

# Air Pollution, Asthma and Allergies

## Abstract

Using stations, students learn about air pollution, the impacts on asthma and allergies, and everyday solutions to reduce air pollution.

## Logistics

### Time Required

- **Class Time:** One 50-60 minute class to complete Part A & B. Extension would take additional time.
- **Prep Time:** 20 minutes

### Materials

- “Air Pollution, Asthma and Allergies Student Worksheet: Air Pollution Sources,” one copy of each page, cut
- “Air Pollution, Asthma and Allergies Student Worksheet: Air Pollutions,” 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”
- 8 pairs scissors; 8 glue sticks; 8 different colored sheets of paper (8.5x14);

### Classroom Requirements

- Projector display connected to computer with access to the internet

## Learning Objectives

- Understand the respiratory system and the connection to the air we breathe.
- Understand asthma and the connection between air quality and health.
- Identify air pollution sources and actions that help ensure a healthier environment and to promote healthier lifestyles.
- Identify resources that can assist students in protecting their health.

## Prescribed Learning Outcomes BC Curriculum:

- Manipulate and control a number of variables in an experiment.
- Apply solutions to a technical problem.
- Analyze how different organisms adapt to their environments.
- Explain obstacles unique to exploration of a specific extreme environment.
- Differentiate between renewable and non-renewable methods of producing electrical energy

## Preparation

1. Photocopy the required number of worksheets.
2. Obtain a copy of the “Asthma Fact Sheet” from Appendix B or at [http://www.cleanairchampions.ca/programs/air\\_aware/fact\\_sheets.php](http://www.cleanairchampions.ca/programs/air_aware/fact_sheets.php)
3. Assemble necessary materials.
4. Cut and post the seven sources of air pollution in various locations around the room, found in the “Air Pollution, Asthma and Allergies Student Worksheet: Air Pollution Sources.” Below each source post a blank sheet of paper (8.5x14)
5. Understand how the Air Quality Health Index works to be able to discuss with students.

## Classroom Implementation

### Part A

Students will express their understanding of the respiratory system.

1. Begin a discussion with students about the respiratory system using the following questions as a guide (style of discussion is up to the instructor):
  - a. 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.*
  - b. What are some of the things that can impact the health of our lungs?  
*Inactive lifestyles, smoking, air pollution, inhaling toxic substances, and diseases.*

### Part B

Students will investigate sources of air pollution and possible solutions.

1. Present information on asthma to students using the “Asthma Facts Sheet” found in Appendix B of the Resource Package or online at [http://www.cleanairchampions.ca/programs/air\\_aware/fact\\_sheets.php](http://www.cleanairchampions.ca/programs/air_aware/fact_sheets.php)
2. The next 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:
  - a. Three million Canadians suffer from asthma.
  - b. Asthma is the most common chronic respiratory disease of children and young adults.
  - c. 60% of people with asthma do not have their asthma under control.

- d. Despite the progress made, approximately 20 children and 500 adults die from asthma each year.  
Sources: Asthma Society of Canada; Statistics Canada, Health Reports, Vol. 16: No. 2, March 2005.
3. 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.
  4. Divide students into 8 groups. Distribute one of the “Air Pollution, Asthma and Allergies Student Worksheet: Air Pollution Solutions” to each group and have the group read the info.
  5. Provide each group with a different coloured sheet of paper. Ask the group to cut the paper into 8 sections and then write the name of their solution on each section.
  6. Provide the groups with a glue stick.
  7. When 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.
  8. Give the groups 15 to 20 minutes to rotate through the seven air pollution source stations. You can use a noisemaker to indicate the two-or-three-minute intervals.
  9. After the groups have been through all 8 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.
  10. After the groups rotate through each station and complete the table, have them complete the questions at the bottom of the worksheet.
  11. To sum up, review and discuss their answers to the worksheet questions. Make use of the “Teacher Answer Key” during the discussion.

12. 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.
13. 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.
14. 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:  
<http://www.bcairquality.ca/readings/index.html>
15. 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.
16. Post an Air Quality and Health Index Wheel in your classroom. These can be obtained from the Fraser Basin Council, (207-105 George Street, Prince George, BC) 250 612 0252. Update the AQHI rating daily or give this responsibility to a student(s).

## Extension

### Option 1: Field Trip

Take your students on an out of classroom learning experience. Check out the field trip recommendations in the *Sustainability Education in the Classroom: Air Quality and Health Resource Package for Educators in Prince George, BC*.

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### Option 2: Being Active

**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 or 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 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.*

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### Option 3: Project

#### **Reduce School's Transportation Emission Footprint**

Check out the websites below for ideas and resources:

Clean Air Champions, High School Climate Challenge

[http://www.cleanairchampions.ca/database/files/library/HSCC\\_Personal\\_Transportation\\_info\\_kit.pdf](http://www.cleanairchampions.ca/database/files/library/HSCC_Personal_Transportation_info_kit.pdf)

Ideas and curriculum can be found on the Hub for Active School Travel (HASTE) website:

<http://www.hastebc.org/info/where-begin>

<http://www.hastebc.org/tools/take-action-school-transportation-emissions>

[http://www.hastebc.org/files/IdleFree\\_Intro&Bkgd\\_0.pdf](http://www.hastebc.org/files/IdleFree_Intro&Bkgd_0.pdf)

# Air Pollution, Allergies and Asthma

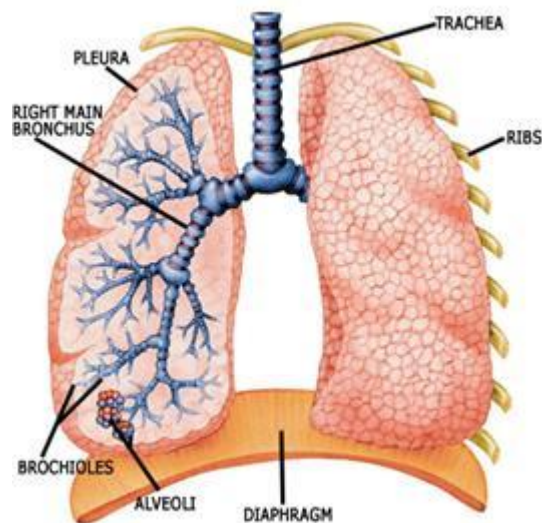
## Teacher Answer Key

### 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.



# Air Pollution, Allergies and Asthma Student Worksheet

## Part B: Air Pollution Sources

### Nitrogen Oxides $\text{NO}_x$

#### Sources

When we burn fossil fuels such as coal, oil and natural gas, we produce Nitrogen Oxides ( $\text{NO}_x$ ). We use oil for transportation, coal in power plants, and natural gas for heating. In the atmosphere,  $\text{NO}_x$  reacts with  $\text{SO}_2$  and water vapour (evaporated water) to form acidic droplets that are called acid rain.  $\text{NO}_x$  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 ( $\text{NO}_2$ ) is one of three substances measured as part of the AQHI (the other two being ozone and particulates).

#### Health Impacts

$\text{NO}_x$  hurts the lung's ability to function.  $\text{NO}_x$  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 $\text{SO}_2$

#### 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 ( $\text{SO}_2$ ). 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,  $\text{SO}_2$  is released into the air.

#### Health Impacts

$\text{SO}_2$  causes wheezing and shortness of breath. It can also lead to lung disease such as asthma.

## 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.



## 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.

## Air Pollutions, Allergies and Asthma Student Worksheet

### Part B: Air Pollution Solutions

#### 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!



## 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.



## 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 below. Encourage family members and others to purchase EcoLogo products when they can.



## 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.

