

Air Quality Resource Package for Teachers in Prince George, BC

Grades 4 to 6

March 2012

This project was undertaken with the financial support of:



**Environment Canada Environnement
Canada Canada**

Ce projet a été réalisé avec l'appui financier de :



**Environnement Canada Environment
Canada Canada**



Fraser Basin Council

The Fraser Basin Council developed this resource package for teachers of grades 4, 5 and 6 in the Prince George area. Section 1 of this package provides background information on air quality in Prince George and why it is important to educate young citizens on air quality, air pollutants, and health impacts of poor air quality. Sections 2 and 3 provide information on the activities that were performed by Fraser Basin Council in March 2012 within local schools and organizations in Prince George. Sections 4 and 5 provide examples of experiments, activities and projects that teachers can implement in the classroom related to air quality education. How the examples align with the current learning outcomes for grades 4 to 6 is also indicated within this document.

We would like to thank the Prince George Air Improvement Roundtable and Northern Health for their contribution to this project.

1.0 BACKGROUND ON AIR QUALITY IN PRINCE GEORGE	4
2.0 TEACHER PREPARATION FOR IN CLASSROOM SESSION IN MARCH	10
3.0 IN-CLASSROOM SESSION IN MARCH 2012.....	11
4.0 TEACHER AIR QUALITY LESSON PLANS AND ACTIVITIES.....	16
4.1. INTRODUCING AND USING THE AIR QUALITY HEALTH INDEX (AQHI).....	16
4.2 AIR QUALITY ACTIVITIES AND EXPERIMENTS	17
4.2.1 <i>Particulates in the Air Experiment</i>	19
4.2.2 <i>Car Exhaust Experiment</i>	21
4.2.3 <i>Weather and Air Quality Project</i>	23
4.2.4 <i>(Your School's) Active Transportation Challenge!</i>	27
5. WEBSITES AND RESOURCES WITH AIR QUALITY INFORMATION, ACTIVITIES AND GAMES AND ADDITIONAL LESSON PLANS	28
5.1. HSBC ACTIVE TRANSPORTATION CHALLENGE PROGRAM	28
5.2. ECOKIDS WEBSITE AND ERRAND RUN GAME	28
5.3 THE BC AIR QUALITY WEBSITE	28
5.4 THE NATIONAL POLLUTANT RELEASE INVENTORY	28
5.5 THE BLUE SKY SMOKE FORECASTING WEBSITE.....	29

1.0 Background on Air Quality in Prince George

“A human can live for about 6 weeks without food, and about 6 days without water, but only 6 minutes without air.”¹

Education on air quality and its relation to our health and the environment has typically received little attention in schools and community organizations in relation to other environmental and health concerns. Air quality may be more difficult to address in the classroom as air is invisible and boundless and air pollution is something that is more nebulous than other environmental problems, such as water pollution and habitat destruction. Air quality is relatively good in British Columbia, however, a 2003 report on air quality by BC’s Provincial Health Officer estimates that current levels of outdoor air pollution in BC cause 25-250 deaths each year (compared to 108 deaths per year from smoking).²

Poor air quality can have adverse effects on human health, at the individual and community level, and can have negative impacts on the environment. In Prince George and other Northern and Interior BC communities, **particulate matter** pollution from industrial and domestic sources is the most crucial air quality issue. **Particulate matter (PM)** refers to tiny solid or liquid particles in the air, some which can be seen (smoke, soot or dust) and others that can only be observed with an electron microscope. PM is measured in microns and PM that is 2.5 microns or less is called PM_{2.5} — which is about 1/20th the diameter of a human hair (Fig 1).

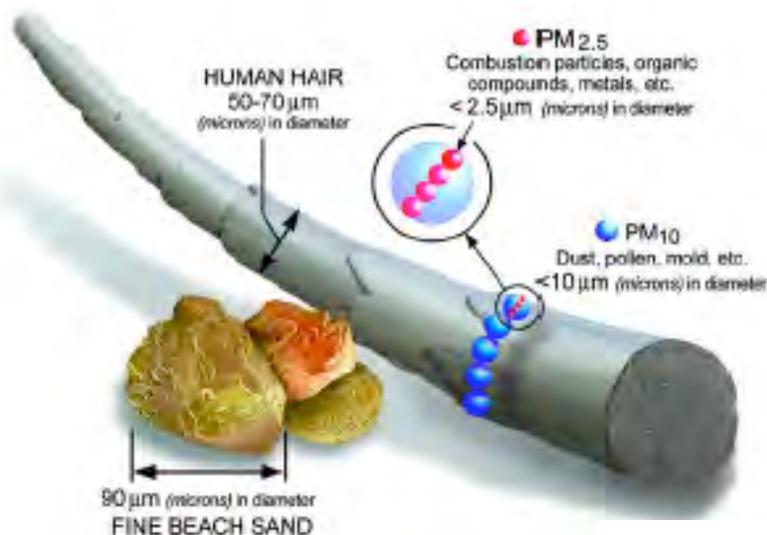


Figure 1: Demonstration of the size of particulate matter (source: PGAIR Phase III Implementation Plan, image courtesy U.S. EPA)

¹ British Columbia Ministry of Environment. Resources for Youth and Teachers. Breathtaking Discoveries: Exploring the Issues and Connections between Human Activity, Air Quality and Health <http://www.bcairquality.ca/education-resources/index.html>

² BC Clean Air Partnership. 2005. Teacher’s Guide to Clean Air. P. 10. www.bcairquality.ca/reports/pdfs/clean%20air_guide_final.pdf

PM 2.5 is of the greatest concern because it can travel deep into the lungs and become lodged there, causing heart and lung disease, and premature death even if levels are below those for air quality advisories. In Northern and Interior BC, 74 deaths / year occur due to human-caused particulate matter³. Despite many years of improvements to our air quality, Prince George still has some of the highest levels of particulate matter (Figs 2 and 3) in the province.

4

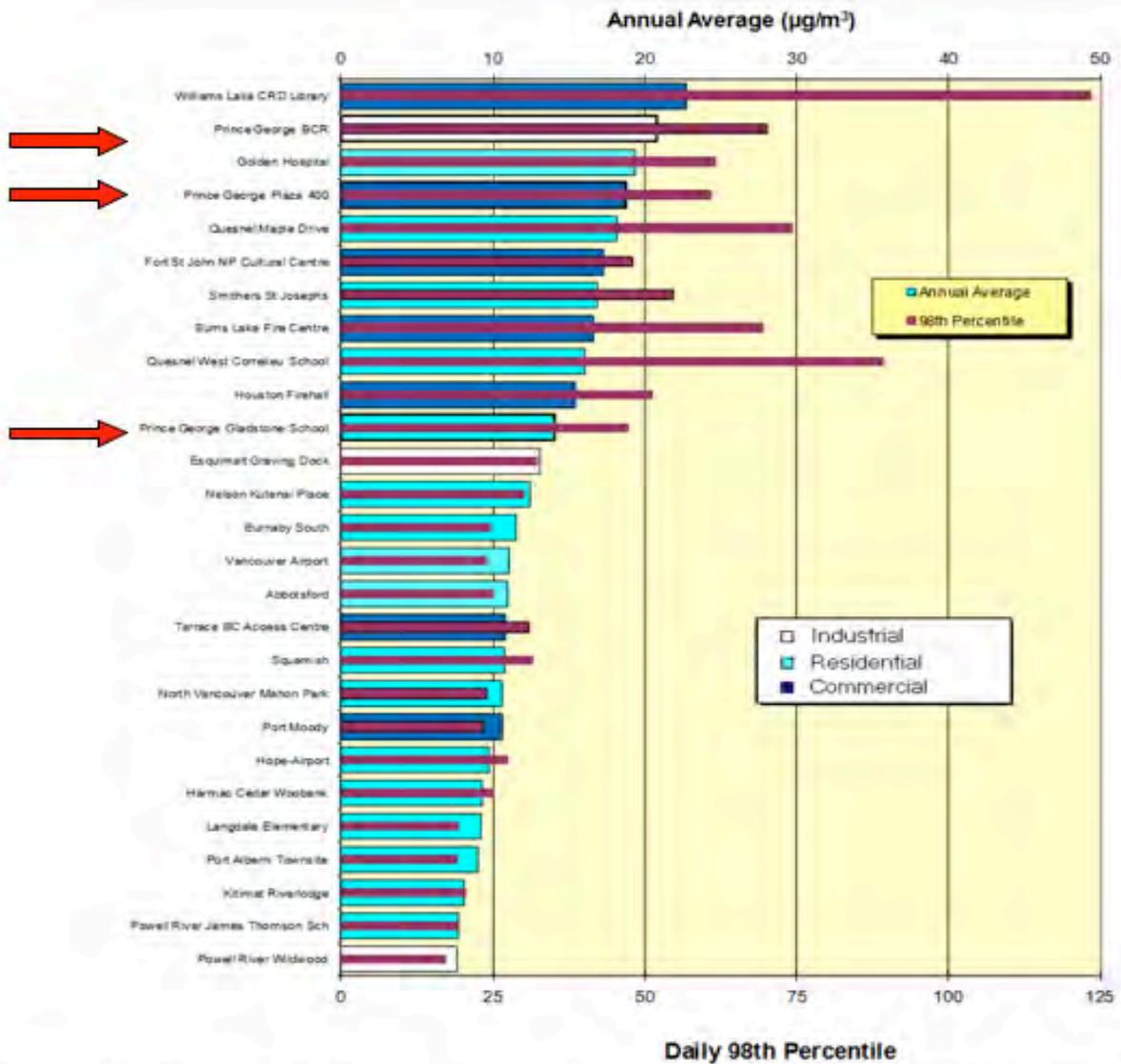


Figure 2. Comparison of 2010 annual average and daily 98th percentile **PM10 levels** ($\mu\text{g}/\text{m}^3$) in Prince George with other B.C. locations (continuous monitors) 4

³ Elliot, C.T. and Copes, R. 2011. Burden of mortality due to ambient fine particulate air pollution (PM2.5) in interior and northern BC. Can. J. Public Health. 102(5): 390-393.

⁴ Fudge, D. BC Ministry of Environment. 2010.

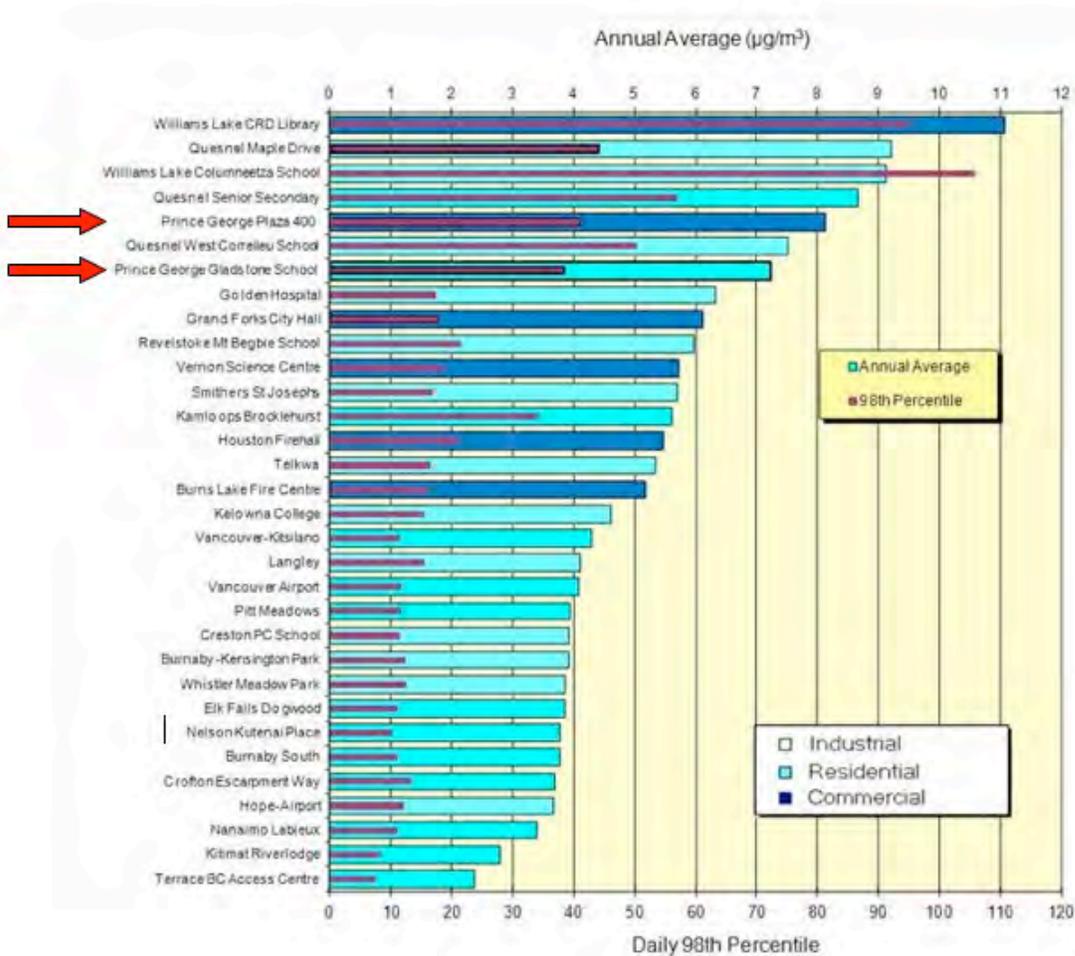


Figure 3. Comparison of 2010 annual average and daily 98th percentile **PM_{2.5} levels** (µg/m³) in Prince George with other B.C. locations (continuous monitors)⁴

Although it seems that air quality is somewhat out of the control of the individual due to industry pollution and natural sources, such as wildfires, there are several sources of PM_{2.5} in Prince George that can be largely influenced by the individual and the behaviours they choose to do every day. Dust (eg. stirred-up dust from roads and parking lots), transportation (eg. cars, trucks) and woodburning (woodstoves, open burning) are the main areas where the community can contribute to reducing the amount of pollution in our airshed. Figure 4 shows the relative contribution of different sources for PM_{2.5} in Prince George.

⁴ Fudge, D. BC Ministry of Environment. 2010.

Relative Proportion of Total PM_{2.5} Emissions (2005 Information)



Figure 4: Relative proportion of PM_{2.5} emissions in the Prince George Airshed (source: PGAIR Phase III Implementation Plan 2011)

There are several resources available that will help individuals make informed decisions about the air quality and how it may impact their health. The Air Quality Health Index (AQHI) was developed as a public health tool and is available at <http://www.bcairquality.ca>. The AQHI is a scale designed by the federal government, supported by provincial governments, to help understand how air quality impacts human health (Fig 5). It provides information to the individual to limit short-term exposure to air pollution and adjust their activity levels during increased levels of air pollution. It also provides advice on how individuals can improve the quality of the air they breathe, such as using active transportation. Prince George's air quality is reflected in the AQHI readings for the community in comparison to other BC communities (Fig 6). Prince George is consistently

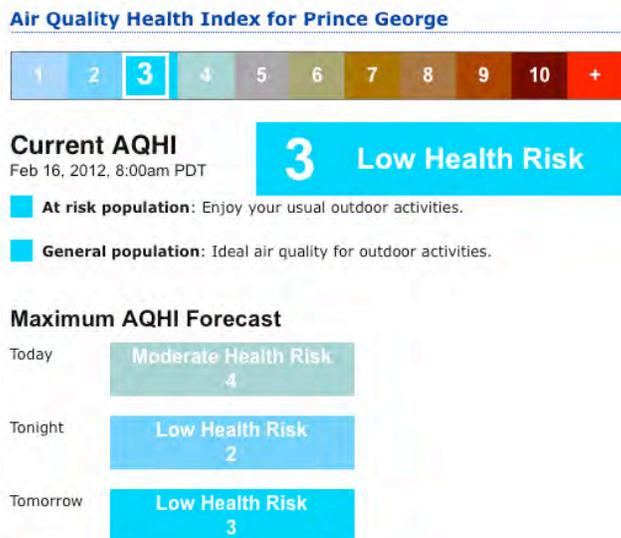


Figure 5. Screen shot of the air quality health index in Prince George. Available at <http://www.bcairquality.ca/readings/prince-george.xml>.

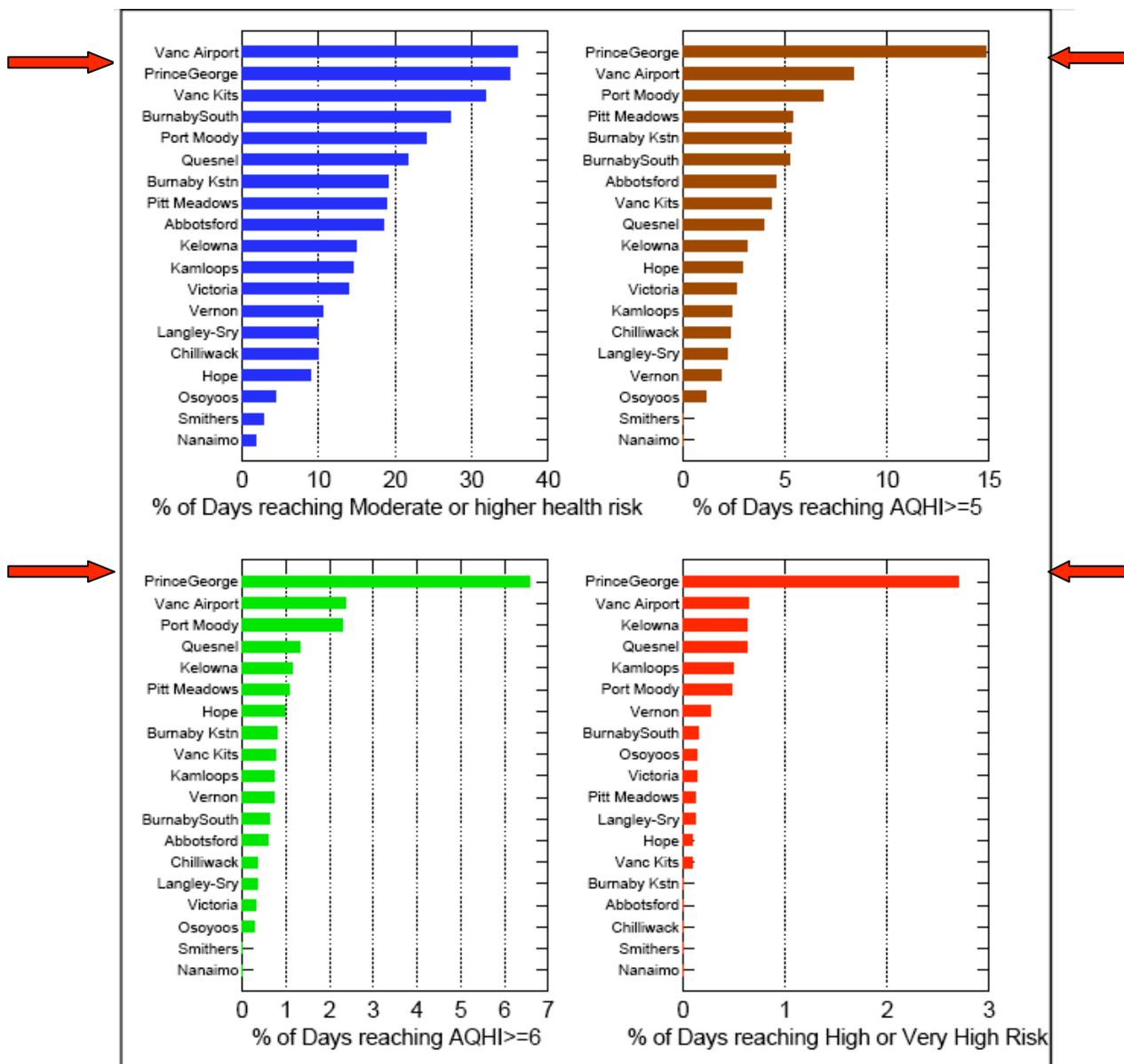


Figure 6. 2000-2006 data comparing the percent of days when the Air Quality Health Index (AQHI) reached various thresholds for at least one hour⁵

As young children are most at risk of poor air because of their less developed respiratory systems and because they inhale more air per kilogram of body weight compared to adults for example, they are considered part of the ‘at-risk’ population⁶. When children

⁵ Hasselback, P. and Taylor, E. 2010. Air quality health index variation across British Columbia. Interior Health and Province of British Columbia. P.7.

⁶ <http://www.airhealthbc.ca>

are educated on the risks and parents and teachers are informed, children can help protect themselves and encourage their families and others to take on responsibility for their own health and the impacts of air quality.

Air quality is an important component of environmental and health education and is of particular importance to Prince George, which suffers some of the worst air quality in province. Education and awareness is pivotal to improving air quality in Prince George. By educating students and children at the elementary level, we can instill a sense of responsibility and environmental and community stewardship on these individuals who will have the ability to change the air they breathe today and for future generations.

2.0 Teacher Preparation for In Classroom Session in March

In preparation for the in class session in March 2012, teachers will introduce the Air Quality Health Index (AQHI) and the BC air quality website resources to students before we come into your classrooms.

- **Click on the website link** <http://www.bcairquality.ca>
- Main page states if there are any **air quality advisories or other air pollution advisories (dust advisory)** currently or when the last air quality advisory ended for communities in BC. (In late winter and early spring Prince George is commonly on this page as having an air quality advisory or one having just ended). These advisories are administered by the Provincial Meteorologist and for Prince George, are usually due to elevated levels of Particulate Matter.
- To access the AQHI, **click on “What’s the Air Like Today”** on the right hand side.
- It will show the AQHI readings for each monitored community in BC on the right side of the page, or you can **click on Prince George on the map** and it will show you the AQHI reading with the health message.
- All of the monitoring stations are also labeled and you **can click on each monitoring station** to see what is measured and the readings for certain pollutants (**PRG Plaza 400** monitoring station downtown measures the most pollutants).

This website provides teachers with resources on the three pollutants used to measure the AQHI (ozone, nitrogen dioxide and particulate matter), and how they individually impact health.

3.0 In-Classroom Session in March 2012

This section provides details on what was done for the March 2012 in-classroom session presented by the Fraser Basin Council with partners from Northern Health and the community. Teachers and organizations are welcomed to use this information for their own in-class air quality education.

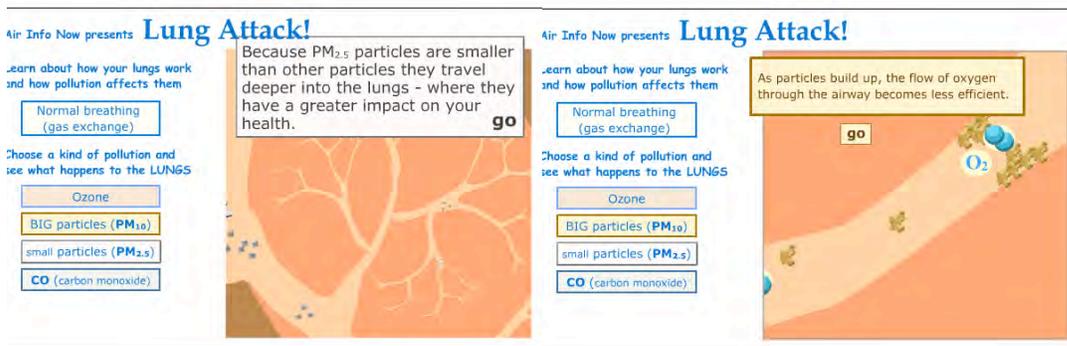
In-Class Session Information

The sessions will be approximately 1.5 hours in length with a 5-10 minute introductory video with questions and 2 10-12 minute learning/activity stations for each age range (primary and intermediate). These sessions will be done simultaneously and children can alternate between stations. The last activity will be a 30 minute scavenger hunt for the kids to do all at once with different clues and questions for each age range. Clues for the scavenger hunt may be given during the activity station sessions, so kids will be told to listen closely and pay attention.

Introductory Video on Pollution Impacts on Health

- Presenter will project the video on PM_{2.5} and PM₁₀ and how they impact our lungs and will make this an interactive video where students must breathe through a straw when the PM becomes trapped in the lungs.

Air Info Now Website <http://www.airinnow.org/html/lungattack/lungplay.htm>



Why this video? Particulate matter is locally relevant for Prince George, so this is a very useful activity.

This video has no sound, however, the teacher or myself can read along or get different students to read out loud. It would be best to have this projected onto a screen for the class to see. Demonstrates how different pollutants can get into the lungs and impact our health.

- Gives information on the human respiratory system
- How pollutants impact our health

Learning Outcomes Linkage:

- Grade 5 - Science/Life Science
 - Human Body: Describe the basic structure and functions of the human respiratory, digestive, circulatory, skeletal, muscular, and nervous systems.

Learning/Activity Stations

Station 1: 3D paper mache model of City of Prince George (Note: Please contact the Fraser Basin Council if you wish to use this model).

Purpose: To illustrate how weather and topography within Prince George can dramatically affect where air pollution settles within our community and to enable students to think about where they pollution comes from and what can be done to reduce their exposure and improve the air.

With help from students, presenter will:

- Blow smoke (dry ice) through the model to illustrate where pollution can settle and why it may settle differently (topography impacts).
- As students to blow on the dry ice, the “wind” will dissipate and disperse the pollution (demonstrating how weather can affect air quality).
- Presenter will ask students key questions and situational questions to get them to point out things on the model
- Students will be told certain things that will help them answer clues in the scavenger hunt.

Learning Outcomes Linkage:

- **Grade 4** – Science/Life Science/Habitats and Communities
 - Determine how personal choices and actions have environmental consequences
 - – Science/Earth and Space Science/ Weather. Analyse impacts of weather on living and non-living things
- **Grade 5** – Science/Earth and Space Science/Renewable and Non-Renewable Resources
 - Describe potential environmental impacts of using BC's living and non-living resources

Station 2: Air Quality Flash Cards JeopAIRdy

Purpose: To understand different pollutants and their sources and health impacts and the individual behaviours impacts on health and air quality. Kids will be separated into teams and given cards that have a picture and description on the back of a source of pollution or pollutant (eg. cars, factory, roads) and an individual behaviour (eg. biking, planting a tree, idling car). Presenter will ask a question below and the first group to hold up the correct picture wins a point (poker chip). Team with the most points (poker chips) wins a prize.

Questions To Ask Students During Activity

1. This is unhealthy for the air because it increases air pollutants and is unnecessary and wastes fuel. People do this at McDonalds.... (answer: Idling your car through a Drive thru!)
2. This way of getting McDonalds is healthy for the air because nothing comes out the tail pipe (there is no tailpipe!). (answer: horse and carriage at a drive thru)
3. This is a clean way to do lawn maintenance. (answer: push mower)
4. This is the healthiest way to get to school. Healthy for the air and for your own physical health. (answer: walking to school).
5. This natural phenomenon disperses pollutants, so the air gets cleaner. (answer: the wind).
6. This is not as healthy as active modes of transportation or public transit, but it makes for fewer cars on the road! (answer: carpooling)
7. This is a healthy way to get somewhere...just make sure you wear your helmet! (answer: biking)
8. This can cause poor air quality, especially if you live in the “bowl” of Prince George. If you use one of these and don’t know proper cleaner burner techniques or if your appliance is out of date its even healthier for the air. Hint: Some people use wood or wood pellets in these. (answer: heating your home with a wood stove).
9. On air quality advisory days, you can ride me for free! (answer: city bus).
10. I not only produce the gas that you need to breathe. I also am healthy for the air because I trap particulates and dust. Hint: I am green (answer: trees).

Learning Outcomes Linkage:

- **Grade 4** – Science/Life Science/Habitats and Communities
 - Determine how personal choices and actions have environmental consequences
- **Grade 4 and 6** - Health and Career Education/ Healthy Living
 - Describe the benefits of attaining and maintaining a balanced, healthy lifestyle, including the benefits of - being physically active

Station 3: Air Pollutants and Temperature Inversion

Purpose: To teach students how temperature inversions can trap pollutants and cause poor air quality.

The presenter will have three large clear glass containers with cold water (blue food coloured) and warm water (canola oil) and another container with just one temperature of water (purple colour). Kids will be asked about what they think causes air pollution and can show flash cards that will be on the table. They will be asked to put the pollution in the large bowls and will see how temperature inversions (cold water on bottom and warm on top) will trap pollutants where they are emitted or where they settle (often at ground level where we live!). Students will see how when the air is the same

temperature, pollutants can move around and get dispersed, but temperature inversions will trap pollutants, affecting air quality.

- Presenter should get kids to list different types of air pollution and behaviours that are unhealthy for the air.
- Presenter will have to change water each time a new group comes to the station. For warm/cold water container, pour cold (blue water in first) and slowly add warm (canola oil) water in second.

The difference in air temperature with warmer air on top and colder air at ground level is called a “temperature inversion”. When the sun goes down in the evening, the air closest to the ground cools down first, making the air colder at ground level. Since warm air is less heavy, the cold air is pushed down and kept below, causing an inversion.

Temperature inversions happen most often in valleys (like Prince George) and in the winter on clear nights when the ground cools down quickly.



2

Learning Outcomes Linkage:

- **Grade 4** – Science/Life Science/Habitats and Communities
 - Determine how personal choices and actions have environmental consequences
 - – Science/Earth and Space Science/ Weather. Analyse impacts of weather on living and non-living things

² Source: BC Clean Air Partnership. 2005. Teacher's Guide to Clean Air. P. 10.
www.bcairquality.ca/reports/pdfs/clean%20air_guide_final.pdf

Clean Air Scavenger Hunt

First team to answer the most questions correctly wins a prize!

1. What number is the AQHI right now? Answer _____.

Does this mean the air is clean? Answer: _____

_____.

2. These **two** natural factors can impact the air and are out of everyone's control. (Hint: You learned about them at the 3D model station). Answer: _____ and

_____.

3. I usually operate on gasoline and can be a push model or a ride-on model. Running me for 1 hour is equal to driving a new car between 320 to 480 kilometres!!! A picture of me is hidden on the biggest tree on the playground. What am I? Answer: _____ .

4. I'm better for the air and lots of people can fit in me. I am yellow when I go to school and I can fit 40-60 people in me, reducing the number of cars on the road. A picture of me can be found outside taped to a wall close to where I might be parked. What am I?

Answer: _____.

5. Find the bird feeder close to a window outside. You will find an envelope that contains images of 3 things numbered 1, 2 and 3. Which numbered image is the healthiest for the air and healthiest for you? Answer: _____

6. I produce smoke and am very hot! I am painted on a garbage can outside. What am I? Answer: _____.

7. The thing you lock to me is an active form of transportation and I can be found outside. I am blue. What am I? Answer:

_____.

8. When making a fire you want to burn **dry, seasoned wood**. You don't want to burn me, because I will release toxic chemicals that are bad for your health. I am **P L _ S _ _ C** .

4.0 Teacher Air Quality Lesson Plans and Activities

This section provides newly developed activities, activities adapted from other sources and resources from other sources related to air quality and health impacts of poor air quality.

4.1. Introducing and Using the Air Quality Health Index (AQHI)

Teachers will be given an AQHI Spin Wheel, which can be placed at the front of the classroom for students to examine. The Spin wheel can be changed every time the teacher or a student checks the AQHI (daily or a couple times per day) and another student will change the number on the wheel and read aloud the health message. Teachers can use different reading and higher AQHI values as an opportunity to ask students what they should or could do to reduce their exposure and improve air quality. Can link this activity with readings for weather parameters (precipitation, wind, humidity, cloud cover, etc.) - see *Weather and Air Quality Project* in next section.

Remember, the AQHI is calculated based on the relative risks to human health for 3 pollutants. These pollutants are:

- **Ozone (O₃)** at ground level,
- **Particulate Matter (PM_{2.5}/PM₁₀)** and
- **Nitrogen Dioxide (NO₂)**.



Figure 7. Example of Toronto's AQHI spin wheel. You have been given a version of the AQHI spin wheel for BC.

Learning Outcomes Linkage:

- **Grade 4** – Science/Physical Science/Weather. Measure weather in terms of temperature, precipitation, cloud cover, wind speed and direction

4.2 Air Quality Activities and Experiments

The following table is a summary of the experiments/activities/projects developed for air quality education in your classroom and how they achieve specific learning outcomes outlined within the *Ministry of Education’s 2010/2011 Searchable Learning Outcomes Database*. The activities are on separate pages below to use whenever possible in your class.

Table 1: Summary of experiments, activities and projects developed for air quality education in the classroom (Grades 4 – 6).

Experiment / Activity/ Project	Objective(s)	Grade Levels	Learning Outcomes Achieved
2.1 Particulates in the Air Experiment	- Students will investigate sources of pollution (particulate matter) - Students will learn how air quality is affected by human activity (human activity, transportation, etc.)	4-6	<p>Processes of Science Grade 4: Make predictions, supported by reasons and relevant content. Use data from investigations to recognize patterns and relationships and reach conclusions. Grade 5: Identify variables that can be changed in an experiment Grade 6: Manipulate and control the number of variables in an experiment.</p> <p>Life Science Grade 4: Determine how personal choices and actions have environmental consequences Grade 5: Describe basic structure and function of human respiratory system</p>
2.2 Car Exhaust Experiment	- Students will learn about testing hypotheses and making inferences from results. - Students will consider health and environmental implications of transportation.	4-6	<p>Processes of Science Grade 4: Make predictions, supported by reasons and relevant content. Use data from investigations to recognize patterns and relationships and reach conclusions. Grade 5: Identify variables that can be changed in an experiment Grade 6: Manipulate and control the number of variables in an experiment.</p>

			<p>Life Science Grade 4: Determine how personal choices and actions have environmental consequences Grade 5: Describe basic structure and function of human respiratory system</p>
2.3 Weather and Air Quality Project	<ul style="list-style-type: none"> - Students will learn how to access and collect weather and air quality data from online sources. - Students will hypothesize on how weather could impact air quality by examining specific pollutant concentrations and weather data. - Dependent on grade level, students will graph data to understand relationships and reach conclusions. 	4-6	<p>Science: Processes of Science: Grade 4: Use data from investigations to recognize patterns and relationships and reach conclusions.</p> <p>Science: Earth and Space Science: Grade 4: Analyse impacts of weather conditions on living and non-living things. Measure weather in terms of temperature, precipitation, cloud cover, wind speed and direction.</p> <p>Mathematics (Statistics and Probability and Data Analysis) Grade 6: Create, label, and interpret line graphs to draw conclusions.</p> <p>Select, justify, and use appropriate methods of collecting data, including</p> <ul style="list-style-type: none"> - questionnaires - experiments - databases - electronic media. <p>Graph collected data and analyze the graph to solve problems</p>
2.4 (Your School's) Active Transportation Challenge	<ul style="list-style-type: none"> - Students will be encouraged to travel actively (walk, bike, or public transit) to school. - Students will understand health and environmental benefits of active transportation. 	4-6	<p>Life Science: Habitats and Communities. Grade 4: Determine how personal choices and actions have environmental consequences</p> <p>Health and Career Education/ Healthy Living Grades 4 and 6: Describe the benefits of attaining and maintaining a balanced, healthy lifestyle, including the benefits of - being physically active</p>

4.2.1 Particulates in the Air Experiment

(Adapted from "A Teacher's Guide to Clean Air – Grade 5 November 2005"

www.bcairquality.ca/reports/pdfs/clean%20air_guide_final.pdf).

Other versions of this experiment are included as appendices in this packages and can also be found at:

<http://www.juliantrubin.com/fairprojects/environment/airpollution.html>

<http://www.starteaching.com/AirPollutionExperiment.pdf>

Students will:

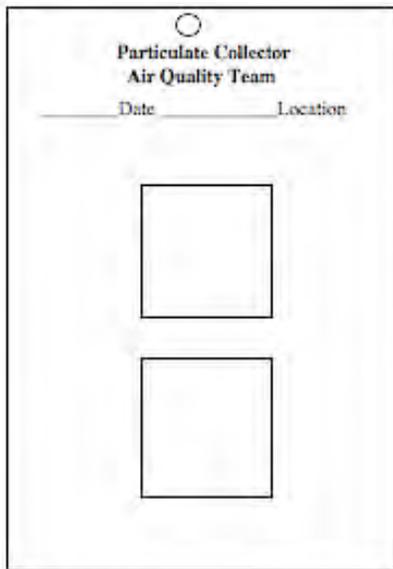
1. Hypothesize and make predictions on where they think visible air pollutants will vary around neighbourhood.
2. Conduct an experiment that illustrates how air quality varies depending on environment and human activities.

Materials Needed:

- Scissors
- Coffee filters
- 3" x 5" index cards
- Microscope or magnifying glass
- Clear Packing Tape
- 1 mm² Graph Paper

In Advance:

1. *Advance Preparation of Particulate Collectors: Before the activity, prepare particulate collectors by cutting two windows in index cards as shown below. Cover each window with clear sticky tape. Hang or tape cards in different locations around the room / school (e.g., near the window or door, in a quiet corner, on the teacher's desk), near the parking lot, in a tree, in the playground, etc. But ensure that they are undisturbed. Expose the collectors to the air for at least seven days. After a week collect the particulate collectors and cut pieces of 1 mm² graph paper and place them over the tape on the sticky side. Use a microscope or hand lens to view the particles collected. The 1 mm² graph paper can be used as a scale while viewing the particulates.



Template for Particulate Collector. Use two windows for particle collection as a method of repeatability (Copyright 2011 Science-As-Inquiry.org)

Note: Use this design as a template to make copies for your students.

Procedure:

1. Get students to decide on where to put particulate collectors and go out and place them in different areas. Consider numbering the particulate collectors, and writing down the location on a separate piece of paper so that students are unaware of where particulate collectors were placed when they are collected a week later.
2. Collect particulate collectors after one week. Rain may disrupt this
3. Divide class into groups and get students to examine particulate collectors and place graph paper on sticky side of tape to help count particulates. If you kept their locations a secret, ask students to guess from a list of where these particulate collectors were placed. Using a microscope or hand lens, students will determine:
 - The average number of particles per square mm
 - The types of particles (small, medium, large; colors; shapes)

Conclusions:

1. Are there differences depending on where the collectors were located? What hypotheses can you make to account for differences? If you wish, put out several new collectors to test your hypotheses.
2. What would you recommend to reduce particulates in these areas?

4.2.2 Car Exhaust Experiment

(Adapted from "What's Making it Brown Outside? Collecting and Measuring Particulate Matter" www.airinfo.org/pdf/CurriculaBrownWithGraphic.PDF)

NOTE: Rainy weather will interfere with the results of this experiment.

Students will:

1. Identify gaseous and solid pollutants in the atmosphere.
2. Observe an experiment that illustrates how to capture particulate pollutants and identify which vehicle gives off more particulates.
3. Conduct an experiment capturing particulate pollutants and determine which locations appear to have more pollution.

Materials Needed:

- Scissors
- Six coffee filters
- Six 3" x 5" index cards
- Microscope or magnifying glass
- Access to six motor vehicles
- Particulate Scale (provided)

Hypothesis:

Older vehicles, and those using diesel fuel, will produce more particulate matter emissions.

Procedure:

1. *Prior to performing this experiment*, find six people who are willing to be interviewed by students and have their automobiles tested (if possible, include a diesel school bus and an older leaded gas vehicle).
2. Divide the class into six groups. Cut the coffee filter into 2"x4" rectangular pieces. Have each group glue one piece of coffee filter to their index card.
3. Allow your students to see the six vehicles you are going to test. Ask them to guess which vehicles will produce the most and least particulate pollution and have them write down why they chose as they did.
4. Assign one vehicle to each student group.
5. Assign one student from each group to interview the vehicle's owner to determine how old the vehicle is, when it was last tuned, what type of fuel it uses, etc. Have another student write the car owner's name, vehicle year and make on the back of the card. When the interviews are complete, have owners start their cars. Have another student from each group hold the index card approximately 6 inches from the automobile exhaust pipe for one minutes.

CAUTION: Do not allow the students to touch the tailpipe and have everyone

avoid breathing the fumes. Do this experiment in a well-ventilated area.

6. After each group has tested their vehicle, bring the index cards back to the classroom and look at the cards under a microscope, or with a magnifying glass. Using the particulate scale (see below), have the students estimate the number of particulates per square inch on their card. Have the students write the approximate number of particles per square inch on their card.

7. Have one student from each group bring their card to the board and relay their findings to the class. As a class, display the cards from least amount to greatest amount of particulates.

Conclusion:

Based on your observations, do the results of the experiment support or reject your hypothesis? Why or why not?

1. Have the students discuss which cars gave off more particulate pollution; was it older cars, larger cars, diesel-fueled cars, cars that hadn't been tuned in a long time?

2. What conclusion do the students draw from this investigation?

3. Would it matter if the car is regularly tuned up?

4. What other car maintenance factors could influence its emissions?

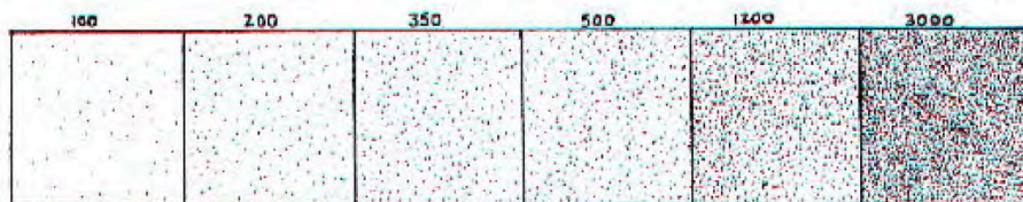
5. Have the students describe any relationship they see between the answers to the interview questions and the level of particulates on the scale.

6. Have the students graph the age of the automobile versus the number of particulates per square inch.

7. What other ways do vehicles contribute to particulate pollution?

8. Do you think the type of fuel used is also responsible for the amount of particulate emissions?

9. Would you expect solar-, electric-, or compressed natural gas-powered vehicles to have more or less emissions?



Particulate Scale

(source: www.airinfonow.org/pdf/CurriculaBrownWithGraphic.PDF)

4.2.3 Weather and Air Quality Project

Students Will:

1. Learn how to access and collect online weather and air quality data
2. Chart data every day as a group or within groups.
3. Make inferences / hypothesize on relationships between weather and air pollutants.
4. Graph specific variables (eg. wind speed and PM levels) to visually interpret and understand relationships.

Materials:

- Pencils, coloured pencils
- Graph Paper
- Large Chart Paper (for class chart of air quality and weather data)
- Computers and access to internet
 - <http://bcairquality.ca>
 - http://www.weatheroffice.gc.ca/city/pages/bc-79_metric_e.html
 - <http://www.airinonow.org/html/makingozone/o3play.htm>
 - <http://www.cleanairtrust.org/nitrogendioxide.html>.
- Rulers

Preparation:

Note: This project can be as complex or simple as you like, depending on your students level of understanding of air quality and data collection / analysis. Use your judgment to refine the activity to the appropriate level for your students by adding or limiting the number of variables you collect and how you decide to analyse the data collected.

1. Introduce students to the AQHI, the pollutants it measures (nitrogen dioxide (NO₂), ground-level ozone (O₃) and Particulate Matter (PM_{2.5} and PM₁₀) and health consequences of those pollutants. Use information in Section 1 and 2 of this report and the websites listed above to help introduce this information.

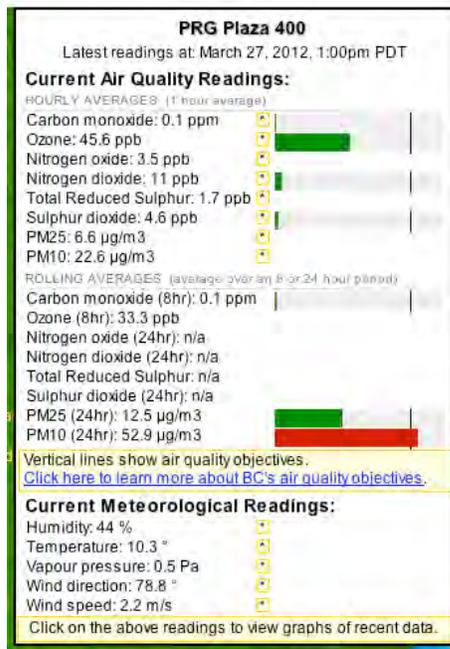
2. Create a class chart that the students will fill in throughout the week with data collected from <http://www.bcairquality.ca> and http://www.weatheroffice.gc.ca/city/pages/bc-79_metric_e.html. All information can be gathered from the bcairquality website except for cloud/sun information. The chart may look like the following:

Time and Date	Temperature	Conditions (sunny, cloudy...)	Wind Speed	Ozone	Nitrogen Dioxide	PM_{2.5}	PM₁₀	AQHI	Notes

Procedure:

1. Students can go to the BC Air Quality website at the same time every day and write down information from the “**Current Air Quality Readings**” and “**Current Meteorological Readings**”, and the Environment Canada weatheroffice website to collect information on the current condition (eg. partly cloudy) and the AQHI reading (AQHI can be found on both websites). Students will add this information to the class chart for the entire week.

BC Air Quality website Screen Shot:



Environment Canada Weatheroffice Website Screen Shot:



2. Once students have collected all the data, the teacher can ask if they have any hypotheses on the relationships between meteorological data and air quality data. Questions such as:

- How do you think the wind will affect pollutants in Prince George? (answer: wind disperses pollutants, so higher wind speeds, may mean better air quality)
- Does the sun help produce a specific pollutant? (answer: ozone)
- Does rain/precipitation affect some pollutants? (answer: when it's drier, it is dustier, so could see rise in PM, particularly, PM₁₀).

3. Introduce students to constructing a graph and how it helps to “see” relationships. The following website, may be helpful during this lesson. <http://www.easie-mmsa.org/docs/Data/DataGraphingLesson.pdf>

This website gives information on how to teach students to construct a graph using the “KLINT” approach to graphing.

K = key

L = labels

I = intervals and scale

N = neatness

T = title

4. You can get students to create graphs in groups, as a class or individually. Most graphs created will be line graphs of continuous (i.e. numeric) data (eg. wind speed vs PM, temperature vs. wind speed etc.), however, condition variables (cloudy, sunny, rainy, etc) are categorical, so a bar graph may be more appropriate when examining this variable against other numeric variables (eg. condition vs. ozone concentration).

5. Once students have graphed data, get them to revisit the questions you previously asked them and see if there are any trends from the graphed data and why those trends may be happening.

5. Websites and Resources with Air Quality Information, Activities and Games and Additional Lesson Plans

5.1. HSBC Active Transportation Challenge Program

Teachers can become part of the HSBC Clean Air Achievers Program

http://www.cleanairchampions.ca/programs/hsbc_clean_air_achievers/teachers.php

This is a larger, more complex version of the active transportation challenge activity described in section 4.2.4.

Learning Outcomes Linkage:

- **Grade 4:** Science /Life Science/Habitats and Communities. Determine how personal choices and actions have environmental consequences
- **Grade 4 and 6 -** Health and Career Education/ Healthy Living

Describe the benefits of attaining and maintaining a balanced, healthy lifestyle, including the benefits of - being physically active

5.2. EcoKids Website and Errand Run Game

http://www.ecokids.ca/pub/eco_info/topics/environmental/errandRun/index.cfm

- **Errand Run Game** – Allows students to make choices when running errands with regards to their modes of transportation and their route.

Learning Outcome Linkage:

- **Grade 4:** Science /Life Science/Habitats and Communities. Determine how personal choices and actions have environmental consequences

5.3 The BC Air Quality website

<http://www.bcairquality.ca>

- Includes the link to 'What is the Air Like Today?', which you can click, then click on the green parts of the province to see the actual monitoring stations and then click each monitoring stations to see what the air quality is like.

5.4 The National Pollutant Release Inventory

<http://www.ec.gc.ca/inrp-npri/default.asp?lang=en>

- This database collects all of the emission data that is submitted by industry and gives you a summary of their emissions for the year. You can actually download pollution data as a map layer and then look at it on Google Earth.

How could you use this?

- This would be a great resource for a computer class activity. You could ask students to look up the different sources of air pollution (or other pollution) in Prince George (there are lots)!

Learning Outcome Linkage:

- **Grade 5** – Science/Earth and Space Science/Renewable and Non-Renewable Resources
 - Describe potential environmental impacts of using BC's living and non-living resources

5.5 The Blue Sky Smoke Forecasting website

<http://www.bcairquality.ca/bluesky/>

- **This website** shows the smoke forecast on a map (in forest fire season). Students can go on this website and actually see where the smoke is in the Province and determine if and when it may affect our air quality (as it usually does).

How could you use this?

- This would also be a great resource for a computer class activity. Get students to examine this website and then relate it to the current AQHI and air quality readings of the monitoring stations.