the air is called humidity. The amount of water vapour the air can hold depends on the temperature of the air. Warm air can hold more water vapour than cold air. Relative humidity is the ratio of how much water vapour is in the air vs. how much water vapour the air can hold at a given temperature. It is shown as a percentage (e.g., 50% humidity means the air is holding half of the water vapour it can hold).

Precipitation: when there is too much moisture in the air, water will fall as precipitation. Precipitation falls in two main forms: rain (liquid form) and snow (solid form), depending on the temperature of the air through which it falls. Other forms of precipitation include sleet and hail. Meteorologists measure precipitation in millimetres (mm) or centimeters (cm).

SLIDE 12 – HOW AIR QUALITY IS MEASURED BY AIRSHEDS

Continuous air monitoring stations, like this one in Drayton Valley, house special analyzers that provide on-the-spot measurements of pollutants in the air, so that Airsheds can tell us about local air quality.

These stations also contain weather measuring instruments, such as:

CLICK SLIDE TO REVEAL ANIMATION.

- Thermometer – to measure temperature
- Anemometer – to measure wind speed and direction
- Hygrometer – to measure relative humidity
- Rain and snow gauge – to measure precipitation

*If your students are familiar with the equipment mentioned above, you may wish to list the name of the instrument and ask them to identify the weather condition that it measures, or vice versa. If you opt for the latter, be sure to click the slide after students have provided you with the names of the instruments.

SLIDE 13 - WIND

The outside air is constantly moving, and this movement is an important factor in keeping our air clean. Temperature is what drives air motion and the movement of air pollution.

What do we call the horizontal movement of air? **CLICK SLIDE TO REVEAL ANSWER.** [Answer: wind]. *Wind is mainly driven by differences in air pressure (the weight of the air pushing down on us) from one area to another, which results from the unequal heating of Earth's surface.*

Warm, less dense air creates low-pressure zones; cool denser air creates high pressure zones. The greater the pressure difference between zones, the stronger the wind will blow.

Imagine if you were to blow up a balloon and pinch it closed with your fingers – this involves forcing air molecules from your lungs into the balloon. These molecules push up against the walls of the balloon, causing it to expand and creating a high-pressure environment. Now what happens if you release your fingers? [Answer: the air from inside the balloon rushes out].

In this case, the high-pressure air flows out of the balloon and into the low-pressure environment surrounding it.

Air always flows from areas of high pressure into areas of low pressure. **CLICK SLIDE TO REVEAL MEMORIZATION TOOL.** *You can remember this using the following rhyme: the air will blow from high to low.*

So… how does wind impact air quality? [Answer: wind can carry pollutants towards us or away from us]. *When there is little to no wind, pollutants can build up near their source. On the other hand, strong winds can transport pollutants far from their source. It is important to know both the speed and direction of wind when predicting air quality. Depending on conditions, areas located downwind of major pollutant sources can be impacted more than the areas where the pollutants are released.*

Did you know? Landforms, like mountains and valleys, and even tall buildings can affect wind speed and direction. For example, mountains can act as barriers for wind, preventing air from spreading out and blowing away; this can trap pollutants in low-lying areas.

SLIDE 14 – THE HIGHS & LOWS OF AIR QUALITY

High- and low-pressure systems are associated with different kinds of weather. Low pressure systems bring wet and windy conditions and can generate storms. From an air quality perspective, storms are a welcome weather event. Rain and snowstorms are sometimes called "scrubbers" because they help wash away pollutants and can clear the air quickly.

The opposite is true of high-pressure systems, which bring what we tend to consider as "good weather" and create calm and dry conditions with little wind. When there is an absence of wind, local pollutants build up and can create poor air quality.

SLIDE 15 – NATURAL SOURCES OF AIR POLLUTION

Outdoor air pollution comes from both natural and human-caused sources. While natural sources can contribute significantly to poor air quality episodes, these sources do not usually create ongoing air pollution problems. Can you think of some common natural sources of air pollution? Hint: look at the photo on the slide. **CLICK SLIDE TO REVEAL ANSWERS.** [Answers: wildfires, lightning, volcanic eruptions, dust & sand storms].

POINT OUT IMAGE OF THE WILDFIRE. The photograph seen here depicts a wildfire in Northern Alberta that occurred in May of 2019. 2019 was a particularly bad year for wildfires in Alberta; 989 wildfires broke out, leading to poor air quality days in communities throughout the province.

Figure 3. Northern Alberta Wildfire, 2019. From The Chuckegg Creek Wildfire post by Alberta Wildfire Twitter account. https://twitter.com/AlbertaWildfire/status/1130218989613768704.

SLIDE 16 – HUMAN-CAUSED SOURCES OF AIR POLLUTION

Human activities create much more air pollution than natural sources. Human-caused sources of air pollution can be found in our current patterns of energy production and use, as well as in our manufacturing industries, and in the products that we produce and use.

Can you think of some human-caused sources of air pollution? **CLICK SLIDE TO REVEAL ANSWERS.**
[Answers: transportation (i.e., cars, trucks, buses, trains, airplanes, etc.), power plants, factories, home heating and cooling, wood burning, industrial activities, agriculture/farming].

ADDITIONAL INFORMATION

- Point sources: pollutants that come from a single, easily identifiable location like a power plant or refinery.
- Mobile sources: sometimes referred to as "non-point sources," are any source of pollution that produces emissions while moving from one place to another (e.g., cars, trains, planes, etc.).
- Area Sources: this encompasses pollutants released from many small sources located together in one area, rather than a specific source. Taken individually, the pollutants emitted from these small sources may be insignificant, but when combined, they can create a great deal of air pollution. Cities are considered "area" sources of pollution but so too are farms. Agricultural air pollution comes mainly from heavily fertilized fields and livestock manure/animal waste.

SLIDE 17 – VIDEO: THE EVERYDAY AIR HERO

While watching this video, you should think about everyday actions you and your family members can do to help improve local air quality.

WAIT FOR THE VIDEO TO LOAD BEFORE PLAYING. Video will stop automatically when complete.
Video Length: 1 minute 30 seconds. *If video is not responding, try this URL:
https://www.youtube.com/watch?v=9oFHPJgB-dw&t=1s

SLIDE 18 – POLLUTION SOLUTIONS

We've learnt how human activities create pollution and impact the quality of our air. What can you and your family do to reduce emissions and help improve local air quality? **CLICK SLIDE TO REVEAL ANSWERS. RESPONSES ARE NOT LIMITED TO WHAT APPEARS ON THE SLIDE. ANSWERS APPEAR ONE AT A TIME.**

ADDITIONAL INFORMATION

To generate electricity and heat our homes, we largely burn fossil fuels, a process that creates air pollution. Turning off lights when a room is empty and closing doors and windows when it is cold outside, reduces our use of fossil fuels and can help improve air quality.

SLIDE 19 – POLLUTION SOLUTIONS: CLEAN ENERGY SOURCES

We know that burning of fossil fuels (i.e., coal, oil, and gas) produces pollutants that negatively impact the quality of our air but did you know that there are some energy sources that are considered "clean" because they emit little to no harmful substances during operation?

Can you think of some examples? **CLICK SLIDE TO REVEAL ANSWERS.** [Answer: wind, solar, and hydroelectric energy fit into this category].

Another advantage of these clean energy resources is that they are considered "renewable." What does this term mean? [Answer: renewable energy is not depleted over time as it can be naturally replenished if handled responsibly]. *On the other hand, non-renewable energy resources are depleted over time because they will not be naturally replenished for thousands or millions of years. Fossil fuels are considered non-renewable resources.*

ADDITIONAL INFORMATION

It should be noted that while renewable energy resources are considered more environmentally friendly than their non-renewable counterparts, not all of these resources are considered "clean" from an air quality perspective. For instance, biomass energy emits large quantities of particulate matter that is harmful to our health.

***This is the end of Module 1 and is a good place to stop if you'd like to break up the lesson.

THIS IS THE END OF MODULE 1.

SLIDE 20 - MODULE 2 (SLIDES 20 - 40)

No notes

SLIDE 21 - WHAT IS CLIMATE?

Can you recall the definition of weather given at the beginning of the unit? [Answer: the state of the air and atmosphere at a particular time and place]. *What is climate and how does this compare to weather?* **CLICK SLIDE TO REVEAL DEFINITION.** [Answer: Climate is the long-term weather patterns of a region over a period of at least 30 years. Like weather, the key characteristics of climate include temperature, precipitation, humidity, and wind. However, while weather is short-term and changes daily, climate tells you what the weather is usually like over decades].

SLIDE 22 - HOW DOES WEATHER COMPARE TO CLIMATE?

REVIEW AND EXPLAIN TABLE.

SLIDE 23 - SEASONAL IMPACTS ON AIR QUALITY IN ALBERTA

Why is it important to know about both weather and climate when studying air quality? [Answer: air quality is affected by both weather and climate]. *Weather can change air quality quickly, like when wind blows pollution out of the region. Climate, on the other hand, helps us predict what kind of air quality problems we might encounter at a particular time of the year.*

The air is usually pretty clean in Alberta, however, its continental climate characterized by long cold winters and hot dry summers can create conditions for smog in both seasons. The following slides dive deeper into how Alberta's climate impacts the quality of the air in these seasons.

SLIDE 24 – CONVECTION: POLLUTANTS ON THE MOVE

We've already learned about the horizontal movement of air in our atmosphere (wind), but did you know that our air also moves vertically? **REFERENCE AND EXPLAIN IMAGE.** *Because energy from the sun is absorbed by the Earth's surface, air near the ground is typically warmer than air further up in the troposphere. Warm air is less dense, so it rises, while cool air is denser, so it sinks. This vertical movement of air is known as convection.*

Thanks to convection, air pollutants do not remain in the place where they are released. This natural force moves pollutants from the ground to higher altitudes, where wind speeds are faster and can help disperse (or spread out) pollution, making it less harmful to humans.

The constant movement and mixing of air allows the atmosphere to dilute and absorb a certain amount of pollution. Poor air quality often occurs when the air is stagnant (or unmoving), allowing pollutants to build up in an area.

SLIDE 25 – ACTIVITY 3: INVERSION DIVERSION

*This activity requires preparation – see Teacher Overview and Activity Guide for materials list and preparation instructions.

Are you familiar with the words "inverse" or "inversion?" If so, how would you define these words? [Answers may include: a change or reversal in the normal order, direction, position, or relationship of things; to turn something upside down or inside out].

As mentioned in the previous slide, under normal atmospheric conditions, we have warm air at ground level, and cooler air above. Keeping this in mind, what do you think is meant by the term "temperature inversion?" [Answer: a temperature inversion is a reversal in the normal temperature layers]. *In a temperature inversion, the temperatures are upside down: the cooler air is at ground level, and the warmer air is higher up.*

I will be conducting two demonstrations; one will act as a model for normal atmospheric conditions and the other will simulate a temperature inversion. Note that in this experiment, water will act as a substitute for air. Both water and air are considered fluids, and so they flow (or move) in the same way.

*See Teacher Overview and Activity Guide experiment instructions.

SLIDE 26 – TEMPERATURE INVERSIONS

A temperature inversion is a weather event that limits the vertical movement of air (convection) and can contribute to poor air quality.

In a temperature inversion, cooler air sits at ground level and warm air is higher up in the troposphere. The warm air above acts like a lid, preventing cooler air from rising and trapping pollutants near the ground, where they can cause us harm. When a temperature inversion traps harmful gases and particles near the ground, then a visible layer of pollution can form. These pollutants can then be inhaled (breathed in) by humans.

Inversions can last for hours or even days. For example, during London's Great Smog of 1952, a temperature inversion coupled with an absence of wind trapped toxic pollutants in the city for five days.

SLIDE 27 – TEMPERATURE INVERSIONS IN THE ALBERTA CAPITAL REGION

Temperature inversions can occur at anytime of year, but they are most common in one particular season…

Look carefully at this graph, which shows how often temperature inversions occur in the Edmonton area. In what season does the Edmonton area experience the most temperature inversions? [Answer: winter].

During the winter months, the Edmonton area frequently experiences inversions. At this time, the sun is weaker, so Earth's surface does not absorb as much heat during the day and nights are at their longest, giving the ground a lot of time to cool off. Likewise, bright white snow reflects incoming sunlight that would otherwise heat the ground and cause pollutants to rise up into the atmosphere and spread out. When this occurs, pollutants stay trapped at ground level and we get what is known as "winter smog."

What activities might we do more often in winter than in other seasons that could cause pollution levels to be high? [Answers: driving, heating our homes, making wood fires, etc.].

Figure 4. Temperature Inversions in Alberta Capital Region 2006-2011. From *Figure 9. Frequency of Inversions in the Capital Region Detected by Month and Year for 2006-2011*. In Capital Region Fine Particulate Matter Science Report, pg. 15, by Government of Alberta, 2014. https://open.alberta.ca/dataset/51e77770-bf72-4851-8a6b-240d0f5b3856/resource/88698cff-7d86-4dc7-964a-4dc6d0433c04/download/2014-CapitalRegion-PMScienceReport-Dec2014.pdf. Public domain.

SLIDE 28 – SUNLIGHT & PHOTOCHEMICAL SMOG

We've already learnt that in the winter, Alberta's cold temperatures, long nights, and snow cover can create conditions for "winter smog," however, the hot and sunny days of summer are associated with their own air quality problems, one of which is "photochemical smog".

On a clear, cloudless day, intense summer sun can cause chemical reactions among pollutants that are already in the air (i.e., nitrogen oxides (NO, NO_2) and volatile organic compounds (VOCs) seen in the image). **POINT OUT IMAGE ON SLIDE.** *These chemical reactions form a secondary pollutant, called ground-level ozone (O_3), a major part of photochemical smog and one of the gases that Alberta's Airsheds monitor.*

Thankfully, hot summer days are often followed by late-afternoon storms, which can improve air quality. Clouds block sunlight, causing ozone production to slow down for the day, while rain washes away the ground-level ozone that has already formed.

ADDITIONAL INFORMATION

Mobile sources (vehicles) and oil and gas operations emit large quantities of nitrogen oxides and VOCs, the primary pollutants involved in the formation of ground-level ozone. Trees (such as poplar, oak, and willow) can also emit a significant amount of VOCs into the air. They do so partly to repel insects and attract pollinators.

SLIDE 29 – POLLUTANT SPOTLIGHT: GROUND-LEVEL OZONE (O_3)

The term "ozone" can be confusing. You may have heard that the "ozone layer" is necessary for life on Earth and in need of protection. However, while ozone in the upper atmosphere plays an important role in protecting us from the sun's UV rays, ozone produced near the Earth's surface (what we call "ground-level ozone") causes environmental, health, and economic problems. You can remember this with the following rhyme: ***ozone is good up high but bad nearby.***

In fact, ground-level ozone causes more damage to plants, including farming crops, than all other air pollutants combined. When exposed to ground-level ozone, plants can display visible injuries **(POINT OUT IMAGE ON THE SLIDE)** *and can become more susceptible to disease and pests.*

Ground-level ozone also negatively affects humans. This pollutant can make it hard to breathe deeply, increase the frequency of asthma attacks, and worsen other lung diseases. Further symptoms include chest pain, coughing, and a scratchy throat.

Lastly, ground-level ozone is also a greenhouse gas which causes our climate to warm at a quicker rate than is normal.

SLIDE 30 – AIR POLLUTION & THE CHANGING CLIMATE: AN UNHEALTHY RELATIONSHIP

Air pollution and climate change are closely related, each affecting the other. Air pollutants can contribute to climate change by affecting the amount of incoming sunlight that is reflected or absorbed by the atmosphere. Some pollutants cause the Earth to warm, while others cause a temporary cooling effect.

Greenhouse gases, like ground-level ozone, act like a blanket trapping heat in our atmosphere and warming the planet. This warming effect causes problems such as melting ice and rising sea levels. In addition, because of the Earth's changing climate, we are experiencing more extreme weather events that, in turn, can impact local air quality. The prevalence of wildfires are a good example of this relationship.

With the changing climate, Alberta is experiencing more heat waves and drought (lack of rain). These hot and dry conditions lead to more frequent and intense wildfires during the summer. Wildfire smoke creates poor air quality because it contains a mixture of harmful gases and small particles. Of all the pollutants generated by wildfires, fine particulate matter poses the greatest risk to human health..

SLIDE 31 – WILDFIRES

In recent years, Alberta's worst air quality episodes have been associated with wildfires. 2023 was a particularly bad year for wildfires in Alberta. **REFERENCE THE INFOGRAPHIC ON THE SLIDE.** *That year, more than 2 million hectares of land burned in the province, which is over 10 times more land than the previous five-year average.*

Look at the graph. How are wildfires started? [Answer: either by lightning or careless human activities]. *Lightning ignited 1/3 of the wildfires in Alberta in 2023, while the other 2/3 of fires were started by human activity.*

In addition to hot temperatures and dry conditions, what other weather conditions play a large role in wildfires? [Answer: wind speed and direction]. Strong winds enable fires to grow quickly, hopping from tree to tree. In addition, strong winds transport smoke long distances and can lead to poor air quality in places far away from the fire itself.

Figure 5. 2023 Alberta Wildfire Season Statistics. From 2023 Alberta Wildfire Season Statistics, by Government of Alberta. Retrieved January 23rd, 2026 from https://open.alberta.ca/publications/alberta-wildfire-season-statistics

SLIDE 32 – POLLUTANT SPOTLIGHT: FINE PARTICULATE MATTER ($PM_{2.5}$)

Your body can get rid of unwanted substances by coughing, sneezing, or swallowing. However, some particles are so small they can make their way deep into your lungs. This is the case with fine particulate matter. Fine particulate matter consists of tiny particles that are 30 times smaller than human hair and invisible to the naked eye. **POINT OUT IMAGE COMPARING THE SIZE OF HUMAN HAIR TO PARTICULATE MATTER.** *Sources of fine particulate matter include vehicles, agriculture, wood burning, and industry.*

ADDITIONAL INFORMATION

As shown on this slide, there are two main types of particulate matter, PM_{10}, which includes particles less than 10 microns in diameter, and $PM_{2.5}$ (what we call "fine particulate matter"), which includes particles less than 2.5 microns in diameter. The latter is of more concern to air quality scientists.

SLIDE 33 – HUMAN-CAUSED SOURCES OF $PM_{2.5}$ IN CANADA

Look carefully at this donut chart – each colour represents a different human-caused source of $PM_{2.5}$ emissions in Canada for 2023. Of the major sources of fine particulate matter (i.e., vehicles, agriculture, industry, and wood burning), which do you think produces the most emissions in Canada? In other words, which source is represented by the dark blue section of the donut chart? **CLICK SLIDE TO REVEAL THE ANSWER.** [Answer: home firewood burning accounted for over 32% of $PM_{2.5}$ emissions in Canada in 2023]. *Because of the risks it poses to human health, $PM_{2.5}$ is one of the main pollutants that Alberta's Airsheds monitor.*

Figure 6. 2023 Human-Caused Sources of $PM_{2.5}$ in Canada. From Fine Particulate Matter – Sources of Pollutant Emissions in 2023 by Canadian Council for Ministers of the Environment. Retrieved January 23, 2026. https://ccme.ca/en/air-quality-report#slide-11. Public domain.

SLIDE 34 - ACTIVITY 4: CONNECTING CONCEPTS

*See activity instructions in the Teacher Overview & Activity Guide.

SLIDE 35 – AIR QUALITY HEALTH INDEX

Data from Airshed monitoring stations contributes to the Air Quality Health Index (AQHI), a tool that helps us understand how local air quality can impact our health.

The AQHI is a colour-coded numerical scale used to communicate levels of air pollution across Canada. It is numbered from 1-10. The number of the AQHI refers to the health risks associated with outside air quality. The higher the AQHI number, the greater the health risk and need to take precautions. Occasionally during extreme pollution events (like wildfires), AQHI levels may reach 10 or 10+, indicating "very high health risk."

SLIDE 36 – WHO IS MOST AFFECTED BY POOR AIR QUALITY?

The AQHI provides "health messages" for specific groups of people. These messages help us make decisions about our outdoor activities. Messages vary depending on whether an individual fits into the "general population" or is considered part of an "at-risk" group. **CLICK SLIDE TO REVEAL ANSWERS.** *Who do you think is most at risk to suffer from poor air quality?* [Answer: people with existing heart or lung conditions (such as asthma), seniors, children, pregnant women, and people participating in sports or strenuous work outdoors].

"General population" refers to otherwise healthy people, and those not exerting themselves outdoors.

SLIDE 37 – ACTIVITY 5: GET YOUR MESSAGE STRAIGHT

*See activity instructions in the Teacher Overview & Activity Guide.

SLIDE 38 – WHAT WOULD YOU DO?

This is a photo taken in the Drayton Valley/Brazeau county area on May 30th, 2019. On this date, the area's AQHI jumped to 10+ (i.e. "very high risk") because of wildfire smoke blown in from northern Alberta. If today's AQHI was at a similar level how would you modify your daily routine to protect your health? What types of outdoor activities would you consider reducing or rescheduling?

SLIDE 39 – SUMMATIVE ASSESSMENT: AIR QUALITY JEOPARDY

*If you'd like to assess how well students grasped the concepts introduced in this lesson, play our Jeopardy game (located in a separate PowerPoint). Downloadable at: https://wcas.ca/resources/teachers-corner/

SLIDE 40 - CLOSING

We encourage you to visit your local Airshed's website to find air quality forecasts for today, tonight, and tomorrow. Links to all of Alberta's Airsheds can be found at AlbertaAirshedsCouncil.ca.

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