



Chemistry 11

Air Quality and Health

Abstract

Using five information sheets on air quality and health, and solutions for reducing air pollution, groups of students teach the rest of the class about their topic.

Logistics

Time Required

- **Class Time:** Part A, 60 to 80 minutes; Part B, 60 to 80 minutes
- **Prep Time:** 5 minutes

Materials

- Information Sheets: Air Quality and Health (5 unique sheets) (one per class)
- Worksheet: Air Quality and Health (one per student)
- Teacher Answer Key: Air Quality and Health (one per class)

Classroom Requirements

- Computer with Internet access, projector and screen (optional)

Learning Objectives

- Identify air pollutants and the health risks that result from poor air quality.
- Develop an awareness of asthma and allergies and the connection between these and air pollution.
- Understand the Air Quality Health Index and identify its benefits.
- Identify personal actions that can be taken to improve air quality.

Prescribed Learning Outcomes B.C. Curriculum

- G3 – generate names and structures for simple organic compounds
- G4 – differentiate the various types of bonding between carbon atoms

Preparation

- Assemble necessary materials



Classroom Implementation – Part A

Students investigate topics of air quality and health and prepare group presentations.

1. Explain to the class that they are to become experts on topics related to air quality and health and on actions people can take to improve air quality. Part of their role as experts will be to teach the rest of the class about their topic area.
2. Organize the class into five groups. Assign each group one of the five topic areas (1. Air Pollutants, 2. Health Effects of Air Pollution, 3. Asthma and Allergies, 4. Air Quality Health Index, 5. Air Pollution Solutions) and provide each group with a copy of their corresponding **Information Sheet: Air Quality and Health**.
3. Ask each group to design a method for teaching the rest of the class about their topic. They can use games, skits, PowerPoint presentations, or other means to teach. Remind students that the purpose is to teach. Encourage them to come up with the best way to teach the information.
4. Share all of the topic areas with the groups. If students know what each group is covering, they will be less likely to cover the topic areas of the other groups.
5. Provide the rest of the class period for the students to prepare to teach.

Air Quality and Health Information Sheet 1

Air Pollutants

Air pollution is the presence of any substance in the air in high enough concentrations to be harmful to the environment or to human health. Human activities such as the combustion of fossil fuels and industrial processes are the primary source of most pollutants. Pollutants also come from natural sources such as fires, wind-blown dust, and volcanoes. There are several classes of air pollutants: criteria air contaminants, hazardous air pollutants, and greenhouse gases.



Criteria Air Contaminants

Nitrogen Oxides (NO_x), consisting of nitrogen oxide (NO) and nitrogen dioxide (NO_2), are produced during the combustion of fossil fuels. They are pollutants themselves, but they also react with water vapour to form fine acidic droplets (e.g. nitric acid), and they react with VOCs to generate ozone.

Sulphur Dioxide (SO_2) is generated by industrial processes and the combustion of fossil fuels. It is a pollutant itself, but it also reacts with water vapour to form fine acidic droplets (e.g., sulphuric acid).

Carbon Monoxide (CO) is generated by the combustion of fossil fuels, primarily from automobiles. It is also released by wild fires and volcanic eruptions.

Volatile Organic Compounds (VOCs) are a group of carbon-containing compounds, both natural and synthetic. They are released primarily by the evaporation of petroleum products, such as gasoline, as well as solvents and other volatile products such as paints. VOCs react with NO_x in the presence of sunlight to form ground-level ozone. Some VOCs are carcinogenic (cancer-causing), such as benzene and formaldehyde.

Ground-Level Ozone (O_3) is formed by a chemical reaction between VOCs and NO_x in the presence of sunlight. Ground-level ozone is one of the main components of smog. The reaction that generates ozone accelerates at higher temperatures, therefore, climate change and warming temperatures are expected to increase concentrations of ground-level ozone and lead to more smog.

Particulate Matter (PM) includes both solids and droplets from a variety of natural sources and human activities. In most cases, coarse particles (PM_{10} , less than 10 microns in diameter, about 1/5 the width of a human hair) are emitted directly into the air — such as dust, pollen, diesel soot, and smoke. Fine particles ($PM_{2.5}$, less than 2.5 microns in a diameter, about 1/20 the width of a human hair) may be emitted directly or formed through secondary chemical reactions involving NO_x , SO_2 , water vapour, VOCs and ammonia. Particulate matter is one of the main components of smog.

Ammonia (NH_3) is a colourless gas with a pungent odour at higher concentrations. Most NH_3 is emitted from livestock and fertilizer. It can react with other substances in the air to form secondary PM.

Hazardous or Toxic Air Pollutants

Hazardous air pollutants, such as metals (e.g. lead, mercury, cadmium, manganese) and various persistent organic pollutants (e.g., polychlorinated biphenyls [PCBs], dioxins) are also found in air pollution.

Greenhouse Gases

Greenhouse gases (GHGs), include substances such as carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). These substances contribute to the greenhouse effect in the atmosphere, and to climate change on Earth, which has a multitude of adverse impacts.

What is smog?

Air pollution is a general term covering all forms of pollutants while smog refers to a certain mixture of gases and particles in the air that often appear as a haze. The term smog – which is a combination of fog and smoke – originated in the United Kingdom after the Great Smog of 1952, an air pollution episode that killed thousands of people in London. Smog most often occurs on hot, sunny, calm days. It appears as a yellowish haze that sits over cities, towns, and regions.



The two main ingredients of smog are ground-level ozone (O_3), which is formed by a chemical reaction between NO_x and VOCs in the presence of sunlight, and fine airborne particles ($PM_{2.5}$). Summer smog formation depends on heat and sunlight so smog generally peaks in the late afternoon and early evening. It is most obvious in large cities, but wind patterns and topography

allow smog to travel and be trapped in areas that may be distant from the source. As a case in point, smog may be worse in the Fraser Valley of British Columbia than in the City of Vancouver. Both an urban and rural phenomenon, smog can occur at any time of the year. Summer tends to have more smog due to higher temperatures. Winter smog acts slightly differently than summer smog because it consists of different pollutants such as PM_{2.5}, which is mainly due to wood smoke, road dust, road salt, and industrial activities. Smog will stay in an area until it is dispersed by heavy winds or washed out of the local atmosphere by precipitation (which is why smog is worse on calm, sunny days).

There are two types of ozone, a good one and a bad one.

Good Ozone – Stratospheric Ozone

Stratospheric ozone, the good ozone layer, is located 16 to 50 km above the ground. It has a cooling effect on the earth and protects humans and other life from ultraviolet (UV) radiation. When scientists refer to holes in the ozone layer, they are referring to the stratospheric ozone. Stratospheric ozone is not a pollutant; ground-level ozone is a pollutant.

Bad Ozone – Ground-level Ozone

Ground-level ozone is formed when VOCs and NO_x react in sunlight (or NO_x + VOC + sunlight = ground-level ozone). Ground-level ozone is toxic to humans. This air pollutant contributes to smog and does not protect us from UV radiation.



Air Quality and Health Information Sheet 2

Health Effects of Air Pollution

Air pollutants cause a wide variety of adverse health effects. These impacts range from subtle biochemical and physiological changes to difficulty breathing, wheezing, coughing and aggravation of existing respiratory conditions (asthma) as well as cardiac (heart) conditions. These effects can lead to increased medication use, increased doctor or emergency room visits, more hospital admissions, and even premature death. Exposure to toxic airborne substances such as mercury and lead can also lead to neurological (brain) damage, particularly in children. Still other air pollutants, such as benzene, are carcinogenic.

The respiratory system

Air pollutants can irritate your eyes, nose, and throat. They can also irritate and inflame your airways and lung tissue that can reduce your lungs' ability to collect and deliver oxygen, cause long-term lung damage, and aggravate existing respiratory conditions (e.g., asthma, bronchitis, chronic obstructive pulmonary disease). On-going exposure to pollutants can damage deep portions of the lung. The damage can remain even after symptoms such as coughing or a sore throat disappear. Air pollution can also reduce your resistance to respiratory infections.

The cardiovascular system

Pollutants are either absorbed into the bloodstream, or they interact directly with the cardiovascular system. Pollutants that are absorbed into the bloodstream travel throughout the body, starting a kind of chemical chain reaction. Through a variety of complex pathways, this reaction can affect blood vessels and ultimately the heart. Pollutants that interact directly can cause structural changes in the cardiovascular system. For example, air pollutants can contribute to degenerative necrosis (cell death), inflammatory reactions, and arrhythmias. They may lead to the formation of free radicals, which are thought to contribute to narrowing of the arteries (by formation of atherosclerotic plaques).

Ozone and Particulate Matter

All air pollutants, including nitrogen oxides (NO_x), sulphur dioxide (SO_2), and carbon monoxide (CO), affect our health, but ozone and particulate matter (PM) are of particular concern. Ozone is highly reactive and can damage lung tissue and significantly reduce lung function, even when the exposure is to low concentrations and for relatively short periods. PM can irritate and inflame the respiratory system, impairing lung function. Fine and ultra-fine particles cause the greatest damage, as they can penetrate deep into the lung,



carrying with them allergens and toxins. PM that is generated by the combustion of fossil fuels is particularly toxic. There is no safe level of exposure to air pollution, particularly to ozone and PM. Health effects result from long-term and short-term exposure, even at low levels of pollution. We need to be concerned about ozone and PM levels even on days when no smog warning is in effect.

Who does air pollution and smog affect?

Everyone. Individual reactions to air pollutants depend on the type of pollutant a person is exposed to, the degree of exposure, the individual's health status, and genetics. Children, the elderly, those who are physically active outdoors, and those with pre-existing medical conditions are especially vulnerable. But the reality is that air pollution affects all of us. Even healthy people have difficulty breathing on days when the air is heavily polluted. Ozone and particulate matter cause inflammation and in lung tissue and decreased lung function in everyone. There is no safe amount of exposure to ground-level ozone or particulate matter.



Children and youth up to the age of 18 are very vulnerable to the effects of air pollution because:

- Their respiratory and neurological systems are still developing.
- They tend to spend more time outdoors being active, so they inhale more pollutants.
- They breathe more per unit of body weight than adults, meaning they filter more polluted air through their lungs.
- They have smaller airways and lungs.
- Their immune systems are immature, making them more vulnerable to respiratory infections.

The elderly and those with pre-existing medical conditions are also particularly susceptible to impacts from air pollution. This is because reduced lung and cardiac function may be present as a normal part of aging, and this population is more likely to have pre-existing heart or lung conditions, which can be exacerbated due to air pollution.

Athletes of all levels, including weekend athletes, are also particularly at risk from air pollution and smog because they spend a lot of time training outdoors. During exercise, particularly at high intensity, athletes inhale very deeply, drawing large volumes of air deep into their lungs. They breathe in through their mouths, bypassing the body's natural filtration system in the nose. Athletes may have high metabolic rates and are more susceptible to infections, because intense training temporarily depresses the immune system.



Air Quality and Health Information Sheet 3

Asthma and Allergies

Asthma

Asthma is a chronic inflammatory disease of the airway that causes shortness of breath, tightness in the chest, coughing and wheezing. Asthma can vary in its severity, vary from person to person, and flare up from time to time. The cause of asthma is not known, and currently there is no cure.

People with asthma often have trouble breathing when they encounter their triggers. When someone has asthma and their symptoms are triggered, it means that the flow of air is obstructed as it passes in and out of the lungs.

There are two types of asthma triggers:

- **allergy triggers** that cause inflammation of airways – dust mites, animals, cockroaches, moulds, and pollen.
- **non-allergy triggers** that can irritate airways already inflamed – viral infections, smoke, exercise, cold air, chemical fumes and strong-smelling substances, certain air pollutants, and intense emotions.



People with asthma often also have allergies. People with allergies and asthma who come in contact with their allergic triggers will have a reaction in their airways as well as the usual allergy symptoms (itchy, watery eyes, etc.) An allergy is an abnormal reaction by the body to foreign bodies to which the body becomes sensitive. These are called allergens.

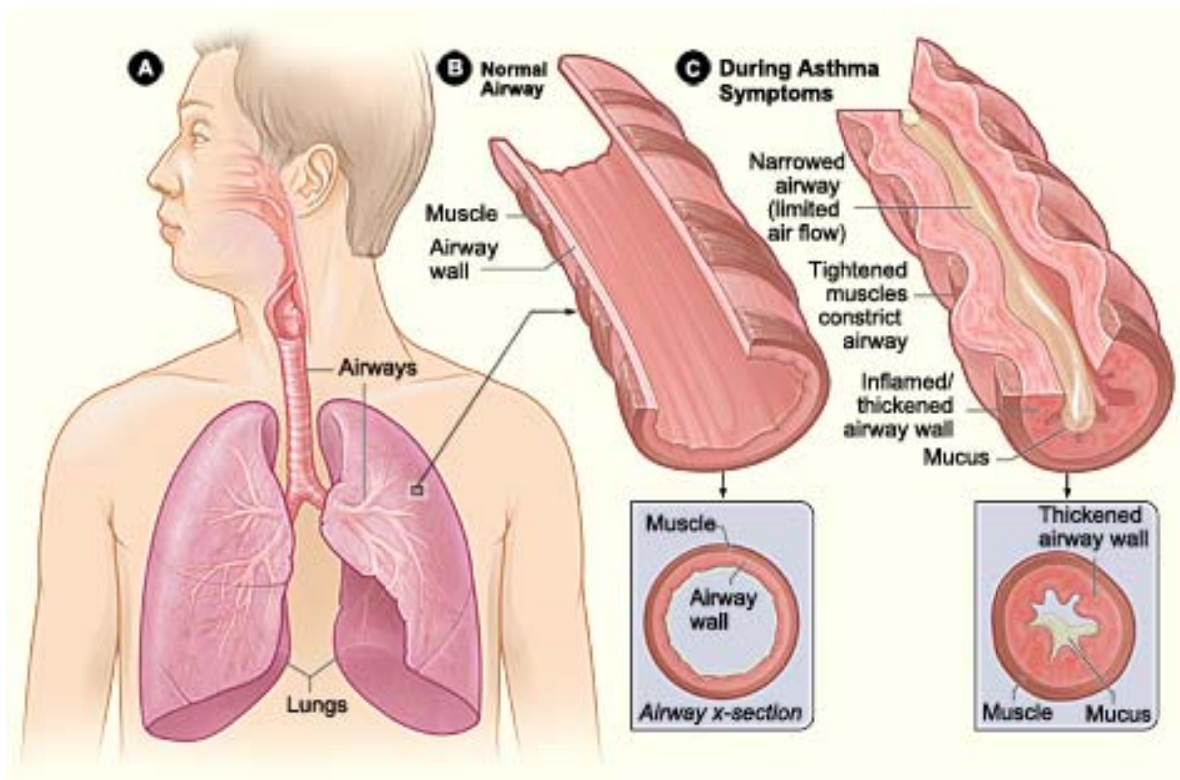
There are two types of allergens:

- ingested allergens (such as food, drink, and medicines) and
- inhaled allergens (such as pollen, dust, animal dander, and mold). Inhaled allergens are the most common cause of allergy problems in people with asthma.

Viral infections such as the common cold are one of the most common non-allergic triggers. Another non-allergic trigger is exercise, and this results in what is called exercise-induced asthma.

Cold, dry air is believed to be the main cause of exercise-induced asthma. When exercising, we tend to breathe faster and not as deeply, and through the mouth. Air reaching the lungs through the mouth isn't warmed and humidified as much as when it travels through the nose. Smoke from burning cigarettes, second-hand smoke, or smoke from fires is another non-allergic trigger. Strong-smelling substances such as perfume can trigger asthma. Air pollution such as ground-level ozone, particulate matter and nitrogen dioxide are known triggers of non-allergic asthma symptoms.

Asthma can affect anyone. Most people with asthma can live full, active lives. Asthma symptoms can be managed, and the goal is to be symptom-free by avoiding asthma triggers, by taking medication, by following an asthma action plan, and by following up regularly with your doctor.



Allergies

Allergies are the body's over-reaction to common substances – called allergens – such as pollen, dust, or animal dander. The over-reaction is triggered by the body's immune system that consists of cells, tissues, and organs that work together to defend the body against harmful infections with bacteria, parasites, and fungi. Although we know a lot about the immune system, there is still much to learn about how the body launches an attack on infected cells and tumors but not on healthy tissues. The immune system is amazingly complex. Sometimes the immune system acts inappropriately, and this results in problems such as allergies and autoimmune diseases.



The immune system produces five types of antibodies or immunoglobulins (Igs) to protect our bodies. Each Ig has a distinct and specific job. The antibody IgE is the one involved in allergic reactions. When pollen enters the nose, it binds IgE, which triggers the release of histamine from mast cells. This results in inflammation and leads to allergy symptoms such as a runny or stuffy nose, sneezing, and itching. People often take medication such as anti-histamines or nasal steroid sprays to alleviate their allergic symptoms.

Asthma and allergic rhinitis (the clinical name for allergic inflammation of the nose) are related conditions linked by a common airway. The air we breathe in passes through our nose, which is at the start of the airway, and continues down the airway into the lungs. Allergic rhinitis and asthma can cause problems with our breathing by obstructing the free passage of air along this path.



Allergens such as animal dander and house dust mites can be present all year round whereas tree, grass, and ragweed pollen appear during certain seasons.

With asthma, the breathlessness and wheezing is caused by a narrowing of the bronchioles, which are the small branched airways in the lungs. Inflammation of the membranes of these small airways leads to increased mucus production, airway obstruction, and coughing. For people who have allergic rhinitis and asthma, both the upper airway (nose) and lungs are affected, and so both need to be treated. If allergic rhinitis is not treated, asthma symptoms can worsen. Treating allergic rhinitis will help both the upper airway and lungs.

Air Quality and Health Information Sheet 4

Air Quality Health Index

Canada is the first country to combine air quality with a health index. The Air Quality Health Index (AQHI) is a health protection tool that helps people by limiting short-term exposure to air pollution and adjusting their activity during increased levels of air pollution. The three pollutants the AQHI measures are ozone (O₃), fine particulate matter (PM_{2.5}), and nitrogen dioxide (NO₂). The AQHI is measured on a scale from 1 to 10+, much like the UV index, with 1 being low risk and 10 being high risk. The AQHI values are grouped into health risk categories:



| Health Risk | AQHI | Health Messages | |
|-------------|----------|--|---|
| | | At Risk Population* | General Population |
| Low | 1-3 | Enjoy your usual outdoor activities. | Ideal air quality for outdoor activities. |
| Moderate | 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 or throat irritation. |
| High | 7-10 | Reduce or reschedule strenuous activities outdoors. Children and elderly should take it easy. | Consider reducing or rescheduling strenuous activities outdoors if you experience symptoms such as coughing or throat irritation. |
| Very High | above 10 | Avoid strenuous activities outdoors. Children and elderly should also avoid outdoor physical exertion. | Reduce or reschedule strenuous activities outdoors, especially if you experience symptoms such as coughing or throat irritation. |

*People with heart or breathing problems are at greater risk. Follow your doctor's usual advice about exercising and managing your condition.

Air Quality and Health Information Sheet 5

Air Pollution Solutions

There are a number of actions we can all take to reduce emissions of air pollutants and thereby make the air we breathe cleaner.



Walk. When you travel using your own energy (from food), you don't create any harmful emissions from burning gasoline, diesel or other fossil fuels. Living close to where you work or go to school makes it easier to walk rather than drive. Use the Walk Score – see www.walkscore.com – to rate your neighbourhood on walkability and to see the locations within walking distance of your home.



Bike/Rollerblade/Skateboard. Like walking, these modes of travel are easy on the air. As they do not burn fossil fuels, they have no harmful emissions. Many communities are making it easier to get around by bike, rollerblades and skateboard. Some public transit buses have bike racks on the front so you can travel by bike and bus. Some events are now offering bike valet parking to encourage more people to come by bike. The bicycle is the world's most widely used form of transportation and its most energy efficient.



Use public transit or carpool. Public transportation and carpooling can be a breath of fresh air. Public transit and carpooling reduces the number of individual vehicles that are on the road burning fossil fuels. A single bus, subway or train can carry a lot of people. Carpooling allows a few people to travel together to work or school. When fewer people drive, they reduce the amount of pollution emitted into the air.



Use less hot water. Natural gas or electricity heats the water in our homes. By taking shorter showers or washing clothes in cold water, we can use less natural gas or electricity used and reduce air pollution. Turn down the temperature on hot water tank by a few degrees. Bathroom water use accounts for 65% of the water used in the home.



Turn off lights and appliances. Turning off electrical items – such as lights, TVs, computers, air conditioners, and other appliances – reduces the amount of air pollution that comes from generating electricity, from coal-fired plants and from hydro-electric dams. Become involved in **Lights Out Canada** (<http://lightsoutcanada.tpweb.ca>) or **Earth Hour** (<http://wwf.ca/earthhour/>) to see the difference small actions can make on reducing air pollution from using electricity.



Unplug cell phone chargers. Cell phone chargers are usually left plugged in all the time, but they only need to be plugged in while a cell phone is charging. A cell phone charger uses electricity even when it is not charging a cell phone. In fact, only 5% of the electricity used by cell phone chargers is actually used to charge phones. The other 95% is wasted electricity that may be from coal-fired power plants or hydroelectric sources. Think of all the cell phone chargers that are left plugged-in across North America.



EcoLogo products are reviewed to ensure they meet strict environmental standards. Products such as paints, glues, cleaners and adhesives must be made using less toxic materials that release fewer pollutants into the air to get the EcoLogo logo. Encourage family members and others to purchase EcoLogo products when they can. You can check out the many EcoLogo products at: <http://www.ecologo.org/eb/greenproducts/consumers>



Turn down the heat. Turning down the heat is an easy way to save energy. The best time to do this is at night when everyone is sleeping or when the home is unoccupied. A programmable thermostat can be purchased and installed so that it can be programmed to turn down the heat at night and when no one is home. This makes it even easier to turn down the heat, as it does not rely on people to remember.



Drive energy-efficient vehicles, such as hybrids or electric cars. Driving an energy efficient vehicle can have a big impact in reducing air pollution. Electric vehicles in particular produce zero air emissions as no gasoline or diesel is consumed. Transportation fuels made from oil account for a large percentage of air pollution. Transportation emissions are a big contributor to ground-level ozone, smog, particulate matter, nitrogen oxides and hazardous air pollutants, and these are some of the most harmful air pollutants.

Develop fuel-efficient driving habits. Learn to 'hyper mile.' Smooth out your ride (instead of accelerating rapidly or braking hard) to save hundreds of dollars a year and help the environment. Your driving habits affect how much fuel you will use. For example, idling for more than 10 seconds burns more gas than shutting off your car and restarting. Idling for 10 minutes a day increases your fuel consumption by 5% over the course of a year. Small changes add up. If every driver in Canada cut their idling by five minutes per day, it would reduce greenhouse emissions by two million tonnes per year – the equivalent of taking 350,000 cars off the road!



Classroom Implementation - Part B

Students express findings of air pollution investigation through presentations.

Distribute the **Worksheet: Air Quality and Health** to each student.

Invite the groups to teach. The recommended topic order is:

- Air Pollutants
- Health Effects of Air Pollution
- Asthma and Allergies
- Air Quality Health Index
- Air Pollution Solutions

As each group teaches their topic area, have the students answer the questions for that topic on the **Worksheet: Air Pollution and Health**. Ensure there is time for questions and discussion after each group's teaching session.

If you want to generate feedback for the group at this point, you could provide the following statements for students to complete: I like the way you taught _____. Something that could be improved is _____.

Lead a class discussion that deals with all of the topics. From the list provided, which solutions would be easier for them to do in their daily lives?



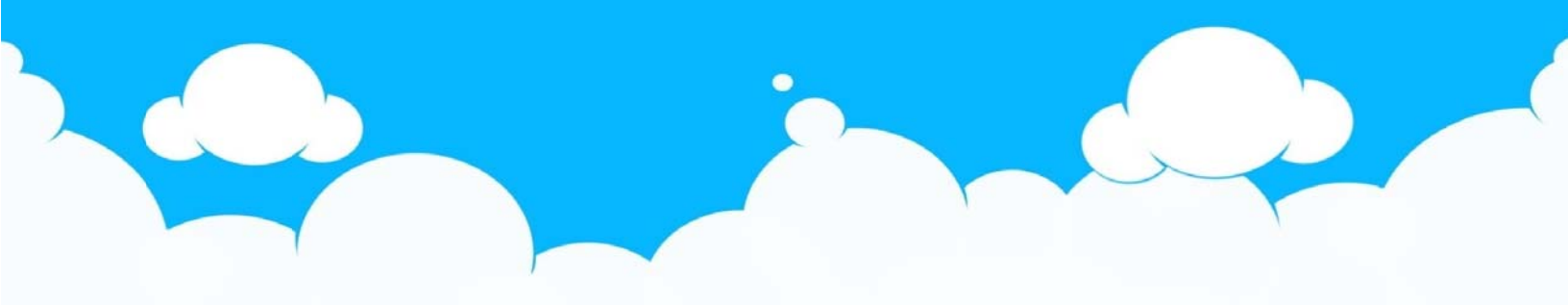
WORKSHEET: AIR QUALITY AND HEALTH

Answer the following questions as each group teaches their topic area.

1. List the different types of air pollutants.
2. Describe the health impacts of air pollution.
3. What is the connection between asthma and allergies?
4. Describe the Air Quality Health Index and its benefits.
5. List at least five things people can do to improve air quality.

Teacher Answer Key: Air Quality and Health

1. List the different types of air pollutants.
 - NO_x, SO₂, CO, VOCs, ground level ozone, particulate matter, ammonia and hazardous air pollutants are major types of air pollutants. Greenhouse gases are also emissions of concern due to their role in causing climate change.
2. Describe the health impacts of air pollution.
 - Air pollution impacts the respiratory and cardiovascular systems. It can irritate the eyes, nose and throat and also irritate and inflame airways and lung tissue. Pollutants can enter the bloodstream and affect blood vessels and the heart. Ground level ozone can damage lung tissue and significantly reduce lung function. Of particulate matter, fine and ultra-fine particles cause the greatest damage as they can penetrate deep into the lung. Everyone is affected by air pollution but the most vulnerable are children, the elderly, those physically active outdoors and those with lung or heart diseases.
3. What is the connection between asthma and allergies?
 - More than 80% of people with asthma also suffer from allergic rhinitis or sinusitis. Asthma and seasonal allergies are related conditions that affect a common airway. Both obstruct the free passage of air into our bodies. Asthma is an inflammation of the bronchioles, and the inflammation increases the production of mucus. Seasonal allergies obstruct the upper section of the airway (in the nose). For people who have asthma as well as seasonal allergies, both the upper airway and lungs are affected and so both need to be treated. If allergic rhinitis is not treated, asthma symptoms can worsen. Treating allergic rhinitis will help both the upper airway and lungs.
4. Describe the Air Quality Health Index and its benefits.
 - The Air Quality Health Index (AQHI) is a health protection tool that is designed to help you make decisions to protect your health by limiting short-term exposure to air pollution and adjusting your activity levels based on air quality (recommending reduced activity when air quality is poor). It uses a scale from 1 to 10, with 1 being low risk and 10 high risk. The three pollutants the AQHI measures are ozone, particulate matter and nitrogen dioxide. Canada is the first country in the world to develop an air quality health index.
5. List at least five things people can do to improve air quality.
 - Walk instead of drive.
 - Bike, skateboard, or rollerblade instead of drive.
 - Take public transit or carpool instead of drive.
 - Use less hot water (e.g. shorter shower).
 - Turn off lights and appliances (e.g. cell phones) when not in use (reduce electricity consumption). Install compact fluorescent lights.
 - Purchase EcoLogo products.

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- Use a programmable thermostat.
 - Purchase an energy efficient vehicle. Use energy efficient driving habits (e.g. don't idle, drive smoothly).

Extensions

1. Record the AQHI (<http://www.bcairquality.ca/readings/aqi.xml>) for a location closest to your school over the school year. Use a spreadsheet to track the information. The spreadsheet could also include the weather and temperature for each day (Environment Canada Weather, http://weather.gc.ca/forecast/canada/index_e.html?id=BC).
2. Use the data to compare the AQHI with weather patterns and seasonal effects. Students could provide information for the school's bulletins for days that the AQHI is moderate to very high. They may wish to include other health information such as the UV rating and pollen report (both are found on the Weather Network, www.theweathernetwork.com).
3. Host a **Commuter Challenge** to include staff, students, parents and local celebrities. Include three to five people and assign a mode of transportation to each person (e.g., bus, carpool, bike, skateboard and walking). Determine one starting point for all participants and set the end point as the school. Assign a time for participants to leave, and ensure that the start timer and end timer are synchronized. Create a large poster display to list the different participants and their times and post the results in school newsletters or bulletins. Invite the media to share in the event and to share the results.
4. **Challenge students to use forms of transportation** other than cars for a period of time. Divide students into small groups and have them choose a name for their group. Post the group names on a poster board. Place a check mark beside the group name each time a student in that group used active transportation for getting to school (or another location they choose to travel to from their home). When the time is up, select the group with the most check marks and award them the Commuter Challenge prize. Award certificates, create awards, or see if a local retailer would sponsor items like gift certificates or water bottles. For ideas research:
 - **Bike to Work Week BC:** www.biketowork.ca
 - **Commuter Challenge:** www.commuterchallenge.ca

Refer to the Clean Air Champions website for other **quizzes, activities and games**:
www.cleanairchampions.ca/programs/air_aware/quizzes_activities_and_games.php



For additional lessons and to complete an evaluation survey, visit: www.fvrd.ca/airquality

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