

## ACTIVITY #2: AIR POLLUTION, ASTHMA AND ALLERGIES

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**TIME** 50 minutes

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### **REQUIRED Activity** **RESOURCES**

- "Air Pollution, Asthma and Allergies Student Worksheet: Air Pollution Sources," one copy of each page, cut
- "Air Pollution, Asthma and Allergies Student Worksheet: Air Pollution Solutions," one copy of each page, cut
- "Air Pollution, Asthma and Allergies Student Worksheet: Pollution Solutions and Sources Worksheet," one per student, and "Teacher Answer Key"

### **Making it Real**

- Computer lab for using Google Maps/Google Earth
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### **Objectives**

1. To understand the respiratory system and its connection to the air we breathe.
2. To understand asthma and the connection between air quality and health.
3. To identify air pollution sources and actions that help ensure a healthier environment and to promote healthier lifestyles.
4. To identify resources that can assist students in protecting their health.

### **Curriculum Connections**

This activity is designed for Grades 6 to 9 Science. It also covers some Health topics. Curriculum connections are listed by province, grade and subject on the Air Aware website,

[http://www.cleanairchampions.ca/programs/air\\_aware/teacher\\_zone/curriculum\\_connections.php](http://www.cleanairchampions.ca/programs/air_aware/teacher_zone/curriculum_connections.php)

### **Activity**

1. Begin a discussion with students about the respiratory system using the following questions as a guide:

- What is the function of the respiratory system?

*The primary function of the respiratory system is to supply our blood with oxygen. The cardiovascular system then delivers the oxygen to all parts of the body. The respiratory system does this through breathing. When we breathe, we inhale oxygen, and we exhale carbon dioxide.*

- What are some of the things that can impact the health of our lungs?

*Inactive lifestyles, smoking, air pollution, inhaling toxic substances, and diseases.*

2. Share information about the condition of asthma and that air pollution has an impact on everyone, but especially people with lung diseases such as asthma.

[http://www.cleanairchampions.ca/programs/air\\_aware/fact\\_sheets.php](http://www.cleanairchampions.ca/programs/air_aware/fact_sheets.php)

*Asthma is a "chronic inflammatory disease of the airway" that causes the following symptoms: shortness of breath, tightness in the chest, coughing, and wheezing. Asthma can vary in its severity, can vary from person to person, and can 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 are in the presence of what are called "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:*

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

*Many people with asthma 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 your body to things that your body becomes sensitive to. These are called allergens. There are two types of allergens: ingested allergens (food, drink and medicines) and inhaled allergens (pollen, dust, animal dander, mould, etc.) 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 is often referred to as exercise-induced asthma. Cold, dry air is believed to be the main cause of exercise-induced asthma. When exercising, we tend to breathe quickly, shallowly and through the mouth. The air reaching the lungs misses the warming and humidifying effects of breathing through the nose. Smoke from smoking cigarettes, inhaling second-hand smoke or smoke from fires is another non-allergic trigger. Strong-smelling substances such as perfume can be another trigger. Air pollution is also a non-allergic trigger — ground level ozone, particulate matter and nitrogen dioxide are three pollutants that can trigger 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.*

3. This part of the activity will outline the different types of air pollution, the sources of air pollution, and what we can do to reduce air pollution. Share the following facts about asthma:

*Three million Canadians suffer from asthma.*

*Asthma is the most common chronic respiratory disease of children and young adults.*

*In 2001, a total of 299 Canadian deaths were attributed to asthma. 60% of people with asthma do not have their asthma under control.*

Sources: Asthma Society of Canada; Statistics Canada, *Health Reports*, Vol 16. No. 2, March 2005.

- 4.** Tell students that they will now participate in an activity to learn more about air pollution sources and about solutions for reducing air pollution. The best way to protect our health is to reduce the amount of air pollution that is created and to minimize our exposure to it. Students will explore seven sources of air pollution and eight solutions.
- 5.** Using the “Air Pollution, Asthma and Allergies Student Worksheet: Air Pollution Sources,” cut and post the seven sources of air pollution in various locations around the room.
- 6.** Explain that students will be working in groups and each group will represent a solution for reducing air pollution. Eight groups will represent eight air pollution solutions. The groups will rotate through the other seven air pollution source stations located around the room.
- 7.** At each station, the group will read the air pollution source card and determine whether their air pollution solution will help reduce that source. If yes, they post their air pollution solution below the air pollution source card.
- 8.** Divide the students into eight groups. Distribute one of the “Air Pollution, Asthma and Allergies Student Worksheet: Air Pollution Solutions” to each group and have the group read the information.
- 9.** Provide each group with a different coloured sheet of paper. Ask one member of the group to cut the paper into eight sections, and tell the other group members to write the name of their solution on each section.
- 10.** Provide each group with something to attach their solution cards under the air pollution source cards (e.g., glue, tape, push pins).
- 11.** When the groups are ready, assign an air pollution source station to each group (two groups will have to be assigned to the same station). Tell students they will hear a sound when it is time for them to rotate to the next station. Indicate whether they will rotate clockwise or counterclockwise.
- 12.** Give the groups 15 to 20 minutes to rotate through the seven air pollution source stations. You can use a noise maker to indicate the two-or-three-minute intervals.
- 13.** After the groups have been through all eight stations, they will rotate through the stations a second time to fill in a table of the solutions that have been listed under each source. Distribute a copy of the table—the “Air Pollution, Asthma and Allergies Student Worksheet: Air Pollutions Sources and Solutions”—to each student.
- 14.** After the groups rotate through each station and complete the table, have them complete the questions at the bottom of the worksheet.
- 15.** To sum up, review and discuss their answers to the worksheet questions. Make use of the “Teacher Answer Key” during the discussion.
- 16.** Ask students to identify challenges they may have in incorporating active solutions into their daily lives and to brainstorm ways they could overcome these challenges.

17. Consider making a display using the “Air Pollution Sources” and “Air Pollution Solutions” to help educate others about air pollution, health impacts and solutions for reducing air pollution.

18. Tell students that since air quality can affect our health, it is important to have accessible information on current air quality conditions. Using the Internet and LCD projector or SMART Board, showcase the Air Quality and Health Index (AQHI) website. You can link to AQHI from the Clean Air Champions website:

[http://www.cleanairchampions.ca/programs/air\\_aware/the\\_aqhi.php](http://www.cleanairchampions.ca/programs/air_aware/the_aqhi.php)

19. Click on the map of Canada with the title “Check your local AQHI.” Choose a location and look at the current and forecasted AQHI rating. Because AQHI is not yet reported in all regions, you may need to select a location other than your own. Discuss why the AQHI rating is the number it is today. Discuss how the AQHI number might be related to today’s weather. Discuss what the AQHI measures, how the scale works, who is most at risk, and how the AQHI forecast can help when planning activities.

20. Refer back to the solutions that were identified to reduce air pollution. Many of the solutions focused on active transportation that requires people to be outdoors while being active. Ask students the following questions:

*How many other things do you do outdoors (e.g., soccer, skating, skiing)?*

*How important is using the AQHI to protect your health?*

*Thinking back to the Champion presentation, how important is good air quality to athletes?*

21. Submit a summary of what students learned about air quality, asthma and allergies to Air Aware’s National Program Coordinator, Angela Melhuish, at [angela@cleanairchampions.ca](mailto:angela@cleanairchampions.ca). You can submit a simple summary or include photos of the air pollution sources and solutions. All classes that submit information on the impact of the program will be entered in a draw to win a Giant Bike! Go to the link below to enter the contest.

[http://www.cleanairchampions.ca/programs/air\\_aware/enter\\_our\\_giant\\_contest/for\\_schools.php](http://www.cleanairchampions.ca/programs/air_aware/enter_our_giant_contest/for_schools.php)

## Extension — Making it Relevant

- Invite students to use Google Maps/Google Earth or go on a walk-about in your local community to locate local air pollution sources from those listed on the “Air Pollution and Asthma Student Worksheet: Air Pollution Sources.” Using the worksheet, students identify sources of air pollution and locations in their community that produce them. Students record each location they identify on a piece of paper. They name the industry or type of manufacturer and the air pollution produced at that location. Students then use Google Earth to print a local map. The pieces of paper can be placed around the map, using string to connect the paper to the air pollution source location on the map. Students can use other websites to help them with this activity such as <http://www.emitter.ca>.
- If your school’s location is suitable, ask students to record the number of vehicles, the type of vehicles (truck, SUV, large car, small car), and the number of people in the vehicles (an estimate) that pass the school or arrive at the school in the morning. If there isn’t much

traffic at the school, students could record the traffic that goes by their homes. Students then research the energy efficiency of some of the vehicles they saw to understand the amount of air pollution they emit. Have students make postcards about air pollution and their health impacts to place in the front entry of the school. Each postcard can identify a solution for reducing air pollution.

- Vehicles idling in front of schools are also a source of air pollution. Create an Idle Free School Zone. There are many idle-free programs that can guide you through the process:  
<http://www.hastebc.org/tools/anti-idling-cookbook>  
<http://www.saferoutestoschool.ca/noidling.asp>  
<http://www.onesimpleact.alberta.ca/get-involved/schools.asp>
- Print a Champion biography for each student or for small groups of students. Ensure a few of the biographies are athletes with asthma, such as Lisa Bentley, Sharon Donnelly, Kirsten Manley-Casimir, Charles Bryer, and Douglas Vandor. Students read the information about the Champion and then write a biography from the perspective of an athlete that has asthma or trains outdoors most of the time. The Champion athlete information can be used as a template. Each biography should include facts, why the environment is important to the athlete, and why the athlete is a Clean Air Champion. Students could also include a photo of the sport they chose for their athlete. Put students in groups of four (if they wrote the biographies individually) or put three small groups together (if they wrote in small groups), and have them share the Champion biography they created.

## Extension — Being Active

1. The Allergens Game: Play this game in a gymnasium, outdoors, or in a large open space. Assign five students to be people with allergies. Assign the remaining students to be allergens:

- Pollen – 12 to 15 students - Red
- Animal dander – 2 students - Green
- Dust – 5 to 6 students - Yellow
- Mould – 1 to 2 students - Blue

The people with allergies try to run from one end of the space to the other and back, trying to avoid as many allergens as they can. The allergens try to tag the people with allergies, leaving their colour mark on the people with allergies. For colour marking, you can use large adhesive dots, coloured duct tape or painters tape, felt pens on old T-shirts or sandwich boards (two sheets of poster board connected with string worn over the shoulders). After the five people complete their run, have them tally the number of strikes for each colour. Ask the following questions: Which allergens tagged them the most? Which allergens were easier to avoid? How do you think this compares for people with allergies? Explain the immune system to students and the role of antibodies or immunoglobulin's in protecting our bodies from harmful foreign substances such as bacteria and viruses.

*The immune system produces five types of antibodies or immunoglobulin's (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 runny/stuffy nose, sneezing, and itching. People often take medication such as anti-histamine or nasal steroid sprays to alleviate their allergic symptoms.*

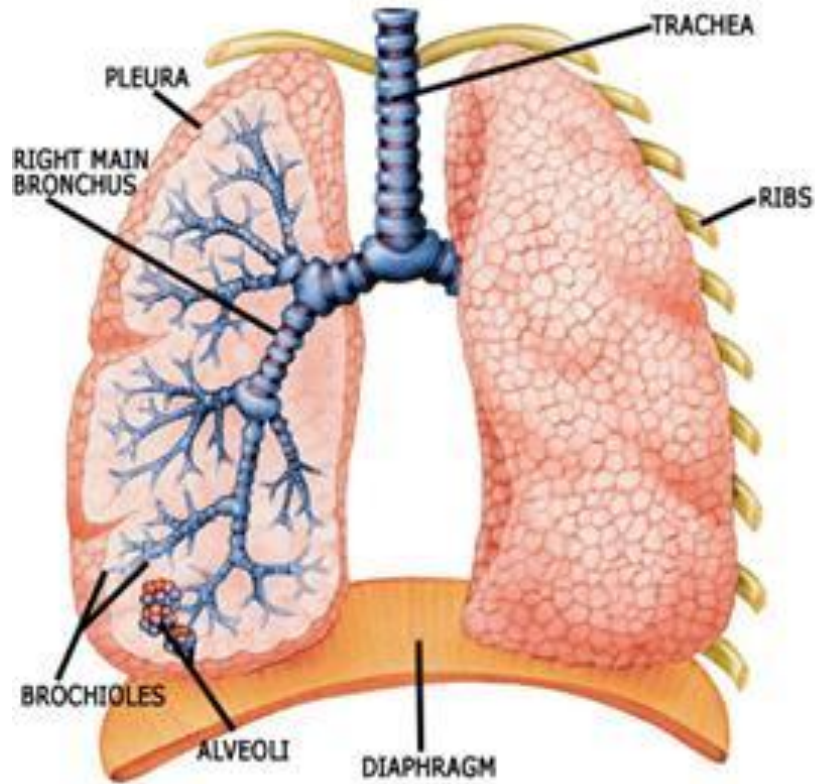
2. Refer to the Clean Air Champions website for other active games:

[http://www.cleanairchampions.ca/programs/air\\_aware/quizzes\\_activities\\_and\\_games/php](http://www.cleanairchampions.ca/programs/air_aware/quizzes_activities_and_games/php)

## ACTIVITY #2: AIR POLLUTION, ALLERGIES AND ASTHMA

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### TEACHER ANSWER KEY Part A: Respiratory System



Breathing is the process by which oxygen in the air is brought into the lungs. The blood absorbs the oxygen and carries it to all parts of the body. At the same time, the blood gives up waste matter (carbon dioxide), which is carried out of the lungs with the air breathed out.

When we breathe in (inhale) through our nose and mouth, air travels down our trachea (windpipe) and into our lungs through the left and right bronchi. Each bronchus splits into smaller bronchioles and then leads to small sacs called alveoli.

It is in the alveoli that the oxygen-rich air we have inhaled is absorbed into our blood. In the blood, the oxygen is carried to the heart and is then pumped to the trillions of cells throughout our body. Our cells use the oxygen to make energy and then release carbon dioxide (CO<sub>2</sub>), a waste product that is removed from the body as we exhale.

## ACTIVITY #2: AIR POLLUTION, ALLERGIES AND ASTHMA

### STUDENT WORKSHEET

#### Part B: Air Pollution Sources

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## Nitrogen Oxides

# NO<sub>x</sub>

### Sources

When we burn fossil fuels such as coal, oil and natural gas, we produce Nitrogen Oxides (NO<sub>x</sub>). We use oil for transportation, coal in power plants, and natural gas for heating. In the atmosphere, NO<sub>x</sub> reacts with SO<sub>2</sub> and water vapour (evaporated water) to form acidic droplets that are called *acid rain*. NO<sub>x</sub> also reacts with Volatile Organic Compounds (VOCs), which are carbon compounds that evaporate easily into the air to create ground level ozone that is a highly irritating gas. Nitrogen dioxide (NO<sub>2</sub>) is one of three substances measured as part of the AQHI (the other two being ozone and particulates).

### Health Impacts

NO<sub>x</sub> hurts the lung's ability to function. NO<sub>x</sub> causes tightness in the chest, difficulty breathing, coughing and wheezing. It can harm tissues and cells in the body.

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## Sulphur Dioxide

# SO<sub>2</sub>

### Sources

When we burn fossil fuels such as coal, oil and natural gas, and when we refine ores such as iron ore and copper ore, we release sulphur dioxide (SO<sub>2</sub>). Besides metals such as iron and copper, ore contains other substances such as sulphur. Smelting is a process that uses high heat and chemical reactions to release metal from the other substances. In the smelting process, SO<sub>2</sub> is released into the air.

### Health Impacts

SO<sub>2</sub> causes wheezing and shortness of breath. It can also lead to lung disease such as asthma.

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# Carbon Monoxide

# CO

## Sources

Carbon Monoxide (CO) is mainly produced by the combustion of gasoline in vehicles. 76% of all CO in the atmosphere comes from vehicles. Wild fires, other sources of burning wood, and volcanic eruptions, also release CO.

## Health Impacts

CO reduces the body's ability to use oxygen. Even a little exposure to CO for a short amount of time can hurt an athlete's performance or worsen the symptoms of someone with heart problems.

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# Volatile Organic Compounds

# VOCs

## Sources

Volatile Organic Compounds (VOCs), which are natural and man-made compounds made up of carbon, are released into the air through evaporation. Examples of these compounds are gasoline, natural gas, paints, cleaners, inks, and acetone.

## Health Impacts

VOCs irritate the eyes and nose.

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## Airborne Particulate Matter

PM

### Sources

Particulate Matter (PM) can be coarse or fine. Coarse PM includes dust from construction, dirt from plowing farmland, smoke from burning wood, and diesel soot. Fine PM is formed through chemical reactions when  $\text{NO}_x$ ,  $\text{SO}_2$ , water vapour, VOCs and ammonia combine to create particulates of sulphate, nitrate and ammonium. Fine PM can also come from smoke from burning wood and diesel exhaust. PM is one of three substances measured by the AQHI and is classified as a toxic substance by Environment Canada.

### Health Impacts

PM irritate the nose and throat. It can cause coughing and breathing difficulties and hurt the lung's ability to function. PM can get lodged in lung tissue and cause damage. Fine particulates are most damaging to our health.

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## Ground Level Ozone

$\text{O}_3$

### Sources

Ground-level ozone ( $\text{O}_3$ ) is a colourless gas that forms just above the earth's surface when  $\text{NO}_x$  and VOCs react in sunlight and still air.  $\text{O}_3$  is different than the natural ozone in the stratosphere that protects the earth from harmful ultraviolet (UV) rays. Ground-level ozone is one of the three substances measured as part of the AQHI.

### Health Impacts

$\text{O}_3$  makes the eyes itch and burn. By lowering our resistance, it makes us more likely to catch colds and get pneumonia, and it aggravates existing respiratory conditions (e.g., asthma, bronchitis). Ground level ozone can also cause permanent lung damage and lead to early death.

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## Smog

### Sources

Smog is mostly made up of ground-level ozone (O<sub>3</sub>) and airborne particulates (PM). Because sunlight is needed to create ground-level ozone and ground-level ozone is needed to create smog, smog usually appears on sunny days with little wind. Smog is a year round phenomenon that is also influenced by weather patterns resulting in smog being as likely in rural as in urban settings. Smog levels usually peak in mid-afternoon due to higher temperatures and higher levels of fossil fuel consumption.

### Health Impacts

Smog irritates the eyes, nose and throat. Smog can cause coughing and wheezing. People with lung or heart conditions are affected by smog as it makes their symptoms worse. Smog also lowers our resistance to infections and can lead to early death.

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## ACTIVITY #2: AIR POLLUTION, ALLERGIES AND ASTHMA

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### STUDENT WORKSHEET

#### Part B: Air Pollution Solutions

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### Walking



Walking, like biking, is easy on the air. Unlike riding in a vehicle, walking produces ZERO air pollution and is an excellent form of physical activity. Oil, which is refined into gasoline for transportation, releases pollutants in the air when it is refined and again when it is burned for fuel.

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### Biking/Rollerblading/Skateboarding



Biking, rollerblading, skateboarding, and walking are easy on the air. Unlike cars and other vehicles, these forms of transportation do not require fossil fuels. Oil, which is refined into gasoline for transportation, releases pollutants into the air when it is refined and again when it is burned for fuel. The bicycle is the world's most widely used form of transportation and its most energy efficient. Studies have proven that the fastest way to travel less than 5km in urban centres is by bicycle!

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### Using Public Transit or Carpooling



Public transportation or 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 that is emitted into the air.

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## Turning 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. In Canada, much of the electricity we use is produced from coal-fired power plants. Like all fossil fuels, coal releases pollutants into the air.

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## Unplugging 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 energy. Think of all the cell phone chargers that are left plugged-in across North America!

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## Purchasing EcoLogo Products



EcoLogo products are reviewed to ensure they meet strict environmental standards. EcoLogo products such as paints, glues, cleaners, and adhesives are made using less toxic materials that release fewer pollutants into the air. EcoLogo products can be identified by the EcoLogo, shown here. Encourage family members and others to purchase EcoLogo products when they can.

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## Turning Down the Heat



Turning down the heat is an easy way to save energy. The best time to lower the heat is at night when everyone is sleeping or during the day when everyone is out. A programmable thermostat can be programmed to automatically turn down the heat at certain times of the day or night. Programmable thermostats are helpful in saving energy because once they are programmed, people don't have to remember to turn down the heat.

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## Reducing the Use of Hot Water



Natural gas or electricity heats the water in our homes. In Canada, much of the electricity we use is produced from coal-fired power plants. When burned, the fossil fuels natural gas and coal release pollutants into the air. By taking shorter showers or washing clothes in cold water, we can reduce the amount of natural gas or electricity used for heating water.

Another way to reduce the use of hot water is to turn the thermostat on the hot water tank down a few degrees so that the hot water is less hot.

## ACTIVITY #2: AIR POLLUTION, ALLERGIES AND ASTHMA

### STUDENT WORKSHEET

#### Part B: Air Pollution Sources and Solutions

Place a checkmark in the table below for each of the solutions that are posted for each Air Pollution Source.

	Nitrogen Oxides (NO <sub>x</sub> )	Sulphur Dioxide (SO <sub>2</sub> )	Carbon Monoxide (CO)	Volatile Organic Compounds (VOCs)	Airborne Particulate Matter (PM)	Ground Level Ozone (O <sub>3</sub> )	Smog
Walking							
Biking/Rollerblading/etc.							
Using Public Transit or Carpooling							
Turning off Lights and Appliances							
Unplugging Cell Phone Chargers							
Purchasing EcoLogo Products							
Turning Down the Heat							
Reducing the Use of Hot Water							

Which air pollution solutions can help reduce many sources of air pollution?

Which air pollution solutions promote an active lifestyle?

What situations in your daily routine would have to change for you to lead a more active lifestyle?

## ACTIVITY #2: AIR POLLUTION, ALLERGIES AND ASTHMA

### TEACHER ANSWER KEY

#### Part B: Air Pollution Sources and Solutions

Place a checkmark in the table below for each of the solutions that are posted for that Air Pollution Source.

	Nitrogen Oxides (NO <sub>x</sub> )	Sulphur Dioxide (SO <sub>2</sub> )	Carbon Monoxide (CO)	Volatile Organic Compounds (VOCs)	Airborne Particulate Matter (PM)	Ground Level Ozone (O <sub>3</sub> )	Smog
Walking	✓	✓	✓	✓	✓	✓	✓
Biking	✓	✓	✓	✓	✓	✓	✓
Using Public Transit or Carpooling	✓	✓	✓	✓	✓	✓	✓
Turning off Lights & Appliances	✓	✓			✓	✓	✓
Unplugging Cell Phone Chargers	✓	✓			✓	✓	✓
Purchasing EcoLogo Products				✓		✓	✓
Turning Down the Heat	✓	✓			✓	✓	✓
Reducing the Use of Hot Water	✓	✓			✓	✓	✓

Which air pollution solutions can help reduce many sources of air pollution?

- *Walking, biking, rollerblading, skateboarding, using public transit, carpooling, turning off lights and appliances, unplugging cell phone chargers, turning down the heat, reducing the use of hot water.*

Which air pollution solutions promote an active lifestyle?

- *Biking, rollerblading, skateboarding, and walking.*

What situations in your daily routine would have to change for you to lead a more active lifestyle?

- *Answers will vary.*