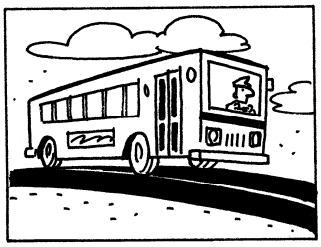
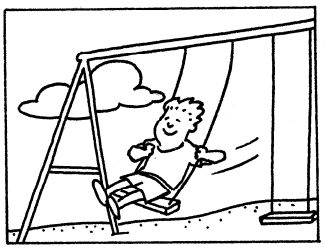




The Air We Share: a Teacher's Guide

In Partnership between:

Alberta Environment
Alberta Health and Wellness
Edmonton Public School Board, Energy and Environmental Management
Calgary Board of Education, Energy and Environmental Services
City of Edmonton, Office of the Environment
Alberta Capital Airshed Alliance
Calgary Region Airshed Zone
City of Calgary, Community Sustainability Team
Clean Calgary Association

Alberta Environment,
Education & Information Centre
Main Floor, 9820 - 106 Street
Edmonton, Alberta, T5K 2J6

Toll-free: Dial 310-0000 and the phone number (780) 427-2700
Fax: (780) 422-4086
E-mail: env.education@gov.ab.ca

Printed: October 2009

ISBN:

Introduction
The lessons contained in this guide are intended for Division II students and teachers, primarily grade six, though can be modified and used for grades four and five. The lessons are curriculum-connected for science and social studies and include a combination of inquiry-based, experiential activities. Student worksheets are provided for various activities, as are background information sheets for activities. There is a glossary of key terms and definitions in the back of the guide as well as a definition worksheet for students.

This guide is connected to the Idle-free schools program; it can be used as a resource to facilitate student's learning about air, air quality and air pollution, specifically the types of pollutants associated with vehicle emissions and actions we can take to improve our air quality.

Lessons in this guide can be used sequentially throughout the school year, or as needed or desired under the teacher's discretion. Using these lessons sequentially, however, will enable students to develop a more comprehensive understanding of air, air quality and air pollution. At the culmination of these lessons students will be able to tell the story of air and actions we can take to improve our air quality.

Key learning's that students should be able to identify include:

- → At least five air pollutants that may negatively effect the environment and human health
- → Describe how these pollutants may negatively effect the environment and human health
- → Three ways we can help improve our air quality (actions we can take)

It is suggested students keep their air information and learning's in an air duo tang.

Why is this important? Understanding our environment, such as air quality, is important for children because it can foster deeper connections to the natural world as well as shed light on how human actions can affect air, land, water and biodiversity. Children who develop a more comprehensive understanding of the environment and its varied processes, such as the fragility of air, can learn to make better lifestyle choices, for now and the future. The choices we make to help improve the world we live in are relatively easy to commit to. **One Simple Act**, an Alberta Environment initiative, has many tips and tricks for reducing our ecological footprint. Many lessons in this guide include action components that children and teachers can commit to. Visit One Simple Act at www.onesimpleact.ca, to learn more!

Curriculum Connections

Grade four to six Science and Social Studies Curriculum Connections for each lesson are listed below. Each lesson is intended to build upon another, though they can be used individually.

Science Program of Studies Curriculum Connections: Division II

Grade 4 Topic A: Waste and Our World Activity 1, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14	**2.** Identify and classify wastes that result from human activity. **7.** Identify kinds of wastes that may be toxic to people and to the environment. **11.** Identify actions that individuals and groups can minimize the production of wastes, etc.
Grade 5 Topic D: Weather Watch Activity 1, 2, 4, 11, 12, 14 Grade 5 Topic E: Wetlands Activity 1, 3, 4, 5, 6, 7, 8, 9, 12, 13, 14	**2.** Describe patterns of air movement, in indoor and outdoor environments, that result when one area is warm and another area is cool. **12.** Recognize that human actions can affect climate, and identify human actions that have been linked to the greenhouse effect. **9.** Identify human actions that can threaten the abundance or survival of living things in wetland ecosystems e.g. adding pollutants, etc. **10**. Identify individual or group actions that can be taken to preserve and enhance wetland habitats **11.** Recognize that changes in part of an environment have effects on the whole environment.
Grade 6 Topic A: Air and Aerodynamics Activity 1, 2, 12, 14 Grade 6 Topic D: Evidence and Investigation Activity 3, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14 Grade 6 Topic E: Trees and Forests Activity 1, 4, 14	**1.** Provide evidence that air takes up space and exerts pressure, and identify examples of thee properties in everyday applications. **8.** Recognize that air is composed of different gases, and identify evidence for different gases. **1.** Recognize evidence of recent human activity… **3.** Recognize evidence found at the scene of an activity may have unique characteristics that allow an investigator to make inferences about the participants and nature of activity. **1.** Identify reasons why trees and forests are valued. Students will become aware forests are…important for life-supporting environment. **3.** Describe the role of trees in nutrient cycles and in the production of oxygen.

Social Studies Program of Studies Curriculum Connections: Division II

Grade 4 Alberta: A Sense of the Land Activity 4, 10, 11, 13, 14	**4.1.1** value Alberta's physical geography and natural environment (outcomes 3 and 6). **4.1.4** analyze how Albertans interact with their environment by exploring and reflecting on the following questions and issues (outcomes 3).
Grade 5: Physical Geography of Canada Activity 4, 11, 12, 13, 14	**5.1.1** value Canada's physical geography and natural environment (outcome 1 and 6). **5.1.3** analyze how people in Canada interact with the environment by exploring and reflecting on the following questions and issues (outcomes 2).
Grade 6: Local Government Activity 4, 10, 12, 13, 14	**An individual has the responsibility and rights as a citizen, which begins at the local level:** - Difference between needs met by families and by government - Difference in needs met by local, provincial and federal governments - Political decisions form the basis of by-law and laws - How individuals can contribute to and participate in local government by voting, attending meetings, initiating/supporting petitions - Democracy allows and needs people to take part in government - Differences betweens rights and responsibilities of citizens. **Students will:** - Locate/organize/interpret information - Analyze/synthesize/evaluate information - Develop communication skills - Develop participation skills

Table of Contents

Activity 1: Why is Air Important?

Objective: students will identify the components of air, how and why it is vital to life, and how plants provide life-support through producing oxygen and removing carbon dioxide from the air. Students will also develop an understanding of what air pollution is, where it can come from, and how it can affect the environment and potentially humans.

Curriculum Connection: Science 4.2A, 5.2D, 5.11E, 6.8A, 6.1E, 6.2E

Time: 2 classes, depending on research time required; can extend if required.

Materials: chart paper, markers, chalk board, chalk (teacher), paper and pencils (students), computer time, map of your community (Google maps or draw one) large enough to show at the front of the class.

Procedure:

1. Ask students if they know what *air* is? Solicit answers from students.
2. Now describe what air is (mixture of gases that make up our atmosphere, allow us to survive by breathing oxygen, etc. See "**The Big Picture**" for more info at the end of this activity).
3. Have students brainstorm individually for ~2 minutes about the components of air, what air does for humans, animals, and plants.
4. As a class, make a mind map of the components and the functions of air, such as supporting life, and other ideas the students brainstormed.
5. Next, ask students if they can explain what air pollution is, provide examples of air pollution, and sources of air pollution. Have students brainstorm individually for ~2 minutes and then solicit for answers.

6. Make a mind map of air pollutants and air pollution sources (e.g. “smoke stacks,” cars, exhaust, etc). Connect the components and functions if air mind map to the air pollution mind map. Ask students what they think the connections are.
7. Next, tell students they will map out sources of air pollution in their community. This can be done in groups of two or individually.
8. During this class period, or in the next class, have students make a map of their community and the surrounding buildings, activities, etc. in the area. You can use Google maps, or Google Earth, to print out a map of your community. Either have students use this printed map to make their own (art and geography curricular connection) or have students use the printed map.
9. Provide some example of air pollution sources on the map, such as a factory or transportation route (e.g. highway), to get students started. Then have students identify other sources of air pollution on their maps. have students make a chart with the below headings:

Signs of Air Pollution	**Location and Sources in My Community**	**Possible Effects of Air Pollution**

10. Students can refer to the internet in their search to identify air pollution sources. Some possible types of air pollution they may want to research for sources are: nitrogen oxides, ozone, particulate matter, sulphur dioxide or benzene. You can also have students refer to the background information sheets provided. These air pollutants are the primary pollutants that come from vehicle exhaust, among other sources.

The Big Picture:

Air is a mixture of gases that make up the atmosphere surrounding Earth. Air does not have a color or taste, and contains approximately 78% nitrogen, 21% oxygen and small quantities of other gases such as carbon dioxide, ozone, hydrogen, and other gases. Water is also in the air. The air is largely odorless as well, but human-created and animal-created wastes can contribute to the air having a “smell.” For example, industrial and transportation activities can create air pollution, in the form of exhaust which is the emissions from fuels being burned in a combustion engine.

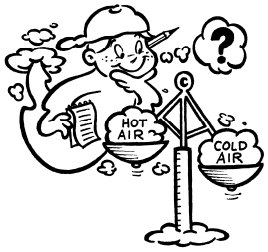
Smog is another form of air pollution, which contains smoke and gases also produced by burning fuels. Air pollution is any visible or invisible particle or gas that is not naturally in air. However, there are natural sources of air pollution, from forest fires, volcanic eruptions, etc. These natural sources are generally not a long-term harm to the environment, in comparison to the impact that human-created pollutants can have on the environment and potentially human health. Often, human-created air pollutants come from burning fossil fuels; in our cars, homes, schools, businesses, factories and so on. There are a few air pollutants created by humans that are a large concern; they are particulate matter, nitrogen oxides, sulphur dioxide, benzene and ozone.

Air, particularly clean air, is important because it allows us to breathe and live on Earth. Air is equally important for plants and animals. We can improve our air quality by reducing the amount of pollutants that are emitted into the air. We can do this by driving less or abiding by regulations on industrial emissions. We can also improve the energy efficiency of our vehicles, homes, industry, commercial buildings, etc., to use less fuel and use fuel more efficiently. We can also use alternative energies, such as solar, wind or water to create electricity, and we can use other forms of transit, such as car pooling, public transportation, walking or riding a bicycle.

How does knowing about air pollution sources in your community affect you? How could you reduce the amount or type of air pollution affecting your community? Is there anything you can do, or your parents/guardians? What kind of effects do you think air pollution has on your communities green spaces, such as parks, or on other ecosystems?

For more information:

www.ec.gc.ca/default.asp?lang=En&n=F3622FE4-1



Activity 2: Calculating the Volume of Air

Objective: Students will develop an understanding of how air takes up space, both indoors and outdoors. Students will also identify how air moves (patterns) and that it is composed of various gases.

Curriculum Connection: Science 5.2D, 6.1A, 6.8A (also Math connections)

Time: 35-45 minutes

Materials: stopwatch, measuring tape, rulers, pencils and paper, calculators, 2L pop bottle (empty), worksheet provided.

Procedure:

1. Ask students if they think air takes up space. Ask how they know, or don't know, if air takes up space? Write their answers on the board.
2. Explain that air, even though we can't see it, is all around us taking up space. Air has volume, just like water or other liquids. See "**The Big Picture**" at the end of this activity for more information.
3. Next, ask students if they think the air in their lungs is taking up space. Solicit for answers.
4. Next, ask students how many times they breathe a day. Have them guess. Afterwards, ask students to partner up. Have one partner use a stopwatch to time the "breathing partner. Start the stopwatch when the "breathing" student says go (or the teacher).

5. Have the “breathing” partner breathe normally and while doing so, count the number of breaths in and out she or he takes, in one minute. ON the board, demonstrate the following equation:

Your # of breaths in one minute multiplied by 1440 minutes (24 hours) will give you the average number of times you breathe in one day, IF you do not do any stressful activity (like gym – the number of breaths per day would increase!).

Have students complete their own equations. They may need calculators. Have students record their data on the worksheet provided in this lesson.

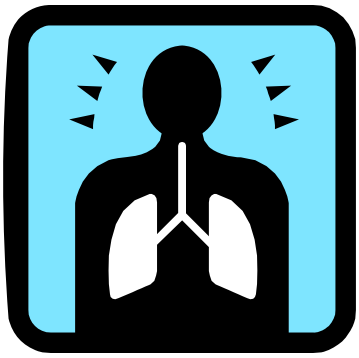
6. Next, ask students again if they think their lungs have volume, that is, if air in their lungs takes up space? Solicit for answers and then explain that your lungs do have volume (breathe in and hold to demonstrate – your chest will be puffed out). Explain that scientists use special equipment to measure the volume of our lungs, and that the volume of our lungs is approximately 0.5 liters, on average. Use the empty 2L pop bottle to demonstrate how much that is.
7. Explain to students that we had to determine the volume of air our lungs can hold because we will now discover in liters how much air our lungs can hold every minute.
8. Demonstrate the following equation: multiply your number of breaths (worksheet answer #1) by 0.5 L for L/minute of air in your lungs. Have students complete this equation. Calculators may be necessary.
9. Next, demonstrate the following: multiply the total L/minute of air in your lungs (worksheet answer #2) by 1440 minutes (24 hours), to discover how much air enters and leaves our lungs throughout one day (with no strenuous activity) (worksheet answer #3). Have students do the same.
10. Have each student tell you, and you record on the board, their answers for their own (personal) number of breaths in one day (worksheet answer #3). Average this number for the class’s average number of breaths in one day (total number of breaths added together and then divided by the total

number of students) (worksheet answer #4). You can choose to include yourself or not in this question.

11. Now that we know our lungs have volume, and that we can only take in a certain amount of air per each breath, in each day, ask students if they think the air inside the classroom has a volume. Solicit for answer based on what they have learned about their lungs.
12. Next, ask students to estimate the volume of air in the classroom. Solicit for answers. Explain we will measure the length, width, and height of the classroom to discover the volume of air inside the classroom.
13. In groups of four, have students measure the classroom's dimensions and record findings on their worksheet (worksheet answer #6). Next, determine the volume of air in the class by multiplying length X width X height (worksheet answer #7).
14. Next, ask students to multiply the class's average number of breaths in one day by the volume of air in the classroom. This is the amount of air the class uses each day – this is the amount of air required to support life in this classroom! Think of how much air we need for all things that breathe!
15. Discuss with students if they think that the quality of our air, and things such as air pollution, may have an effect on our lungs or health. How and why? Ask students if they think the quality of our air may have an effect on the environment. How and why? Ask them what they can do to help keep our air clean so that our lungs have the best quality of air to breath in each day. Brainstorm ideas. You can use Activity 1 to help discover what we can do to reduce air pollution.

The Big Picture: Ask students if they knew that air takes up space before this lesson. Ask them to take a deep breath in and hold it. Observe how their chest is all puffed up – that's space! Ask students how the space air takes up affects their lives. What if they stopped breathing in as much air as they normally do (refer to their worksheet to determine how much air they need each day),

because the quality was lessened by, for example, pollutants? How does air movement affect the location of pollutants in certain areas? Would the space that air takes up in lower regions be different than in higher elevations, such as grasslands compared to mountains? How would or could this effect the functioning of our lungs? Or how would or could this affect other animals, or the environment as a whole?



Measuring the Volume of Air – Worksheet

1. Measure how many breathes you take in one minute. Have your partner time you using a stopwatch. Count the number of breaths in and out for one minute and record below.

Number of breaths in one minute = _____

2. Multiply the number of breaths in one minute by 1440 minutes (24 hours) to determine how many breaths you take in one day, without doing any difficult physical activity. Record below.

Number of breaths _____ X 1440 minutes = _____ breaths in a day

3. Volume, called tidal volume of our lungs is approximately 0.5 liters (L). Using the answer from question #1, the number of breaths you take per minute, determine the volume of air you breathe in per minute.

Number of breaths/min _____ X 0.5 L (Volume of lungs) = _____ L/minute

4. Multiply the total L/minute of air in your lungs for every breath in a one minute period by 1440 minutes; this is a 24 hour period. You will discover how much air, in liters, would be in your lungs on an average day, without difficult physical activity.

L/minute	X 1440 minutes (24 hours) =	L/day (24 hours)

5. Total number of breaths for the class in one day. _____
6. Determine the volume of air inside your classroom. Using the measuring tape, measure the length, width and height of the classroom. Record below.

Length=	m	Width =	m	Height =	M

7. Multiply the length X width X height to discover the volume, in meters squared (m^3) of your classroom. This is the approximate volume of air contained inside your classroom, if the doors and windows are closed.

Length	X Width	X Height	=	m^3 air

8. Multiply the number of students in the class by the average L/day of air breathed in for your students (take an approximation from all students). This is how much air is required in the closed classroom to support life.

Class average L/day breathed	X	m^3 air in the class =

Activity 3: What is Air Quality?

Objective: Students will be able to identify and describe what air quality is and why it is important for environmental and potentially human health. Students will also recognize that changes in air quality can effect the environment and potentially our health.

Curriculum Connection: Science 5.11E, 6.3D

Time: 20-30 minutes

Materials: dictionary, internet, pencils, paper

Procedure:

1. Ask students if they know what Air Quality is, and solicit responses. Write their ideas on the board.
2. Have students look to a dictionary (online or text) to help them define air quality. Write this definition on the board. Have students use their ideas and the formal definition to devise their own understanding of air quality and write this out on the board. Have students write their definition of air quality on their worksheet provided.
3. Next, ask students what they think might affect the quality of our air. Learning's from Activity 1 and 2 may help. Write their thoughts on the board in an air quality mind map, or as a word wall.
4. Explain to students, using their ideas on the board, that air pollutants are both human-created and natural. Have students define these as a class and write on their worksheet.

5. Next ask students where and how they think the products to make air pollutants come from. If they are natural, what is a natural raw material to make an air pollutant (e.g. trees = wood = forest fires = smoke). Have students use a dictionary to define raw materials, pollutant and goods and services and record on their worksheet. Discuss these concepts so that students develop an understanding of them. You may want to make mind maps of each on chart paper or the board and have students copy this for later referral.
6. As a class, have students discuss the Goods and Services we “do” daily, such as taking a bus, etc. Ask them to explain to you how this is a Goods and Services. Using their knowledge of Goods and Services, and pollutants, have students work together to fill in the blanks on their worksheets. Repeat this step for Raw Materials required to “power” these Goods and Services, as well as Pollutants that might come from the Goods and Services and/or Raw Materials (e.g. nitrogen oxides, etc). Discuss their ideas as a class.
7. After the chart has been filled, ask students what effects Goods and Services, Raw Materials and Pollutants might have on the environment and potentially on human health. Brainstorm some ideas on the board and then ask students to work together to fill in the remainder of their chart.

The Big Picture: Air quality describes the level of air pollutants in a certain area. Air pollutants can become dangerous if people are sensitive to elevated levels of pollutants or are exposed to them for extended periods. Alberta Environment scientists assess air quality by collecting and analyzing samples taken from near ground level. Pollutant levels are affected by such factors as emissions sources, weather conditions and topography. Alberta Environment reports on the current air quality throughout the province, based on data from over 40 monitoring stations. How does air quality affect your life? Effect the environment? What do we do in our everyday lives that might affect air quality? What can we do to help

improve air quality? How does this lesson relate to other learning's in their education resource, about air?

For more information: www.telusgeomatics.com/tgpub/ag_air/default.asp

What is Air Quality – worksheet

1. Define Air Quality:

2. What can Affect Air Quality? List as many things as you can.

3. Define as a class or using a Dictionary:

Raw materials:

Goods and Services:

_____

_____

Air Pollutants/Pollution:

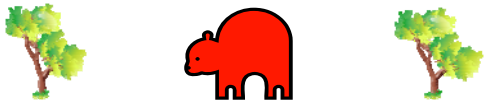
_____

_____

4. In the chart below, discuss in groups or as a class the Goods and Services we need or activities we "do" daily, the raw Materials required for these Goods and Services and the potential air pollutants associated with them.

Goods and Services	**Raw Materials**	**Possible Air Pollutants**

5. List and discuss as a class the possible effects that air pollutants may have on the environment. How might air pollutants affect your health? List and discuss possible answers. You may need to use the internet to search for answers.



Activity 4: What is Climate Change?

Objective: students will be able to identify what carbon dioxide is, possible sources of carbon dioxide emissions, what climate change is, possible effects of climate change, and actions we can take to reduce the effects and mitigate climate change.

Curriculum Connection: Science 4.2, 4.7, 4.11, 5.12D, 5.11E, 6.1D, 6.1E, Social Studies 4.1.4, 5.1.3, 6 as seen fit.

Time: 2 classes, extra time as needed.

Materials:

Procedure:

1. Ask students if they know what carbon is? Have they heard of this word before? Where? Have them explain carbon to you and the class. Then explain the scientific definition for carbon using a dictionary.
2. Ask students to describe a carbon example, such as their pencil, etc (anything that contains carbon can be a carbon example). Discus why the pencil, or anything that contains carbon can be considered a carbon example. Use fossil fuels as an example of carbon.
3. Ask students where fossil fuels come from and if they are renewable or nonrenewable resources. You may need to define or review renewable and nonrenewable resources, then provide examples or ask the students for examples.
4. Next ask students if they know what carbon dioxide is? Where does it come from? To demonstrate, have them take a deep breath in and then emphatically blow it out. What did we just breathe out? Carbon dioxide! Where else might we find carbon dioxide – think of the fossil fuels example we just discussed. Define carbon dioxide using a dictionary and

have students develop a definition they best understand, using the formal definition and their ideas; write this definition on their worksheet.

5. Ask students if they know the difference between weather and climate. Write the two headings on the board and write down their ideas. Have a student use a dictionary to formally define weather and climate and using the student's ideas and the formal definition; write the class definition for weather and climate. It is important to differentiate between weather and climate/climate change as they are not the same thing!
6. Next, ask students if they know how what climate change is; write their ideas on the board. Using the definition for climate, and the background information sheets, and other sources such as Alberta Environment's webpage on climate change, develop a formal definition for climate change and write it on the worksheets.
7. Ask students if they can determine how carbon dioxide is connected to climate change. What is the link? Think of fossil fuels – where they come from, how they are used and what they produce (e.g. vehicle emissions contain carbon dioxide, among other pollutants). Information to explain climate change to students can be found on the background information sheets, as well as below this lesson.
8. Ask students if they can now explain what some sources of carbon emissions are (e.g. vehicles, industrial smoke stacks, forest fires, even human respiration – breathing - etc). You may need to use the internet or other sources, to encourage students to find out what some sources of carbon dioxide or carbon emissions are and have them write their findings on their worksheet.
9. Ask students if they can explain how increased levels of carbon emissions might affect our climate, and how in turn a changing climate change might affect the environment as well as human lives (e.g. the way we live, the resources we have available to us, our health and safety, etc). Use the internet to search for possible changes to the environment and write down some impacts of climate change.

Good sites to look at are:

Alberta Environment www.environment.alberta.ca/3293.html

Environment Canada www.ec.gc.ca/cc/default.asp?lang=En&n=3D00CF9C-1

Ask students, using their new-found knowledge of carbon emissions and climate change, to identify actions that humankind can take to help reduce our emissions and help improve, preserve, or conserve our environment. As a class, go through the student's examples and write them on the board and their worksheets. Try visiting One Simple Act's website for ideas on actions: www.onesimpleact.alberta.ca/

10. Next, ask students if they think, as young children, they have an effect on climate change. Ask them to explain their answers, probing for the why's or why not's, depending on their answers. Then brainstorm actions students themselves can take to help reduce their carbon emissions. Get them to think about all the activities they take part in (e.g. riding a bus, using electricity, etc) and what may or may not use energy (they will find that most activities use energy!). Write their ideas on the board and have them copy some down on their worksheet.
11. Explain that the action ideas from students will now be used to make a banner or poster to educate other people in the school and even at home about *Actions Against Climate Change*. You may need another class period or two to develop the banner/poster. Criteria should include:
    - → A definition of climate change, including the difference between weather and climate.
    - → Definition of carbon emissions and why/how they can affect our climate and environment.
    - → Actions we can take to reduce our energy consumption, conserve our resources to help combat climate change

You can revisit the One Simple Act website to have your students commit to taking action to reduce energy consumption and have an effect on climate change and air quality! Click on the title "Make your action count" to visit the

survey to fill out the commitment forms. You can also use the printed copies of the One Simple Act Commitment form, sign the forms, and post them in the school on a brag board!

12. When finished display the banner/posters in the school. You could also have an information session with other classes/students to explain what you have learned about climate change!

Extensions:

1. Develop an action plan for your school on reducing the effects of climate change. Think of actions students, teachers, administration and volunteers can take, and suggest they sign the One Simple Act commitment forms. Write down the action plan and post it in the school. Actions can include waste-free lunches and snacks, composting and recycling initiatives, school and home energy audits, committing to walking, riding bikes, rollerblading etc.
2. Refer to the One Simple Act School toolkit for more lessons and activities on how to reduce your waste and conserve energy and water.

The Big Picture: Climate change is a wide-scale change in average weather over a time period of at least 30 years. Climate change can be caused by a number of factors, such as changes in the Earth's orbit, volcanic eruptions, or changes in energy from the sun.

Greenhouse gases have an important effect on Earth's temperature. They trap heat in the atmosphere and cause global temperatures to rise. This is called "the greenhouse effect." Greenhouse gases (GHGs) include:

- Carbon dioxide / Methane / Nitrous oxide / Water vapour / Perfluorocarbons (PFCs) / Sulphurhexafluoride (SF_6) / Hydrofluorocarbons

The first four gases occur naturally in our environment and make up less than one per cent of the Earth's atmosphere. Naturally occurring GHGs are essential

for our survival; they act like a blanket around Earth, trapping heat in the lower layer of our atmosphere and prevent most heat from escaping.

The issue is that humans have substantially increased the amount of naturally occurring GHGs by burning fossil fuels, including coal, oil and natural gas. Scientists now agree that human activity is most likely responsible for most temperature increases over the past 250 years. The biggest concern is the *speed* at which these changes are happening.

Carbon dioxide is the main concern. Information shows that atmospheric levels of carbon dioxide are increasing by more than 10 per cent every 20 years. If emissions continue to grow at current rates, the level of atmospheric carbon dioxide will almost double during the 21st century; it's possible it could even triple.

However, we *can* mitigate and reduce the effects of climate change. By protecting, conserving, and enhancing our wetlands, forests, and other natural spaces, we help preserve carbon sinks. We can also *reduce* our energy consumption, and commit to actions that help *conserve* our natural resources.

Information from Alberta Environment's Climate Change WebPages, available at: www.environment.alberta.ca/3294.html

How might climate change affect our lives? How is climate change related to air quality? What things might we do that affects the rate at which the climate is changing, and may also contribute to air quality issues? How does this activity relate to other air lessons in this resource? How does your climate change action plan affect your life, or others? What actions do we need to take to reduce the effects of climate change, which might also help improve air quality? How can you encourage others to take action on climate change and air quality issues?

The Air We Share

Background Information

What is Climate Change?

Climate change is a wide-scale change in average weather over a period of time, for at least 30 years. Climate change can naturally occur due to a number of factors, such as changes in the Earth's orbit, volcanic eruptions, or changes in energy from the sun.

What are Greenhouse Gases?

Greenhouse gases can include:

Carbon dioxide / Methane / Nitrous oxide / Water vapour / Perfluorocarbons (PFCs)

Sulphurhexafluoride (SF_6) / Hydrofluorocarbons

Greenhouse gases (GHGs) have an important effect on Earth's temperature. They trap heat in the atmosphere and cause global temperatures to rise. This is called "the greenhouse effect." The first four gases above occur naturally and make up less than one per cent of the Earth's atmosphere. Naturally occurring GHGs are essential for survival; they act like a blanket around Earth, trapping heat in the lower layer of our atmosphere and preventing most heat from escaping. The issue is that humans have increased the amount of naturally occurring GHGs by burning fossil fuels, including coal, oil and natural gas. Scientists now agree human activity is most likely responsible for most temperature increases over the past 250 years. The biggest concern is the *speed* at which these changes are happening.

Carbon Dioxide

Carbon dioxide is a chemical compound composed of two oxygen atoms and a single carbon atom. It is a gas that exists in Earth's atmosphere. Carbon dioxide is the main concern in climate change. Atmospheric levels of carbon dioxide are increasing by more than 10 per cent every 20 years. If our emissions continue to grow at current rates, the level of atmospheric carbon dioxide will almost double during the 21st century; it is possible it could even triple!

Alberta's Climate Change Strategy

As a global energy producer, Alberta's challenges are perhaps bigger than those of other jurisdictions, but so too are the opportunities to find real and positive solutions to climate change. Alberta's C*limate Change Strategy* addresses not only how much energy we use,

but also how we can combine technology and expertise to capture emissions and produce cleaner energy for Alberta and the world. The strategy is divided into three areas of focus:

- Conserving and Using Energy Efficiently, ranging from in the home to businesses, institutions and government.
- Implementing Carbon Capture and Storage, a technology to store carbon emissions deep underground, in Earth's geological formations.
- Greening Energy Production, by expanding our use of alternative energy sources such as wind and solar, water and geothermal energy.

There are also many other important initiatives working to reduce carbon emissions, such as the City of Edmonton's CO2RE program, the City of Calgary's Climate Change Action Plan, and Climate Change Central's energy efficiency rebates program, in partnership with the Government of Alberta.

Adapting to Climate Change

Scientists agree climate change caused by human actions will continue for centuries to come. Strategies to adapt to climate change must go hand-in-hand with actions to reduce current and future greenhouse gas emissions. It is important to understand that we *can* mitigate the effects of climate change by protecting, conserving, and enhancing our wetlands, forests, and other natural spaces. These spaces act as carbon sinks, which store carbon dioxide. We can also *reduce* our energy consumption, and commit to actions that help *conserve* our natural resources. This will impact how much carbon dioxide is emitted into the atmosphere.

Reducing Our Footprint

"Footprint" refers to the impacts our actions have on the Earth. Everything we do has an effect on the natural resources in our province – the goods we buy, the energy and water we use, and the waste we throw away. What is important is how we manage and reduce these effects by choosing to make small changes. By reducing our energy consumption, as well as conserving our natural resources, we can make big changes for future generations! Committing to *One Simple Act* is one way to help reduce our footprint; through this program we can reduce waste, conserve water and reduce energy consumption!

For More Information:www.environment.alberta.ca/3293.html or www.onesimpleact.alberta.ca/
www.climatechangecentral.com/
www.co2re.ca/www.content.calgary.ca/CCA/City+Hall/Business+Units/Environmental+Management/Climate+Change/Climate+Change.htm

What is Climate Change - Worksheet

1. Define Carbon:

_____

_____

2. Define Carbon Dioxide, given a few examples of where it comes from and include an illustration of the molecule:

_____

_____

_____

_____

3. Define Weather:

_____

_____

4. Define Climate:

_____

_____

5. Define Climate Change:

_____

_____

_____

6. Where do carbon emissions come from? Example: vehicle exhaust. List them.

_____

_____

_____

7. What actions do we take that increase carbon emissions in the atmosphere and contribute to climate change effects? List them.

_____

_____

_____

_____

_____

8. What are the impacts on the environment and possibly on humans as a result of climate change?

_____

_____

_____

_____

9. What are some actions we can take to reduce carbon emissions? Example: walking.

_____

_____

_____

_____

_____

10. Write down ideas for your classroom's action plan on climate change. Develop a poster or banner showing how this action plan affects climate change.

_____

_____

_____

_____

_____

_____

_____

Activity 5: What is Particulate Matter?

Objective: Students will be able to identify and describe what particulate matter is and how it effects the environment and potentially human health. Students will also identify sources of particulate matter and what we can do to reduce emissions.

Curriculum Connection: Science 4.2A, 4.7A, 4.11A, 5.9E, 5.10E, 5.11E, 6.1D

Time: 30 minutes to five days (for activity). It is preferable to begin this on a Monday and end on a Friday.

Materials: two index cards for each group of two students, markers, Vaseline (petroleum jelly), cotton swabs, magnifying glass, tracking data sheet, 3-5 days with no rain (rain will damage index cards), windows, tape.

Procedure:

1. Ask the students if they think there are particles, tiny little pieces of matter, in the air around them, both indoors and outside. Use the Particulate Matter background information sheet to assist with this lesson (can read aloud, read as a class, or pull out key ideas for students). Ask: where do they come from? How might they affect the air I breathe in, and how might these affect me? What about effects on the environment, such as water, soils, plants and animals?
2. Using the ideas generated in the discussion, try to define particulate matter as a class; write on the board. Use the background information sheet to formally define particulate matter and develop a definition the class agrees upon. Write this on their worksheets.

3. Explain to students they will be doing a particulate matter experiment, both indoors and outdoors, to discover what is in our air, that we might be able to see, and what we might be breathing in. You will need students in groups of two.
4. For each group of two students, hand out two index cards each. Have them label the index cards as (1) Outside and (2) Inside on the front, and their names on the back.
5. Using the cotton swabs, have students smear a relatively thick layer of Vaseline on each of the index cards, in the center, in an approximately one inch thick square. Do not touch the Vaseline.
6. Have the students place their Inside index card in the classroom on the window with tape, with the Vaseline facing away from the window. Be very careful NOT to touch the Vaseline. Ensure students remember where they placed their cards.
7. Head outdoors and tape the Outside index cards on the windows outside, with the Vaseline facing away from the window. If it is a very windy area, try to place in an area with less wind if possible. Ensure students remember where they placed their Outside cards.
8. Using the Data Observation Sheets, have students record the appearance of the Vaseline/index card on Day One. Repeat for each day, at the same time if possible.
9. At the end of the week take down the index cards and compare the Inside and Outside cards for each group. Fill in the Data Observation Sheet.
10. Discuss findings as a class. How does the air inside and outside compare? Were some cards different than others? Would their location on the windows make a difference to what their Vaseline collects? What does this tell you about air quality? What does this tell you about particulate matter (e.g.) what does it look like, where can it be found, why is it important to be aware of, etc?
11. Explain the difference between the size of particles on the index cards (they will likely be larger than $PM_{2.5}$) and the ones that can potentially be

harmful if they are breathed in ($PM_{2.5}$), such as those found in vehicle exhaust, among other sources. Explain that the tiny particulate matter that we can not see can potentially be harmful to our health as well as the environment. Ask what we can do about this? What actions can we take to reduce the amount of particulate matter in the air around us?

12. Explain that this experiment is similar to how an air monitoring station collects data on the quality of our air. Explain that we have airsheds in Alberta, and that airsheds collect information on air quality, analyze that information for what it tells us, and explains to the government and the public what our air quality is like. Ask students if they think collecting data, analyzing data and reporting on data is important? What does it tell us? What can we do with that information?

The Big Picture: How can particulate matter affect our life? How can it affect plants and animals, or the environment as a whole? How or why is particulate matter related to air quality? Where does particulate matter come from (sources)? What can we do to help reduce the amount of particulate matter in our air? How can you encourage others to take action to reduce particulate matter emissions into our environment?

Particulate Matter diagram below. You can copy this for your students or post in the classroom!

PM2.5 is fine particulate matter less than 2.5 micrometres in diameter (in comparison, a human hair is about 70 micrometres in diameter).

- Fine particles are small enough to penetrate the lungs and can be a human health concern, depending on their composition

Human hair (70 micrometres)

•

Fine PM (2.5 micrometres)

The Air We Share

Background Information

What is Particulate Matter (PM)?

Particulate matter (PM) is tiny solid or liquid particles that are suspended, or floating, in the air. PM can include fumes, smoke, dust, ash, aerosols and pollen from both natural and human sources. Fine particulate matter can be emitted by any form of combustion, which is the burning of fuels. This can include burning gasoline or diesel fuel in vehicle engines, burning fuels or products in industry and burning wood. It can also be formed through chemical reaction of gases in the atmosphere.

What is $PM_{2.5}$?

$PM_{2.5}$ is fine particulate matter that has a width (or diameter) less than 2.5 micrometers – this means $PM_{2.5}$ is about 30 times smaller than the width of human hair! These fine particles are small enough to breathe into the lungs, which can potentially be a human health concern. People who have asthma, lung or cardiovascular issues may be the most sensitive to $PM_{2.5}$. Both short-term and longer-term exposure to $PM_{2.5}$ can potentially cause adverse health effects.

What about the Environment?

Particulate matter can be detrimental to the environment. These tiny particles can be carried by wind and settle in soil or water, where they can increase acidity in water bodies, decrease nutrient levels in soil, or contribute to damaging plant life. Particulate matter can also form haze and reduce long range visibility.

What actions are being taken in Canada and Alberta?

In June 2000, the Canadian Council of Ministers of the Environment established Canada-Wide Standards for particulate matter and ozone. These standards are important steps towards minimizing the potential risks these pollutants can cause to the environment and human health. These standards commit government to significantly reducing ground-level ozone and particulate matter by 2010. Individual actions, such as reducing idling time, are a way we can help achieve this goal.

Alberta Environment has taken the right step by managing ozone in the province before a critical level is reached. Alberta Environment does various monitoring and reporting activities and has developed a Framework to manage particulate matter in the province.

For More Information:www.environment.alberta.ca/1970.html
www.environment.alberta.ca/documents/Particulate_Matter_and_Ozone_Fact_Sheet.pdf

What's all that itty bitty stuff? Particulate Matter!

Day One	**Inside**	**Outside**
Day Two	**Inside**	**Outside**
Day Three	**Inside**	**Outside**
Day Four	**Inside**	**Outside**
Day Five	**Inside**	**Outside**

1. Define Particulate Matter:_____

_____

_____

_____

2. In the chart above describe the appearance of the Inside and Outside Index Cards each day. Are there little or tiny particles on the cards? What do they look like? Did the color change? Does it have a smell?

3. At the end of the week, can you explain what this experiment might tell you about particles in our air, both inside and outside?

_____

_____

_____

_____

_____

4. Using the internet, explore sources of Particulate Matter (PM), specifically $PM_{2.5}$. Where does it come from? What does it do?

_____

_____

_____

_____

_____

Activity 6: What is Smog?

Objective: Students will be able to identify and describe what smog is and how it effects the environment and potentially human health. Students will also identify sources of smog, how it is made and what we can do to reduce emissions.

Curriculum Connection: Science 4.2A, 4.7A, 5.5.9E, 5.10E, 5.11E, 6.1D

Time: 30 minutes

Materials: wide-mouth mason jar per each group of three students, matches, two or three ice cubes, ruler, scissors, stop-watch, one piece of 6X2 inch scrap paper, observation sheet, pencils, aluminum foil, water

Procedure: This can be a DEMO or an experiment, depending on the class.

1. Ask the students if they have heard of the term “smog” before. Define as a class (refer to the Smog background information sheet) and fill in the Observation sheet. You can also provide the class with an image of smog, searched from an internet site.
2. Identify sources of smog – how it is created, what its components are, effects on the environment and potentially on human health. Refer to the background information sheet and/or the internet. Fill out on the Observation Sheet.
3. Explain to students they will complete an experiment where they will make some artificial smog – however, explain that this smog is different than what is typically outdoors.
4. Groups of three will each receive:
    - a mason jar
    - one strip of 6 X 2 inch paper – students must measure and cut their own strip

- pencil
- Observation Sheet
- a piece of aluminum foil - enough to make a lid on the jar
- a splash of cold water to wet the inside of the jar
- a couple matches -BE CAREFUL! You may want to light the match for the students, individually depending on the grade and ability
- copy of the scientific method

5. Have students make a snug lid out of the aluminum foil with a depression on the top, in order to fit two or three ice cubes on the lid. Remove the lid and set aside for later.
6. Have students twist the 6 X 2 inch paper into a “rope”. Set aside for later.
7. Have students swish the splash of cold water around the inside of the jar and pour into a plant when done (or save for another experiment). Ensure that there is not a large pool of water in the bottom of the jar or it will put out the flame of the paper and the experiment will not work (source of error).
8. Have ONE student (or the teacher) light a match, and CAREFULLY light the paper rope on fire and drop the lit rope inside the jar. Ensure that it is still alight and burning – you need the smoke from the paper to actually make smog. Quickly fit the aluminum lid snuggly on the jar and place the ice cubes on top of the lid in the depression. This needs to be done QUICKLY and CAREFULLY!
9. Have ONE student start the stop-watch as soon as the lid is snuggly on the jar and the ice cubes are in place. The student timer must record the exact time the experiment takes to occur – this is until the paper has burned all the way through or has gone out (but still burned enough to produce smoke inside the jar). Other students in the group must observe what happens inside the jar.
10. Use the Observation worksheet to record what they are seeing. Make a sketch of the experiment as it is underway.
11. Once the experiment is complete (paper has stopped burning, smoke in the jar), discuss what was happening. What did you see in the jar? Why do

you think smog formed (smoke from the paper burning plus moisture from the cold water and cold temperatures from the ice cubes cause smog)?
Explain what happened in the experiment by drawing conclusions from your observations. Next, ask students how we could modify the experiment to get different results (e.g.) keep the jars in a refrigerator to stay cold, then splash the water in, then put the burning paper in. Would a colder jar have a great effect?

12. Ask students what their sources of error were – what did they have do differently in their experiment if it did not turn out as they expected or as it should? Did they follow the procedures in this activity exactly? Why or why not?
13. Ask students to think about and explain how smog relates to air quality. How might smog relate to other air pollutants?

The Big Picture: How does smog relate to air quality? From what you know of smog, is the smog in a jar we made similar to smog outdoors? What chemical pollutants might be found in smog outdoors? Where does smog come from and why is it important to have awareness about it? How is smog related to other pollutants? What can we do to reduce the amount of smog days in our environment, where we live, etc?

The Air We Share

Background Information

What is Smog?

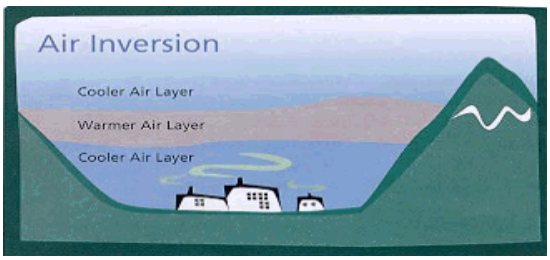
Smog is a combination of pollutants. It can contain ground-level ozone, sulfur dioxide, nitrogen oxides and particulate matter. These pollutants come from vehicle emissions, industry, burning wood and other sources. The word smog was first used in London, England to describe the mixture of smoke and fog – hence the term "smog." Smog can be seen as haze along the skyline of larger cities. On days with little wind, smog and related pollutants can build up and produce poor air quality. Smog can be harmful to the environment and potentially to human health.

Effects of Smog

Smog can affect plants and wildlife, as well as potentially have an effect on human health. Smog can damage crops or slow plant growth, potentially affect the respiratory or cardiovascular systems of animals and humans, cause irritation to the eyes, nose or throat, and may contribute to asthma symptoms. The haze associated with smog can also reduce visibility, which can contribute to safety concerns, while driving for example.

Winter-time Smog

Winter time smog refers to the ground-level buildup of emitted pollutants. In the absence of air movement (calm or low winds), emitted pollutants are not dispersed or transported. In the winter, such conditions are observed during temperature inversions. As you go up in the atmosphere, away from Earth's surface, the temperature normally gets colder; closer to Earth's surface, the temperature is normally warmer. A "temperature inversion" occurs when the reverse takes place; the temperature gets warmer as you move up, away from Earth's surface. An inversion can "trap" smog near to or at ground-level by creating a stable layer of air with little mixing. In the winter, when air is colder and "still," meaning it does not move around as much, smog can build up in a particular area and hang around longer, possibly resulting in poor air quality.



Inversion Layer

Summer-time Smog

Summer time smog is produced as a result of a chemical reaction in the atmosphere. Ozone is a major component of smog during hot summer weather. When winds are light and temperatures are high, smog can build up at ground level and be harmful to the environment and human health.

The Landscape

In addition to weather, the way the land is shaped, also known as topography, can have an effect on how pollutants, such as the ones that contribute to smog, can become concentrated. For example, in a valley or even on rolling plains, the landscape can act as a barricade to air movement, causing the air and pollutants to remain in an area.

For More Information:

www.ec.gc.ca/cleanair-airpur/Pollution_Issues/Smog-WS13D0EDAA-0_En.htm

Something about Smog - Observation Sheet

1. Define "smog:"

_____

_____

_____

2. Describe some sources of smog:

_____

_____

_____

_____

_____

3. Observe the smog experiment and describe what happens inside the jar.

_____

_____

_____

_____

4. Answer the following questions. You may need to search the Internet or look in books for the answers.
Is the smog we made in the jar similar to smog outdoors? What chemicals might be in outdoor smog?

_____

_____

_____

_____

_____

_____

5. How might smog affect the environment? How might smog potentially affect human health?

_____

_____

_____

_____

6. What can we do to reduce smog?

_____

_____

_____

_____

Activity 7: What is Ground-level Ozone?

Objective: Students will be able to identify and describe what ground-level ozone is and how it effects the environment and potentially human health at ground level. Students will also identify sources of ground-level ozone, how it is formed and what we can do to reduce emissions.

Curriculum Connection: Science 4.2A, 4.7A, 5.5.9E, 5.10E, 5.11E, 6.1D

Time: 40 minutes to 2 days (for completion of the poster)

Materials: computer, internet access, worksheet, pencils, poster paper, markers

Procedure:

1. Ask students if they know what ozone is. Solicit for answers and write ideas on the board. Define using a dictionary and write an accepted class definition on the worksheets.
2. Explain we will be doing a research project where students will learn about ozone, both higher up in the atmosphere and closer to Earth's surface – the ozone closer to the earth's surface is called ground-level ozone.
3. Go to the computer room with internet access. When in the computer room, explain that students will need to search for "ground-level ozone" (you may want to write this on the board if possible). They will need to answer the questions on the worksheet so that they can create a poster on Ozone later. Students can also refer to the background information sheet on ground-level ozone. Students can work in partners to compete the worksheet.
4. When students have completed their worksheets explain they will use this information to create an informational poster (in groups of two) on what ozone is, where it comes from, how it affects us and the environment, and actions we can take to reduce ground-level ozone. Refer to the ground-

level ozone background information sheet as well as other informational sources. Including images or drawn pictures is recommended.

5. Post the completed posters inside or outside the classroom and invite other students to read and learn about ground-level ozone.

The Big Picture: How is ground level ozone related to air quality and other air pollutants? How does ground-level ozone potentially affect our health and the environment? What can we do to reduce the amount of ground-level ozone formed? How might ground-level ozone be related to other air pollutants, as learned in this educational resource?

Websites to visit:
www3.gov.ab.ca/env/soe/air_indicators/4_ozone_alberta.html

www.ec.gc.ca/cleanair-airpur/Ground_Level_Ozone-WS590611CA-1_En.htm

The Air We Share

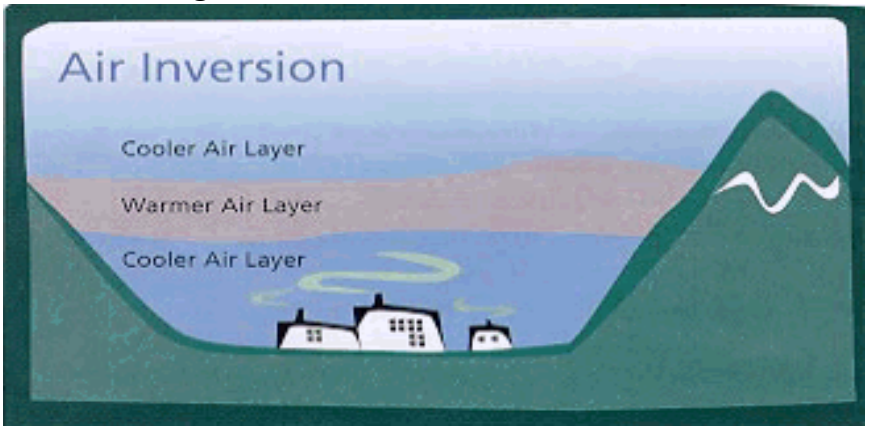
Background Information

What is Ozone?

Ozone is a very tiny molecule that is composed of three oxygen atoms. It is naturally found in our stratosphere, a part of Earth's upper atmosphere. Ozone way up there is known as the ozone layer and it helps to protect life on Earth from the Sun's harmful UV rays. However, ozone can also be found at ground-level, formed through chemical reactions of other gases, many of which come from vehicle or industrial emissions. Ground-level ozone can be harmful to the environment and potentially to human health.

Does Weather have anything to do with Ozone?

Calm or low wind conditions promote the build up of pollutants, such as ozone, as well as the gases that react to form it. Such conditions can result from strong inversions. An inversion occurs when the temperature in the atmosphere increases with height above the ground and vertical mixing of the air is restricted. As you go higher up in the atmosphere, away from Earth's surface, the temperature normally gets colder; closer to Earth's surface the temperature is normally warmer. An "inversion" occurs when the reverse takes place; the temperature gets warmer as you move higher up, away from the surface. An inversion can have an effect on ground-level ozone by making a stable layer of air near the surface with little mixing; this "traps" ground-level ozone and other pollutants near the ground. In the winter, when air is colder and "still," meaning it does not move around as much, ground-level ozone and other pollutants can build up in a particular area and hang around longer. This can result in higher levels of ground-level ozone and poor air quality. In the summer-time hot, sunny weather can result in more ground-level ozone formation.



Inversion Layer

The formation of ground level ozone is also affected by how much solar radiation we receive from the sun. Energy from the sun is required for atmospheric reactions that form ozone. That is why ozone concentrations are typically higher during the afternoons when it is often warmer outside; this effect contributes to the haze that is seen above cities.

Effects of Ground-level Ozone

Ground-level ozone is a major component of smog. During hot weather conditions, emissions from vehicles, industry and other sources can lead to high ozone levels, especially in larger cities. This can cause damage to plants by interfering with the plant's abilities to undergo photosynthesis and other processes. Evidence of ground-level ozone damage can be identified by small white or brown to black spots on broad-leafed plants, such as maple trees or shrubs. On coniferous trees, such as pines or spruces, needles can develop yellow flecks, or brown tips.

Ground-level ozone has also been found to irritate the eyes, and could potentially affect lung function or negatively affect respiratory and cardiovascular systems.

What actions are being taken in Canada and Alberta?

In June 2000, the Canadian Council of Ministers of the Environment established Canada-Wide Standards (CWS) for Particulate Matter and Ozone. These standards are important steps towards minimizing the potential risks these pollutants can cause to the environment and human health. These standards commit government to significantly reduce ground-level ozone and particulate matter by 2010. The Alberta government has developed a Framework to manage particulate matter and ozone in the province in order to meet this target. Individual actions, such as reducing idling time, are a way we can help achieve this goal.

Alberta Environment has taken the right step by managing ozone in the province before a critical level is reached. Alberta Environment does various monitoring and reporting activities, and has worked with airsheds to develop air quality management plans for the Edmonton, Calgary and Red Deer regions.

For More Information:

www.environment.alberta.ca/1970.html
www.ec.gc.ca/cleanair-airpur/Home-WS8C3F7D55-1_En.htm
www.environment.alberta.ca/documents/Particulate_Matter_and_Ozone_Fact_Sheet.pdf

What's that near the ground? Ground-level Ozone!

1. Define ozone:

_____

2. Why is ozone important? Why do we need it when it is found higher up in the atmosphere?

_____

_____

_____

3. Explain what makes up ground-level ozone – what are the pollutants that combine to form ground-level ozone?

_____

_____

4. Where might the pollutants come from that combine to form ground-level ozone come from?

_____

_____

_____

5. Why might ground-level ozone be bad for the environment? What might it do?

_____

_____

_____

6. How might ground-level ozone potentially effect health?

_____

_____

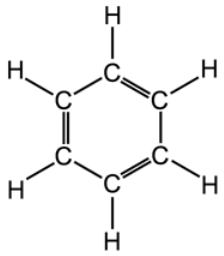
_____

7. What can we do to reduce the formation of ground-level ozone?

_____

---

8. Draw a picture below of what a healthy environment looks like and include yourself in the drawing.



Activity 8: What is Benzene?

Objective: Students will be able to identify and describe what benzene is and how it effects the environment and potentially human health. Students will also identify where benzene comes from and what we can do to reduce emissions.

Curriculum Connection: Science 4.2A, 4.7A, 5.5.9E, 5.10E, 5.11E, 6.1D

Time: 40 minutes to 2 days (for completion of brochure)

Materials: computer, internet, pencils, worksheet, poster paper, markers

Procedure:

1. Put up an image of a Benzene ring and ask students what this might be. Solicit their answers and then explain this is a chemical and it is arranged in a particular circular order. It is kind of like six monkeys in a ring, holding onto each other's tail and each monkey is holding onto a banana in their free hand! Draw the ring on the board (tip – the ring is featured at the top of this page!).
2. Next, using the student worksheet, challenge your students to use the internet and/or other sources of information to explore what Benzene is, where it can come from, how it can be made, and its environmental and potential human health effects. Have students refer to the Benzene background information sheet, Alberta's State of the Environment website, or other sources of information you might find useful. This can be an individual research project or students can work in pairs.

3. After students have completed the worksheet on Benzene, explain they will develop and create a brochure about Benzene. You may want to first have a class discussion on each question on the worksheet, to ensure all students are using the same information. This brochure should include all the information gathered on the worksheet, as well as a drawn picture of a Benzene ring, definition of Benzene, how it is made, sources of Benzene emissions, potential environmental and health impacts and how we can reduce Benzene emissions. This brochure can be used in the school to provide information to other students, teachers, the principal, volunteers, etc on Benzene, or can be taken home after the assessment is complete.

The Big Picture: Why is benzene important to know about? Where does it come from and how does it affect our lives? What can we do to reduce the amount of benzene in our air? How is benzene related to other air pollutants and air quality issues?

Websites:

Alberta's State of the Environment:
www3.gov.ab.ca/env/soe/air_indicators/10_benzene.html

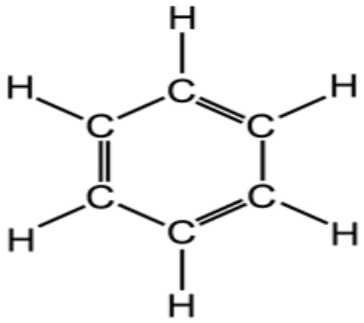
Centers for Disease Control and Prevention:
www.bt.cdc.gov/agent/benzene/basics/facts.asp

The Air We Share

Background Information

What is Benzene?

Benzene is an organic chemical compound, which means it contains carbon and hydrogen. Benzene is grouped into a category called Volatile Organic Compounds, or VOCs.



Benzene Ring

Benzene can be found naturally, or can be synthesized, which means it can be made in a laboratory, from other petroleum compounds. Benzene is naturally found in crude oil, and can also be formed during oil refining processes. Motor vehicle emissions are the main source of benzene in Alberta. Other sources include industrial emissions, handling and storing fuels, forest fires and the burning of other products, as well as cigarette smoke.

Effects of Benzene

Benzene can have an effect on the environment, particularly to aquatic plants and animals. Benzene can damage or even kill plants, it can be fatal to aquatic animals, affect animal reproductive health, or possibly contribute to behavioral issues in animals. Long term and short-term exposure to benzene can lead to serious health effects in humans as well. Benzene is a known carcinogen; longer-term exposure to benzene has been linked to causing some cancers. Short-term exposure to benzene can cause respiratory problems, dizziness or headaches.

For More Information:
www3.gov.ab.ca/env/soe/air_indicators/10_benzene.html
www.bt.cdc.gov/agent/benzene/basics/facts.asp

What about Benzene?

1. Define Benzene:

_____

_____

2. Draw a Benzene ring:

3. What are some natural and non-natural (human-made) sources of benzene? Where does it come from?

Natural:

_____

_____

Non-natural:

_____

_____

4. How can Benzene affect the environment?

_____

_____

_____

_____

5. How can Benzene potentially affect human health?

_____

_____

_____

_____

6. How can we reduce the amount of Benzene in our air?

_____

_____

_____

Activity 9: What is Acid Deposition?

Objective: Students will be able to identify and describe what acid deposition is and how it affects the environment. Students will also identify how acid deposition is formed and what we can do to reduce the effects.

Curriculum Connection: Science 4.2A, 4.7A, 5.9E, 5.10E, 5.11E, 6.1D

Time: 2 weeks (experiment)

Materials:

- markers
- masking tape
- observation sheets
- pencils
- 2 mason jars per each group of three to four students
- distilled water (enough to make +/-10 cups of solution); possibly need baking soda, depending on the pH of the water
- white vinegar (enough to make +/-10 cups of solution)
- measuring cups
- stirring spoons
- pH paper
- beans plants, or any small annual, two for each group
- 2 pie plates per group, to hold each bean plant in (to avoid water messes; DO NOT put both plants in the same pie plate)
- aluminum foil.

Procedure:

1. Ask students if they can describe the things plants need to survive. List them on the board (carbon dioxide, water, soil, nutrients and minerals, invertebrates, transportation for seed dispersal, etc).
2. Ask students if they know what Acid Deposition, or acid rain, is. Solicit ideas, write on the board and then try to define as a class. Use a dictionary for a formal definition and see if the class definition is similar. Determine an accepted definition and write this on the worksheet.
3. Explain to students they will be completing a two week plant experiment on bean plants (or other readily available annual). Ask students if they know what bean plants are? Solicit for answers. Ask if they think the bean plants can be used as an example of other plants found in Alberta? Solicit for answers and explain that yes, we are using the bean plants as an example of what acid deposition can do to other plant life in Alberta.
4. Arrange students in groups of two and number the groups (1, 2, 3…).
5. Hand out two bean plants for each group. Ask students to first observe the plants and write down their observations. Ask guiding questions, such as, what does the plant look like? Color, texture smell? Is it healthy, etc?
6. Label the two bean plants. One label will be “Water;” the other label will be “Acid.” Use the masking tape and markers and wrap the tape around the base of the plant’s pot (they should be in small green potters). Include the group’s number on the plant masking tape as well.
7. Hand out two mason jars per each group, stirring spoons, one teaspoon for each group and one measuring cup per each group.
8. Have the students label one mason jar “Water” and one mason jar “Acid.” Include their group number on the jars as well.
9. Using the measuring cups, assist students in measuring 2 cups of distilled water into the “Water” jar. Using the pH indicator strips, measure the pH of the distilled water. It should read about 7. If it is below 7, add a drop or two of baking soda, stir with a clean stirring spoon, and retest.

10. Use a piece of aluminum foil to make a lid for the “Water” jar, place overtop the jar and set aside.
11. Measure 2 cups of distilled water and pour into the “Acid” jar. Using the teaspoon, measure 1 teaspoon of vinegar and put into the “Acid” jar; stir well using a clean stirring spoon.
12. Use the pH paper and test the pH of the “Acid” jar; it needs to read a 4 or slighter higher. You may need to add more vinegar if it reads below 4.
13. Make an aluminum foil lid for the “Acid” jar, place overtop and set the jar aside.
14. Record your observations of the “Water” and “Acid” jars on your observation sheet. Ask students what we just learned? How can pH indicator strips be use to measure our drinking water? Is it important to know how much acid may or may not be in our water? Why? Expand on this if you wish to.
15. Using a clean measuring cup pour approximately 1/3 cup of distilled water from the “Water” jar into the measuring cup and onto the “Water” bean plant.
16. Using a clean measuring cup pour approximately 1/3 cup of solution from the “acid” jar into the measuring cup and onto the “Acid” bean plant.
17. Record observations for both plants and leave the plants in a well lit area. Store the group’s solutions together, and do not mix them up.
18. The next day, at approximately the same time, record your observations of the two plants.
19. After recording observations prior to watering the plants, water the plants; “Water” jar to “Water” bean plant and “Acid” jar to “Acid” bean plant. Record observations after watering. Repeat these steps every day for two weeks
20. At the end of two weeks and final observations, discuss the class’s findings, on a group by group basis. What happened to each of your plants? Why? What might this tell us about acid deposition in the natural world? How might these effects impact wildlife? Humans? Buildings?

Complete the questions in the observation worksheet when the two week period is over.

The Big Picture: Discuss how acid deposition can affect the environment, both natural and human built. What effects might we see if more acid deposition, such as rain or snow, is produced? What might happen to our wetlands or water bodies, to our soils and farmland? What might happen to some of our buildings, especially older ones? What actions might we have to take to change our built environment or to help out the natural environment? What actions might we have to take to reduce the amount of acid deposition from being formed? How can we change our lives?

The Air We Share

Background Information

What is Acid Deposition?

Acid deposition occurs when acidic pollutants in the air are deposited on the earth's surface. The main acid-forming gases are sulphur dioxide (SO_2) and nitrogen oxides (NO_x). SO_2 and NO_x are emitted from vehicles and industrial activities. These substances react in the atmosphere to form acids (such as sulfuric and nitric acid) that return to the earth in precipitation (e.g. rain or snow), or as particles or gases.

Effects of Acid Deposition

Precipitation that is acidic can be harmful to plants, wildlife, soil, water, and even buildings. Acid deposition can directly damage the leaves, flowers and stems of plants. Roots of plants can also be damaged if the soil can not neutralize the acidity of the precipitation. Trees, such as white pine, jack pine, aspen and birch are sensitive to acid deposition.

Soil quality can be affected by increasing acidity (lower pH). This can cause nutrients, such as nitrogen, to leach from the soil. Additionally, increasing soil acidity makes toxic metals such as aluminum and lead more soluble, where they can be taken up by the roots of plants. Water quality can also be affected by acid deposition. One of the first signs or effects is the disappearance of crustaceans, insects and some plankton species from aquatic ecosystems. As the pH continues to drop, loss of fish populations occurs. If the pH drops low enough (below pH 5.0) very few fish can survive and the shore area may be covered by mosses.

$SO_2$and NO_x can potentially affect human health by contributing to the production of smog and ozone. SO_2 can also irritate the nose and throat, and $SO_2$and NO_x can potentially contribute to respiratory issues.

What is being done in Alberta?

Alberta Environment monitors air, rain, snow, water, and soils for acid deposition throughout the province. Governments and industry are working together to reduce air pollution. Alberta Environment establishes ambient air quality objectives for major air pollutants including sulphur dioxide and nitrogen dioxide, as well as a management program for acid deposition. Individual action, such as reducing driving time, can also help!

For More Information: www.ec.gc.ca/cleanair-airpur/Acid_Rain-WSAA1521C2-1_En.htm
www.environment.gov.ab.ca/info/library/6193.pdf

Acid Deposition: Observation Worksheet

1. List the things plants, animals and ecosystems need to survive?

_____

_____

_____

_____

_____

2. Define Acid Deposition

_____

_____

_____

3. In the table on the next page, record your observations of the plants and solutions over a two week period. Be sure to include the time and date for every observation, as well as what type of plant you are using, appearance changes, etc.

Day, Date, Time	Plant	Water jar	Acid Jar
Day 1 Date: Time:			
Day 2 Date: Time:			
Day 3: Date: Time:			
Day 4 Date: Time:			
Day 5 Date: Time:			
Day 6 Date: Time:			
Day 7 Date: Time:			
Day 8 Date: Time:			
Day 9 Date: Time:			
Day 10 Date: Time:			

4. Describe what happened to the "Water" plant and the "acid" plant after ten days.

_____

_____

_____

5. How might this effect be similar to Acid Deposition, in the environment? What effects might Acid Deposition have on the environment?

_____

_____

_____

_____

6. What are some sources of acid rain or snow? How is it made?

_____

_____

7. What can we do to reduce the formation and effects of Acid Deposition?

_____

_____

Activity 10: What is the Air Quality Index?

Objective: Students will understand what air quality is, why it is important to monitor, how to use online/scientific tools, and understand why and how data is interpreted.

Curriculum Connection: Science 6.3D; Social Studies 4.1.4A

Time: 45 minutes to two classes

Materials: pencils, paper, computer, internet access, worksheet

Procedure:

1. Ask students if they know what Air Quality refers to. Solicit answers and explain what Air Quality is. Refer to Alberta Environment's website for more information: **www.environment.alberta.ca/617.html**
2. Explain to students they will be using the internet, and some specific websites, to research Air Quality and the Air Quality Index. They will need to answer the questions on the worksheet using the information they find. This is a scavenger hunt so make it interesting! You can add a challenge into this! Be creative! ☺
3. After the students have answered the questions, take up the worksheet and share answers. Discuss why this information might be useful to Alberta Environment as well as the general public, scientists, students, industry, etc. Why do we need this type of information? How can we use it? What do we learn from this information? What did YOU learn from this information?
4. To challenge your student to learn more about local air quality, have students continuously visit the CASA website: **www.casadata.org/airqualityindex/GoodAQI.asp.**

5. Discuss what they learn everyday; they can begin to track local air quality, and related issues that might effect the environment or possibly human health.
6. As an extension to the worksheet, have students make a poster on Air Quality, the Air Quality Index and its importance, and actions we can take to reduce emissions of chemical pollutants to help improve the environment and potentially human health. Information to be included on the poster can be taken directly from the students worksheets.
7. To get started, ask the students what THEY think other students, teachers, etc in the school might want to know about Air Quality. Be creative! Posters can be displayed around the school!

The Big Picture: Ask students what they learned from doing this scavenger hunt? How is the information we collected and learned about related to the other activities we have been doing? How are the chemical pollutants we are learning about related to vehicle idling and emissions from vehicles?

Ask students how they think scientific data is collected and analyzed, and then used by scientists and other organizations. Why is this information important? What do we do with this information? Also, ask students what actions they can take to help improve air quality? What do you do everyday that might reduce the quality of our air? What can you do instead (e.g./ walking or biking versus riding short distances in a car, turning off lights when not in use to save electricity – less coal will be burned, etc)

Air Quality Scavenger Hunt

1. What is Air Quality? TIP: visit
   www.casadata.org/airqualityindex/aqi/aqicalculated.asp

_____

_____

_____

2. What is the Air Quality Index? TIP: visit
   www.casadata.org/airqualityindex/index.asp

_____

_____

_____

3. How is the Air Quality Index (AQI) developed and what are the three categories?

_____

_____

_____

4. What is Air Quality monitoring? What does it tell us? TIP: visit www.casadata.org/airquality/index.asp

_____

_____

_____

5. Why and how is Air Quality important to the health of the environment as well as humans? How can some pollutants affect the environment and possibly humans?

_____

_____

_____

_____

_____

6. Scavenger Hunt: visit www3.gov.ab.ca/env/soe/air.html to answer the following questions.

How has Alberta's Air Quality Index rated our air quality from 1998 to 2008? _____

a. Why is the benzene indicator important? What can benzene potentially do to humans?

_____

_____

_____

b. What can suspended fine particulates in high concentrations do to humans?

_____

_____

_____

c. What family of gases is nitrogen dioxide a part of?

_____

_____

d. What can nitrogen dioxide potentially do to human health? TIP: Look in "why is this indictor important?"

_____

_____

e. Describe ozone.

_____

_____

f. What is ground-level ozone a component of?

_____

_____

g. Explain how sulphur dioxide is formed.

_____

_____

_____

h. Describe what sulphur dioxide is a key component of.

_____

_____

i. Explain the environmental effects of acidifying precipitation. TIP: look under Pressures, in "why is this indictor important?"

_____

_____

_____

7. What did you learn from doing this scavenger hunt? Think about all the information you found on air quality! Also, think about what actions you can take to improve air quality!

_____

_____

_____

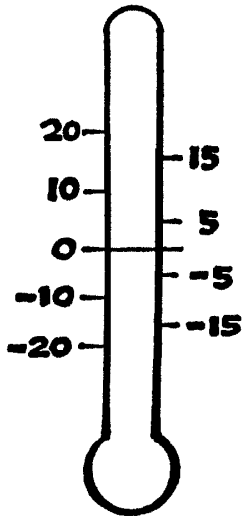
_____

_____

_____

Draw a picture below of the clean air environment you live in and hope to preserve for the future.

8. **Activity 11: How Weather Affects Air Quality**



(Adapted from Project A.I.R.E., US EPA)

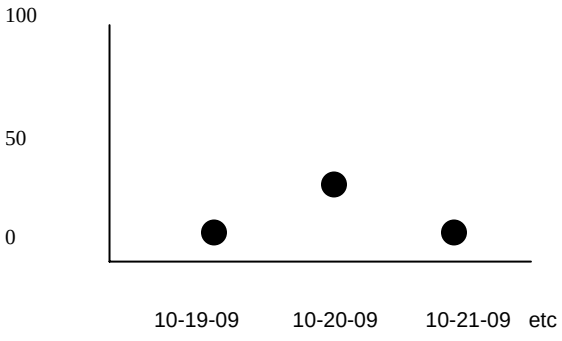
Objective: Students will build on their knowledge of air by recognizing that weather affects air quality as well as its movement (patterns).
Curriculum Connection: Science 5.2D, 5.12D; Social Studies 4.1.1A, 4.1.4A, 5.1.1, 5.1.3
Time: NA

Materials: five sheets of white or light Bristol board, markers in blue, black, green, red, purple and orange, groups of five.

Procedure: *Note that this activity can be completed in the fall/winter, spring and summer to compare the effects weather may have on air quality in their region.*

1. Ask students to look outside and observe the weather. Have them describe the day. What is it like outside? Does weather change every day? How is weather different than climate? Define weather on the board and on the worksheet and ensure you note the difference between weather and climate. A good idea would be to have two definitions displayed creatively in the class. You can even have your students help you design these!
2. Ask students if they think weather has any effect on air quality. Why or why not? Think of windy, rainy, sunny, hot, cold, etc days. Prompt them by asking them if hotter days feel different, compared to cooler or colder days. Refer to the background information sheets as well as visit:
   www.environment.alberta.ca/1050.html
   www.epa.gov/airnow/airaware/day2-detail.html

3. Discuss what the information says then ask, how does weather relate to air quality? Have students explain.
4. Group students in five different teams, categorized as *Temperature, Wind, Precipitation, Relative Humidity and Air Quality Index*. Students in these groups are responsible for collecting information on their group name, for the region in which you live. You will make a class chart displaying all of the information. Be creative! This can be included as an art component!
5. Via a classroom computer, or in the computer library, refer to **www.theweathernetwork.com/weather/cancities_en** for your region, for *Temperature, Wind, Precipitation, and Relative Humidity*. Have students in their groups begin collecting and organizing daily data on weather for their region, for their group name.
6. Explain that you will be visiting this site daily, for at least one week, to learn about regional weather information.
7. Each team will record daily changes on their worksheets over a period of time (one week or longer is suggested, or can be through the seasons, for one to two week intervals).
8. After the time period has ended, have students draw a line graph with an *x, y axis* to represent their findings for their category. Label the *x axis* as the *date* and the *y axis* will be the measurements for their **category**. You will need to specify the *y axis* range limit (e.g. 0 – 100) for their category. Information for the *y axis* range can be found for your region on the Weather Network or CASA website, or by calling local weather information centers. An example:



9. Have students summarize the trend for their category (group name) by answering the following questions:
    - What did you notice happening over time, through the fall/winter and spring and summer for your category?
    - How does the weather affect the quality of our air?
    - What are some potentially dangerous air quality issues we would need to know about that relate to what was happening with weather?
    - If we know the weather might affect air quality on a certain day(s) are there things we can do to reduce the impacts?
10. Discuss findings as a class and have students present their information to each other. The posters, with a summary of Air Quality and Weather, can be placed outside the classroom or on the school bulletin board, to illustrate the relationship between air and weather.
11. **IMPORTANT NOTE**: What is found will depend on what time of day the data is taken for**.** Afternoon will show the most variability. Also be aware that students may find that not all the weather parameters change a lot with time or have a distinct pattern with the season (e.g. wind). Results will all depend on whether or not students record data on a day or on days with the right conditions for pollution production or buildup. You can use this, however, as a teaching tool in your class to discuss the fluctuations, or lack of, in weather conditions, how this might be different during seasons, or even different in other geographic locations.
12. You can also have students visit the TELUS Geomatics website for real-time air quality data, at: **www.telusgeomatics.com/tgpub/tgutil/step1.asp?http://www.telusgeomatics.com/tgpub/ag_air/default.asp** You will need to download the information each time you request it. Alternately, you can call the site listing at (780) 427-7273 in the Edmonton area or toll-free at 1-877-247-

7333 for the rest of Alberta. You could assign each student a turn at calling in, if your school will permit; supervised of course!

The Big Picture: Explain how weather is related to air quality, and how weather can have an effect on the air pollutants found in air. Explain how weather is not climate change, but how they are often mistaken for each other. Ask students to explain what the link is between air quality, climate change and weather, if any? Ask students if they have ideas on what can we do about weather, if anything? Can we change it? Can we prepare for it? Ask student to explain what can we do, if anything, about our air quality on days when we know the weather will not be very good for our health or the environment?

The Air We Share

Background Information

What Is Weather?

Weather is often described as the short-term state of the atmosphere at any time and place. Changes in weather conditions can occur in short periods of time. Weather includes factors such as temperature, wind, moisture such as rain or snow and pressure.

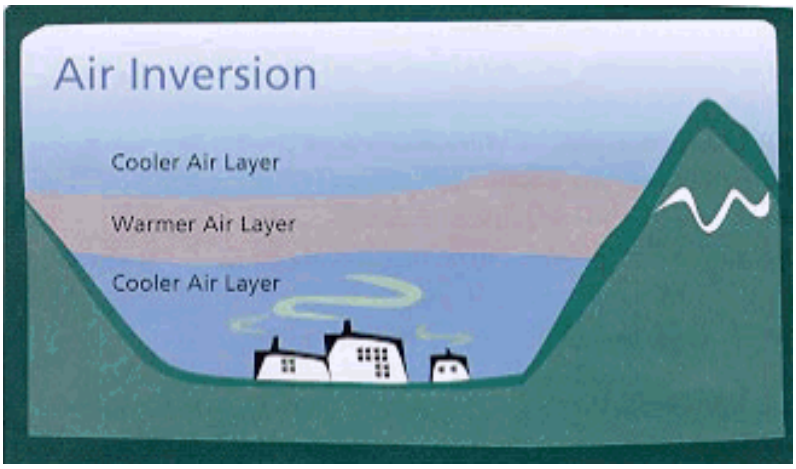
How Does Weather Affect Air Quality?

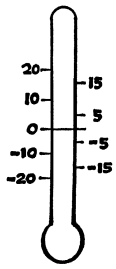
Weather, in terms of temperature, wind speed and direction, sunshine or cloud cover, rain, snow or sleet, can directly affect our air quality in any region. For example:

- High temperatures can increase the frequency or amount of chemical reactions of air pollutants, while low temperatures can slow down chemical reactions.
- Wind speed, the amount of stability or turbulence and the depth that air will mix at can effect how far chemical pollutants might be dispersed, or if chemical pollutants are diluted.
- Sunshine can cause some chemical pollutants to undergo chemical reactions, which could produce smog.
- Rain, snow or other forms of precipitation could dilute some chemical pollutants. However, precipitation can also be the source of acid deposition.

Inversion Layers

The temperature of the air usually gets colder the higher up in the atmosphere we travel. However, there is sometimes an upper layer of air that is warmer, while a colder layer of air is found closer to Earth's surface. Inversion layers are important to understand because the upper layer of warmer air can act like a lid, trapping air pollutants nearer to Earth's surface. Inversion layers can affect air quality by contributing to smog formation, location and how long smog might stay in a particular area.





Weather and Air Quality Worksheet

Category: _____

Date	Reading

1. Define and describe your category:

_____

_____

_____

_____

2. What are the trends in your category? What did you notice happening over time?

_____

_____

_____

_____

3. How might weather affect the quality of air?

_____

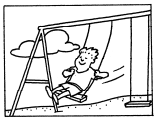
_____

_____

_____

_____

Activity 12: Developing Cleaner Air Spaces



Objective: Students will be introduced to the concept of “objectives” for ambient air quality and why they are important. They will also think critically about how their living and working spaces are designed and constructed.

Curriculum Connection: Science 4.2A, 4.7A, 4.11A, 5.2D, 5.12D, 5.9E, 5.10E, 5.11E, 6.8A, 6.1D; Social Studies 4.1.1A, 5.1.1, 6 local government

Time: 45 minutes to three classes, depending on desired depth of project scope

Materials:

- blank paper
- pencils
- markers, crayons, or pencil crayons
- Bristol board
- chart paper
- dictionary and/or computer with internet access
- Ambient Air Objectives for Alberta: **www.environment.alberta.ca/613.html**

Procedure:

1. Prior to beginning this lesson, visit **www.environment.alberta.ca/613.html** for information on Alberta’s Ambient Air Quality objectives. You should make a definition sheet Ambient Air Quality and what Objectives are, in context of air quality.

Information from Alberta Environment's website can be included:

Ambient Air Quality objectives are intended to provide protection of the environment and human health to an extent technically and economically feasible, as well as socially and politically acceptable.

The objectives are used to report on the state of Alberta's atmospheric environment; to inform Albertans on air quality through an air quality index; to establish approval conditions for regulated industrial facilities; to evaluate proposals for constructing facilities; to guide special ambient air quality surveys and to assess compliance near major industrial air emission sources.

Alberta Environment ensures that emissions from human activities will be minimized and that air quality continues to be better than the Ambient Air Quality Objectives. (Available at: www.environment.alberta.ca/613.html)

2. Discuss how Ambient Air Quality objectives were created (government policy and legislation backed up by scientific investigation) and why they are important (provides guidelines and regulations and ways for monitoring and reporting on ambient air quality). Ask students why this information is important? What does it tell us? How do we or can we use it to make decisions about the environment, industry, commercial businesses, etc? How might ambient air quality objectives be related to vehicle idling and emissions? How might our schools be affected by ambient air quality and related objectives? Why is this important? Are there possible environmental or human health issues? Discuss and record ideas on the board or chart paper.
3. For grade six students you can further discuss how government determines and sets regulations, monitoring and reporting, etc. through legislation. This is a nice tie-in into their social studies curriculum.
4. Next, take a critical look at how your school is designed, where the parking lots are, where bus pick-up is, the locations from public transit stops, sidewalks and their conditions, etc.

You may want to take students for a walk around the school grounds and have them sketch what they see on the blank paper, as well as take notes or their observations. Discuss their findings and thoughts.

5. Ask students if they think the design and location of the school ground is conducive to cleaner air? Ask:
    - What can we do to reduce activities such as driving in and around school grounds, but still make schools accessible for people who need to drive or take the bus?
    - What can we do to reduce our energy consumption in the school as well?
    - How are the windows designed? Do they let in a lot of natural light? Are they older or newer and do they insulate well?
    - Are the doors older or newer, and do they insulate well?

    How might all of these issues affect the environmental and potentially human health in and around school areas? What about the rest of our community? What are the design features? How might air quality issues be impacted by the design of our communities, buildings, etc?

    Note: All these issues contribute to energy consumption, which often has an impact on air quality. These issues are often considered when monitoring and reporting on ambient air quality.
6. Next, ask students how they would redesign their school and/or community to help promote cleaner air spaces? What can they do? How can they design the parking lots? Where can they include more greenery? What about buses and other traffic? What about the building's energy efficiency, like windows, doors, lights, water, etc?
7. Ask students to work together, as a class, to list the key elements they would like to see done differently in their school. Make a list on chart paper to refer to later. On the Bristol board or other paper, have groups of three or four students begin to design their cleaner air school.

You can use the Ambient Air Quality objectives to help frame discussions regarding how changing the designs of our built environments, and the related chemical pollutants that come with built environments, might help create cleaner air spaces. For example, if we designed our communities with little to no road access, where the interior spaces of where we live would only be accessible by walking or biking trails, and vehicles would have to park outside the community boundaries, we might see a difference in air quality nearer to our communities. People would drive less because everything they would need, such as schools, stores, family and friends homes' would be designed in an accessible way, so that vehicles would not be necessary.

8. You may need several days to work on this, depending on your class. Have students present and share their final designs, explaining why their design would promote cleaner air in the school ground areas.
9. Ask students to write a letter indicating how and why their design might be the next future design of schools, to help improve air quality. Display the designs and letters in the school.

The Big Picture: Ask students why this is all important? How does it connect to their lives, in light of what they have learned about air, air quality, air pollutants, and actions we can take to improve our environment? How can we develop cleaner air spaces if others keep on with current actions that may be detrimental to the environment? How can we encourage other people to shift their thinking and attitudes about their lifestyles?

The Air We Share

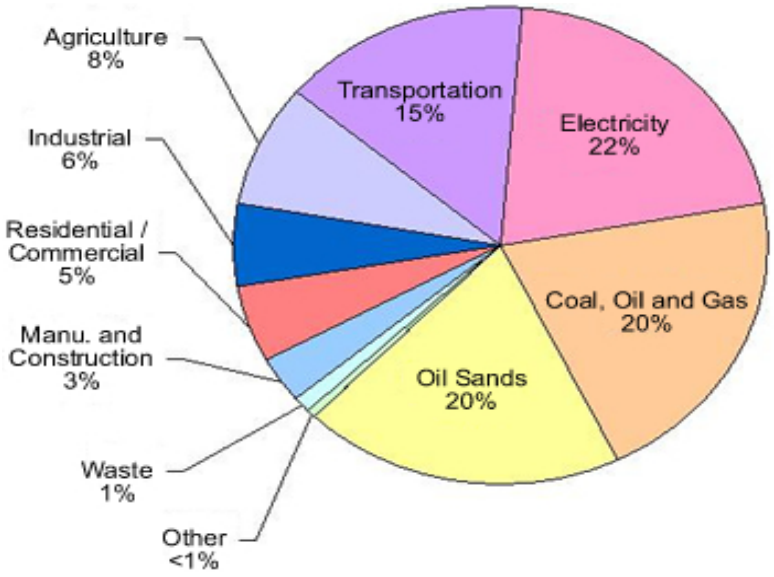
Background Information

Transportation, Emissions and Air Quality

The vehicles we use in daily life are often necessary; our cars, trucks, motorcycles, ATV's, and buses help us travel to and from work, school, to visit family and friends, and enable us to explore our beautiful country. Using our vehicles for these purposes is not necessarily a negative thing – however, keeping our vehicles running when we are not driving them (idling) releases pollutants into the air while the vehicle is not in use. Idling a vehicle can become problematic, especially if we consider the effects that vehicle emissions can have on the environment and potentially on human health.

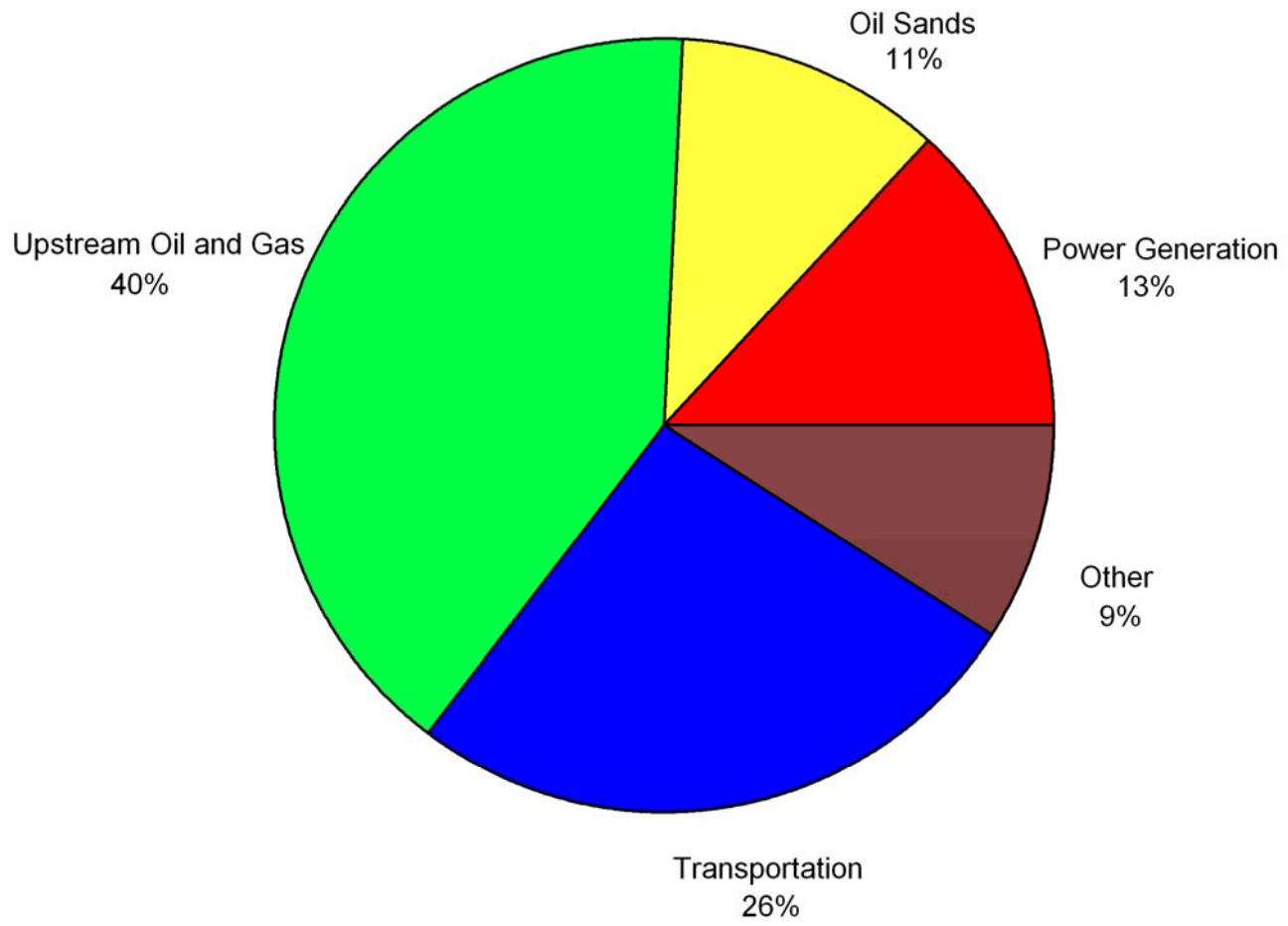
Pollutants released to the air from a source, such as from our vehicles or from industry "stacks", can include nitrogen oxides, sulphur dioxide, benzene, particulate matter and carbon dioxide. These chemical compounds can cause damage to plants, wildlife, water and soil quality, and may have potential impacts on human health. Carbon dioxide, while not impacting human health, can contribute to climate change and be linked to other various issues such as drought, poor soil quality, and potential loss of biodiversity. The chart below illustrates Alberta's 2006 Greenhouse Gas Emissions.

2006 Alberta Greenhouse Gas Emissions - 234 Megatonnes total



Sulphur dioxide, nitrogen oxides, benzene, and particulate matter, are chemicals found in vehicle emissions and can contribute to a variety of environmental issues, such as damage to plants, soil or water and interference with animal reproduction. These emissions may also pose human health risks, such as contributing to the formation of smog or ground-level ozone, potentially contributing to respiratory or cardiovascular issues, or possibly causing some cancers. Depending on weather conditions outside, pollutants can build-up or accumulate in an area, for example, where several cars are idling (pick-up/drop-off points, drive-thru's, stop-lights). The chart below illustrates where oxides of nitrogen emissions in Alberta come from; note the transportation sector.

Alberta Oxides of Nitrogen Emssion by Sector



Data from Environment Canada Criteria Air Contaminants Provincial Summary, June 7 2007

What Can We Do to Reduce Emissions?

The release of the above chemical compounds can be reduced when we are not driving our vehicles, especially if we choose to turn off the engine when we are idling while, for example, waiting to pick-up passengers, waiting in drive-through lines, running a few "short" errands, waiting for a train to pass, or are "warming-up" our vehicle in the winter. We *can* reduce our idling time when it is safe to do so and when idling is not necessary. We can also support the development and purchasing of cleaner fuels and vehicles if possible, participate in vehicle inspections to ensure our
vehicle is running efficiently, or use alternative transportation, such as walking, biking, transit, carpooling, and so on.

How Will It Benefit Me?

Idling can contribute to poor air quality and affect environmental health, as well as contribute to climate change. Components in vehicle exhaust may also affect human health. If we choose to turn off our vehicles when it is not necessary to idle, we are taking the steps toward improving our air quality, which can help to improve the environment and human health.

Will I Save Money If I Turn Off My Engine?

Yes! For a min-van or small SUV, if you choose NOT to idle for 5 minutes each day, *you can save $30 or more a year!* You actually *use more fuel* if your vehicle is idling for more than 10 seconds! So turning off our engines not only help the environment and human health, but can help our pocketbook too!

For More Information:
www.onesimpleact.alberta.ca/
www.env.gov.bc.ca/epd/bcairquality/topics/vehicle-pollutants.html
www.environment.alberta.ca/3293.html

Activity 13: Legislation for Air Quality

Objective: Students will be introduced to the concept of a law and regulation, who develops them, what they are intended to do, and why they are important. Student will also use/refer to their prior knowledge of wastes and/or toxins.

Curriculum Connection: Science 4.2A, 4.7A, 4.11A, 5.9E, 5.11E, 6.1D; Social Studies 4.1.4, 5.1.3, 6 local government

Time: two class periods

Materials:

- chart paper and markers or chalkboard and chalk
- student worksheets
- groups of three to five

Procedure:

1. Ask students what they know or understand about government. After soliciting answers, discuss what government is, the levels of government (municipal, provincial, federal), what government does and why it is important. Depending on your knowledge of government you may need to research this. It is suggested you provide a definition listing on a word wall or by other means in your classroom to assist students. This is a good activity to introduce the concepts of government to students in grades four or five, as well as six, or to review after some time on this topic in grade six.

   For information on provincial government visit:
   www.assembly.ab.ca/visitor/Teachers/index.htm

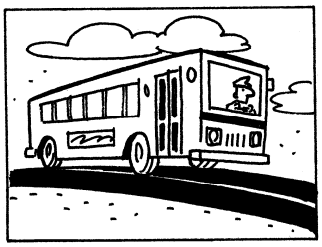
2. Next, develop a problem related to air quality where legislation would need to be passed (e.g. bylaw). Write the problem on the board or chart paper and read aloud to the students. Explain they will work through an activity similar to writing legislation to deal with the problem on the board. Explain this is similar to the process government has to go through! You may want to pre-empt this lesson with a discussion on government structure in Alberta. It does not have to be extensive for grades four and five. Grade six may need/want more depth due to the specific curricular connections. Student will need to refer to their duo tangs of air information from the lessons completed for more information and to support their decisions.
3. Have groups of three to five students begin discussing the problem, their stance regarding the problem and then begin planning what points they will discuss with the rest of the class the next day, why these points are important, and in what order they will speak to the points. This step is critical in that their opinions, knowledge and understanding about air quality in relation to the problem you posed, will help support their views on the problem and to devise the legislation they will all vote on. You may want to dedicate one class period to this discussions and brainstorming.
4. Each group will have one person as the primary speaker and one as the scribe for the duration of the discussion. Students can take turns in each role if they wish, or you can assign rotating roles, depending on how long you would like this lesson to go on.
5. Explain you will act as the council for the town/city (where they are presenting their points on the problem), and though you will all vote on what proposal to enact as the legislation to deal with the air quality problem, you (the teacher) have the right's to speak, stop conversations, etc for the sake of order. Explain that in order for all students to make a sound decision you need them to have the best examples and information ready during the presentation/discussion.

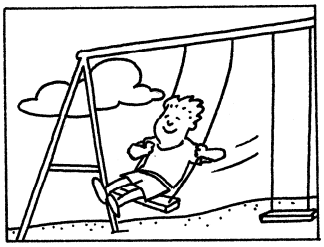
Explain that students do not have to choose their own proposal if their minds have been changed in the end.

6. Students will work in their groups to devise a solution for the air quality problem. They need to consider:
    - Is the solution going to affect the economy? How? What sectors (e.g. industry, commercial/retail, tourism, residential [builders], etc)?
    - Is the solution sustainable over a longer period of time? Does it consider the future?
    - Are the needs of the people and the environment met? How? Why? What things must “go” and what things must stay?
    - What is the timeframe? Is it realistic and achievable in a short or longer term timeframe?
7. Provide students sufficient time to write their proposal, based on their points. You may want to allow them to use the internet to research current legislation for air quality, as examples. This may take one full class period as well.
8. Next class, arrange the desks in a semi-circle with you at the head, as you are the council representative. Have student groups sit together. Ask each speaker to make an introduction to the problem.
9. After the introductions, ask each group to present their proposal to the problem, supported by their points.
10. Students may question and/or challenge other group’s proposals (this is similar to a debate), however, you will moderate each question and answer to ensure civility. You might want to have a gavel of something similar. The scribe for each group should be writing down key ideas, as well as yourself for later referral and for assessment.
11. When all presentations and questions are complete ask students to vote on what proposal should be enacted based on the information presented. They can do this anonymously via little slips of paper handed into you, or in groups as a class.

They must provide an explanation of why they have chosen x proposal. Most votes pass the legislation. However, you may not all come to an agreement. If this is the case, you might want to ask groups to present their points again.

The Big Picture: Ask students if they can explain how legislation affects their lives? Ask students if they can explain how legislation can help conserve and protect the environment, and how legislation is related to air quality. Ask students if they think we can “do” whatever we want, with no consequences, in terms of the environment and out actions? Why should there be consequences, if any? What can we do to ensure other people understand what legislation is and why it is important? Is it difficult to come to an agreement, where the environment or health is concerned?





Legislation for Air Quality - worksheet

Problem: There is too much traffic in the area around your school. Smog and ground-level ozone have begun to build up in the area more frequently. The topography (the shape of the land) has not helped matters because it traps air and pollutants in the area. Safety is also a concern, because f the constant flow of traffic in the area. Additionally, the tourism sector has slowed down because of the smog and poor air quality in the area.

1. What are the key ideas of your proposal?

_____

_____

_____

_____

2. What are the key ideas of other proposals?

_____

_____

_____

3. Are the proposals sustainable, for the economy, society and the environment? Why or why not?

_____

_____

_____

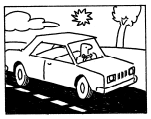
_____

_____

4. Questions to help make a decision for legislation:
    - Does the proposal describe action requirements clearly? E.g. what needs to be done and how? Y N
    - Are the community and the economy, environment and social culture considered well? Y N
    - Are the requirements practical and achievable in the timeframe specified? Y N
    - Does the proposal include enforcement (who will ensure people are doing what they should be doing…)? Y N
    - Are there any penalties for violation (not doing what you should be doing) and are they realistic? Y N

5. What proposal do you think should be enacted? Why?

Activity 14: Let's Help Clean the Air!



Objective: Students will begin to understand the impacts and effects of their choices on the environment and potentially on human health. Students will also recognize that every person has a different lifestyle choice and we need to understand those choices. However, we can strive to affect change in thinking and behavior through education and action projects. In addition to the idle-free program, students may develop and implement various other action projects related to improving air quality, as well as conserving and reducing energy, waste and water.

Curriculum Connection: Science 4.2A, 4.7A, 4.11A, 5.2D, 5.10E, 5.11E, 6.8A, 6.1D, 6.3D, 6.1E, 6.3E; Social Studies 4.1.1, 4.1.4, 5.1.1, 5.1.1, 6 local government

Time: NA

Materials:

- chart paper and markers or chalkboard and chalk
- scenarios (such as one below or your own ideas)

Procedure:

1. Explain to students they will participate in a class discussion about making choices and how our choices affect the environment and potentially human health. Why are our choices important? How do they effect what we think and do? How can our choices affect the environment?
2. Provide a scenario, such as the example below, to the class. It can be written on chart paper or on the board.

The city council has decided to stop all traffic from entering the downtown area due to congestion and excessive idling. It is theorized that the excessive idling has resulted in poor air quality in the downtown area, indicated by data from air quality monitoring stations. During particular times of the year there is an increase in acid deposition in the area, as well as smog and ground-level ozone. There are also higher levels of benzene in the area. City council has proposed that only emergency service vehicles and school buses may pass through the downtown area, and all other traffic must park outside the area and walk to their destination.

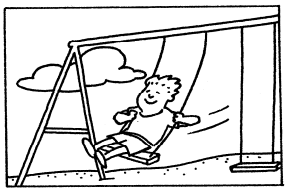
3. Ask students what they think about this problem and solution posed by the city council? What if their parents worked downtown? What about people who lived downtown? How would it impact them directly, or their parents? Do they think this is a good solution? What about other areas that have poor air quality? Discuss as a class and record ideas on chart paper or chalk board.
4. What are the pros and cons of this solution? What would life be like if we didn't drive as much as we appear to do now? What if we walked more, rode our bikes, took public transit, etc? Discuss as a class.
5. What other actions and activities do we do, on a daily basis that may have an effect on air quality? For example, does our electricity consumption have anything to do with air quality? (Yes – electricity is often generated by burning coal which emit pollutants into the air – the more electricity we use, the more electricity needs to be generated, to more coal that needs to be burned…).
6. What can we do to reduce our energy consumption, in the form of vehicle fuels, electricity, home heating, etc? On the board or chart paper list actions the students can take, as well as parents and other adults.
7. Show students the One Simple Act commitment form and explain what it is, or have students visit the One Simple Act website at: **www.onesimpleact.alberta.ca**

Ask students, if they choose to, to select an action they think they can commit to over the next month, the summer, or the upcoming year. It can even be committing to encourage parents, guardians or other adult drivers they know to reduce their idling time. Ask them to fill out the form and/or register their commitments online at: **www.zoomerang.com/Survey/survey-intro.zgi?p=WEB228ZGX26XR8**.

Create a brag board (simply a bulletin board or taping forms on a wall) in your school and post ALL the One Simple Act commitment forms on this board. This board could be located in a highly visible area, so that others in the school or visitors to the school know your school and/or students are doing their part to take action and help improve our environment.

8. After the discussion and visiting the One Simple Act site, brainstorm with the class other action projects you might take on as a class or school, in addition to the Idle-Free Schools pilot program, to help improve air quality by reducing emissions from vehicles. Why would it be important to encourage actions?

The Big Picture: How are all the learning's in this educational resource linked to taking action on cleaner air? Ask student to refer to their worksheets in their duo-tang on all the activities we did, and all the times we tried to think of ways to take action to help improve our environment, or specifically air quality. Track the links to all actions and compose them on one board or chart paper. Display for the class and think of ways to can take action in your school as well as home on these ideas. What can you do? Can you use your action plan that you developed? Can it apply to more than just you? How? What materials do you need to take action?



The Air We Share – Key Terms and Definitions

Acid Deposition:

Air:

Ambient:

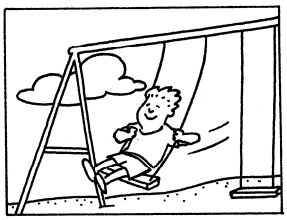
Air Quality:

Air Quality Index (AQI):

Benzene Ring (C_6H_6):

Carbon dioxide (CO_2):

Climate Change:



Emissions:

Legislation:

Nitrogen oxides (NOx):

Ozone (O_3):

Fine Particulate Matter ($PM_{2.5}$):

Smog:

Sulfur dioxide (SO_2):

Weather:

Glossary of Key Terms and Definitions

Acid Deposition: rain or any other form of precipitation that is unusually acidic, (e.g.) elevated levels of hydrogen ions (low pH). It has harmful effects on plants, aquatic animals, and infrastructure. Acid rain is mostly caused by emissions of compounds of sulfur, nitrogen, and carbon which react with the water molecules in the atmosphere to produce acids. However, it can also be caused naturally by lightning strikes or volcanic eruptions.

Air: a mixture of gases (oxygen, nitrogen, carbon dioxide, argon).

Ambient: completely enveloping, such as ambient air.

Air Quality: the composition of air with respect to quantities of pollution.

Air Quality Index (AQI): a number used by government agencies to characterize the quality of outdoor air at a given location. The AQI is calculated from the following five continuously monitored air pollutants –carbon monoxide, fine particulate matter (PM2.5), nitrogen dioxide, ozone and sulphur dioxide. The highest AQI number for any of the five pollutants measured is the AQI value for that hour for that station. The higher the AQI number, the greater the level of pollution; a rating of 0-25 indicates Good air quality, 26-50 is Fair, 51-100 is Poor, and more than 100 is Very Poor air quality.

Benzene Ring (C_6H_6): a colorless, liquid, inflammable, aromatic hydrocarbon which boils at 80.1°C (176.2°F) and freezes at 5.4–5.5°C (41.7–41.9°F). It contains six carbon atoms linked in a hexagon shape, with a hydrogen atom off of the carbon atom. Think of six large monkeys holding each other's tail in a circle, with a small monkey standing on the head of each large monkey!

Carbon dioxide (CO_2): a chemical compound composed of two oxygen atoms covalently bonded to a single carbon atom. It is a gas at standard temperature and pressure and exists in Earth's atmosphere in this state. It is used by plants during photosynthesis to make sugars, and produced during respiration by all animals, fungi and microorganisms that depend either directly or indirectly on plants for food. It is a major component of the carbon cycle. Carbon dioxide is also generated as a by-product of the combustion of fossil fuels or the burning of vegetable matter, among other chemical processes. Small amounts of carbon dioxide are emitted from volcanoes and other geothermal processes such as hot springs and geysers and by the dissolution of carbonates in crustal rocks.

Climate Change: any long-term change in weather over long periods of time, ranging from decades to millions of years. It can express itself as a change in the mean weather conditions, the probability of extreme conditions, or in any other part of the statistical distribution of weather. Climate change may occur in a specific region, or across the world.

Emissions: in terms of air pollution, refers to the introduction of chemicals, particulate matter, or biological materials that may be harmful to the atmosphere, the environment, humans or other living organisms. Vehicles, for example, have emissions in the form of exhaust.

Legislation: "statutory law;" a law which has been enacted by a legislature or other governing body, or the process of making it. It may refer to a single law or the collective body of *enacted* law, while "statute" is also used to refer to a single law. Before an item of legislation becomes law it may be known as a bill, and may be broadly referred to as "legislation" while it remains under consideration. Legislation can have many purposes: to regulate, to authorize, to proscribe, and to provide (funds), to sanction, to grant, to declare or to restrict.

Nitrogen oxides (NOx): is the chemical compound that exists as a radical in nature. One of several nitrogen oxides, NO_2 is an intermediate in the industrial synthesis of nitric acid, millions of tons of which are produced each year. This reddish-brown toxic gas has a characteristic sharp, biting odor and is a prominent air pollutant.

Ozone (O_3): trioxygen is a triatomic molecule, consisting of three oxygen atoms bonded together. It is much less stable than the diatomic O_2, which we breathe. Ground-level ozone is an air pollutant with harmful effects on the respiratory systems of animals. The ozone layer in the upper atmosphere filters potentially damaging ultraviolet light from reaching the Earth's surface. It is present in low concentrations throughout the Earth's atmosphere. It has many industrial and consumer applications.

Fine Particulate Matter ($PM_{2.5}$): includes a wide variety of tiny particles that are small enough to remain in the air for long periods of time. Sources include soil, roads, agricultural dust, vehicles, and industrial emissions. Smoke is another common source. Forest fires, cigarettes, household fireplaces and barbecues all emit fine particulates into the air. Particulates can come from both solid matter, like soil, and liquid aerosols.

Smog: a type of air pollution, the word "smog" is a combination of smoke and fog and can contain ground-level ozone, sulfur dioxide, nitrogen oxides and particulate matter. Classic smog results from large amounts of coal burning in an area caused by a mixture of smoke and sulfur dioxide. Modern smog does not usually come from coal but from vehicular and industrial emissions. It can be harmful to the environment and to humans.

Sulfur dioxide (SO_2): is the chemical compound produced by volcanoes and in various industrial processes. Since coal and petroleum often contain sulfur compounds, their combustion often generates sulfur dioxide.

Weather: The state of the atmosphere at a given time and place, with respect to variables such as temperature, moisture, wind velocity, and barometric pressure.

Online Resources

Provincial Websites:

Alberta Environment: Real-time air quality information
www.telusgeomatics.com/tgpub/ag_air/default.asp

Alberta Environment : Ambient air quality objectives
www.environment.alberta.ca/613.html

Alberta Environment: Alberta and Climate Change
www.environment.alberta.ca/3293.html

One Simple Act www.onesimpleact.ca

State of the Environment: Ozone levels in Alberta
www3.gov.ab.ca/env/soe/air_indicators/4_ozone_alberta.html

State of the Environment: Benzene levels in Alberta
www3.gov.ab.ca/env/soe/air_indicators/10_benzene.html

Alberta Environment : Air Quality Index www.environment.alberta.ca/617.html

CASA Data Warehouse homepage http://www.casadata.org/index.asp

CASA Data Warehouse www.casadata.org/airqualityindex/GoodAQI.asp

State of the Environment: Alberta's Air Quality www3.gov.ab.ca/env/soe/air.html

Alberta Environment: About Air Quality www.environment.alberta.ca/1050.html

Federal Websites:
Environment Canada : Air
www.ec.gc.ca/default.asp?lang=En&n=F3622FE4-1

Environment Canada: Impacts of a Changing Climate
www.ec.gc.ca/cc/default.asp?lang=En&n=3D00CF9C-1

Environment Canada: Ground-level Ozone
www.ec.gc.ca/cleanair-airpur/Ground_Level_Ozone-WS590611CA-1_En.htm

Centers for Disease Control and Prevention: Facts about Benzene
www.bt.cdc.gov/agent/benzene/basics/facts.asp

Other Websites:

The Weather Network
www.theweathernetwork.com/weather/cancities_en

Environmental Protection Agency: What affects my air quality?
www.epa.gov/airnow/airaware/day2-detail.html

The Air We Share

Background Information

What is Particulate Matter (PM)?

Particulate matter (PM) is tiny solid or liquid particles that are suspended, or floating, in the air. PM can include fumes, smoke, dust, ash, aerosols and pollen from both natural and human sources. Fine particulate matter can be emitted by any form of combustion, which is the burning of fuels. This can include burning gasoline or diesel fuel in vehicle engines, burning fuels or products in industry, and burning wood. It can also be formed through chemical reaction of gases in the atmosphere.

What is $PM_{2.5}$?

$PM_{2.5}$ is fine particulate matter that has a width (or diameter) less than 2.5 micrometers – this means $PM_{2.5}$ is about 30 times smaller than the width of human hair! These fine particles are small enough to breathe into the lungs, which can potentially be a human health concern. People who have asthma, lung or cardiovascular issues may be the most sensitive to $PM_{2.5}$. Both short-term and longer-term exposure to $PM_{2.5}$ can potentially cause adverse health effects.

What about the Environment?

Particulate matter can be detrimental to the environment. These tiny particles can be carried by wind and settle in soil or water, where they can increase acidity in water bodies, decrease nutrient levels in soil, or contribute to damaging plant life. Particulate matter can also form haze and reduce long range visibility.

What actions are being taken in Canada and Alberta?

In June 2000, the Canadian Council of Ministers of the Environment established Canada-Wide Standards for particulate matter and ozone. These standards are important steps towards minimizing the potential risks these pollutants can cause to the environment and human health. These standards commit government to significantly reducing ground-level ozone and particulate matter by 2010. Individual actions, such as reducing idling time, are a way we can help achieve this goal.

Alberta Environment has taken the right step by managing ozone in the province before a critical level is reached. Alberta Environment does various monitoring and reporting activities and has developed a Framework to manage particulate matter in the province.

For More Information:

www.environment.alberta.ca/1970.html

www.environment.alberta.ca/documents/Particulate_Matter_and_Ozone_Fact_Sheet.pdf

Government of Alberta

education energy environment
Calgary Board of Education

enviro matters

The Air We Share

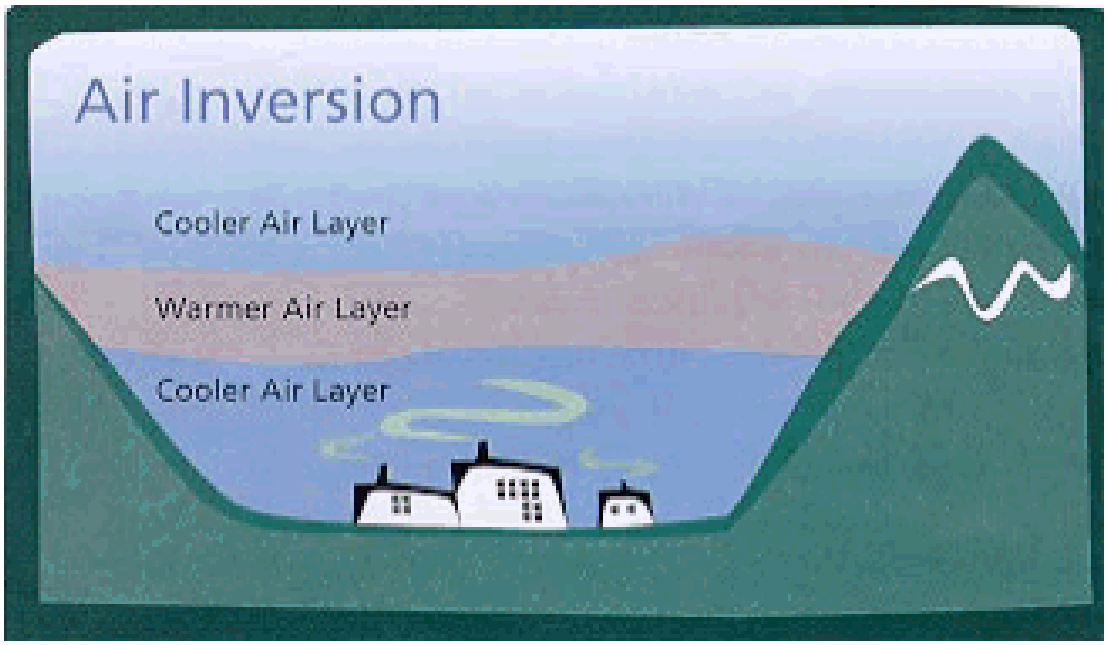
Background Information

What is Ozone?

Ozone is a very tiny molecule that is composed of three oxygen atoms. It is naturally found in our stratosphere, a part of Earth's upper atmosphere. Ozone way up there is known as the ozone layer and it helps to protect life on Earth from the Sun's harmful UV rays. However, ozone can also be found at ground-level, formed through chemical reactions of other gases, many of which come from vehicle or industrial emissions. Ground-level ozone can be harmful to the environment and potentially to human health.

Does Weather have anything to do with Ozone?

Calm or low wind conditions promote the build up of pollutants, such as ozone, as well as the gases that react to form it. Such conditions can result from strong inversions. An inversion occurs when the temperature in the atmosphere increases with height above the ground and vertical mixing of the air is restricted. As you go higher up in the atmosphere, away from Earth's surface, the temperature normally gets colder; closer to Earth's surface the temperature is normally warmer. An "inversion" occurs when the reverse takes place; the temperature gets warmer as you move higher up, away from the surface. An inversion can have an effect on ground-level ozone by making a stable layer of air near the surface with little mixing; this "traps" ground-level ozone and other pollutants near the ground. In the winter, when air is colder and "still," meaning it does not move around as much, ground-level ozone and other pollutants can build up in a particular area and hang around longer. This can result in higher levels of ground-level ozone and poor air quality. In the summer-time hot, sunny weather can result in more ground-level ozone formation.



Inversion Layer

The formation of ground level ozone is also affected by how much solar radiation we receive from the sun. Energy from the sun is required for atmospheric reactions that form ozone. That is why ozone concentrations are typically higher during the afternoons when it is often warmer outside; this effect contributes to the haze that is seen above cities.

Effects of Ground-level Ozone.

Ground-level ozone is a major component of smog. During hot weather conditions, emissions from vehicles, industry and other sources can lead high ozone levels, especially in larger cities. This can cause damage to plants by interfering with the plant's abilities to undergo photosynthesis and other processes. Evidence of ground-level ozone damage can be identified by small white or brown to black spots on broad-leafed plants, such as maple trees or shrubs. On coniferous trees, such as pines or spruces, needles can develop yellow flecks, or brown tips.

Ground-level ozone has also been found to irritate the eyes, and could potentially affect lung function or negatively affect respiratory and cardiovascular systems.

What actions are being taken in Canada and Alberta?

In June 2000, the Canadian Council of Ministers of the Environment established Canada-Wide Standards (CWS) for Particulate Matter and Ozone. These standards are important steps towards minimizing the potential risks these pollutants can cause to the environment and human health. These standards commit government to significantly reducing ground-level ozone and particulate matter by 2010. The Alberta government has developed a Framework to manage particulate matter and ozone in the province in order to meet this target. Individual actions, such as reducing idling time, are a way we can help achieve this goal.

Alberta Environment has taken the right step by managing ozone in the province before a critical level is reached. Alberta Environment does various monitoring and reporting activities, and has worked with airsheds to develop air quality management plans for the Edmonton, Calgary and Red Deer regions.

For More Information:

www.environment.alberta.ca/1970.html
www.ec.gc.ca/cleanair-airpur/Home-WS8C3F7D55-1_En.htm
www.environment.alberta.ca/documents/Particulate_Matter_and_Ozone_Fact_Sheet.pdf

Government of Alberta

enviro matters

education energy environment
Calgary Board of Education

The Air We Share

Background Information

What is Acid Deposition?

Acid deposition occurs when acidic pollutants in the air are deposited on the earth's surface. The main acid-forming gases are sulphur dioxide (SO_2) and nitrogen oxides (NO_x). SO_2 and NO_x are emitted from vehicles and industrial activities. These substances react in the atmosphere to form acids (such as sulfuric and nitric acid) that return to the earth in precipitation (e.g. rain or snow), or as particles or gases.

Effects of Acid Deposition.

Precipitation that is acidic can be harmful to plants, wildlife, soil, water, and even buildings. Acid deposition can directly damage the leaves, flowers and stems of plants. Roots of plants can also be damaged if the soil can not neutralize the acidity of the precipitation. Trees, such as white pine, jack pine, aspen and birch are sensitive to acid deposition.

Soil quality can be affected by increasing acidity (lower pH). This can cause nutrients, such as nitrogen, to leach from the soil. Additionally, increasing soil acidity makes toxic metals such as aluminum and lead more soluble, where they can be taken up by the roots of plants. Water quality can also be affected by acid deposition. One of the first signs of effects is the disappearance of crustaceans, insects and some plankton species from aquatic ecosystems. As the pH continues to drop, loss of fish populations occurs. If the pH drops low enough (below pH 5.0) very few fish can survive and the shore area may be covered by mosses.

$SO_2$and NO_x can potentially affect human health by contributing to the production of smog and ozone. SO_2 can also irritate the nose and throat, and $SO_2$and NO_x can potentially contribute to respiratory issues.

What is being done in Alberta?

Alberta Environment monitors air, rain, snow, water, and soils for acid deposition throughout the province. Governments and industry are working together to reduce air pollution. Alberta Environment establishes ambient air quality objectives for major air pollutants including sulphur dioxide and nitrogen dioxide, as well as a management program for acid deposition. Individual action, such as reducing driving time, can also help!

For More Information:

www.ec.gc.ca/cleanair-airpur/Acid_Rain-WSAA1521C2-1_En.htm
www.environment.gov.ab.ca/info/library/6193.pdf

Government of Alberta

enviro matters

education energy environment
Calgary Board of Education

The Air We Share

Background Information

What is Smog?

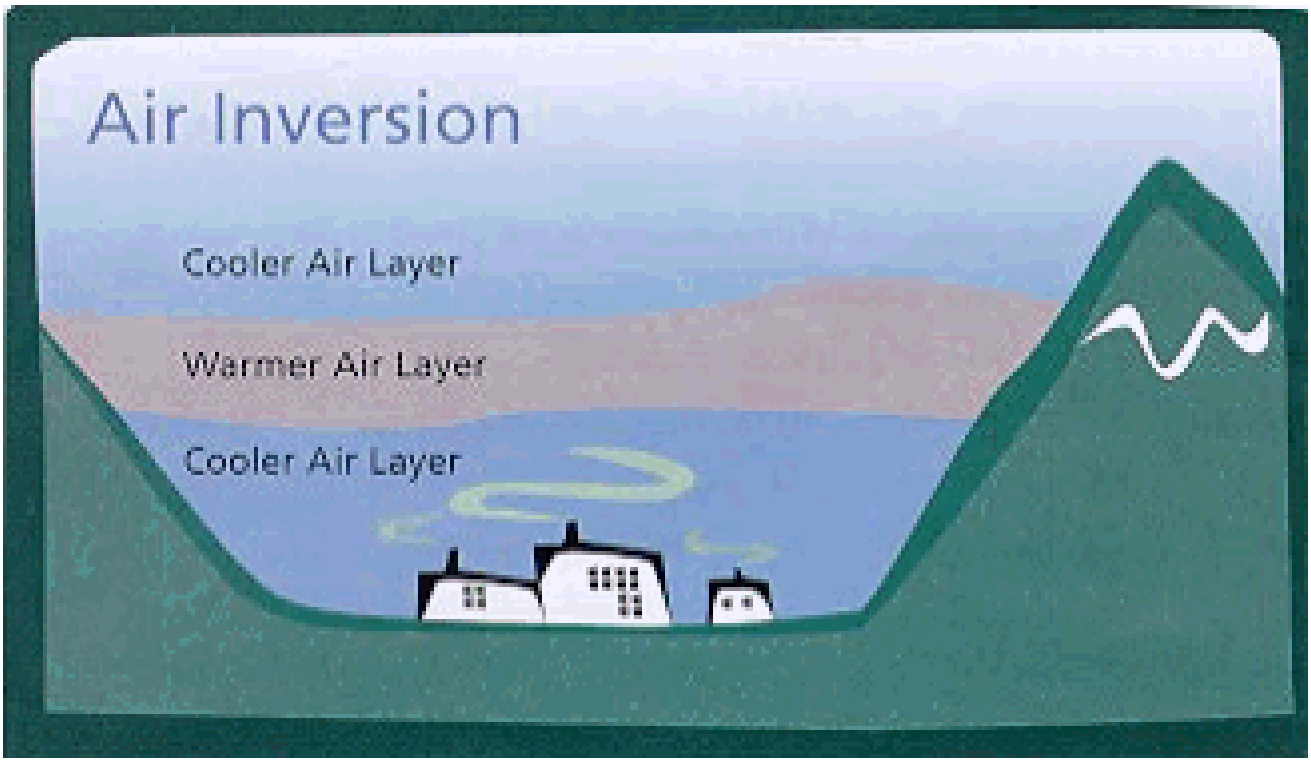
Smog is a combination of pollutants. It can contain ground-level ozone, sulfur dioxide, nitrogen oxides and particulate matter. These pollutants come from vehicle emissions, industry, burning wood and other sources. The word smog was first used in London, England to describe the mixture of smoke and fog – hence the term “smog.” Smog can be seen as haze along the skyline of larger cities. On days with little wind, smog and related pollutants can build up and produce poor air quality. Smog can be harmful to the environment and potentially to human health.

Effects of Smog.

Smog can affect plants and wildlife, as well as potentially have an effect on human health. Smog can damage crops or slow plant growth, potentially affect the respiratory or cardiovascular systems of animals and humans, cause irritation to the eyes, nose or throat, and may contribute to asthma symptoms. The haze associated with smog can also reduce visibility, which can contribute to safety concerns, while driving for example.

Winter-time Smog.

Winter time smog refers to the ground-level buildup of emitted pollutants. In the absence of air movement (clam or low winds), emitted pollutants are not dispersed or transported. In the winter, such conditions are observed during temperature inversions. As you go up in the atmosphere, away from Earth’s surface, the temperature normally gets colder; closer to Earth’s surface, the temperature is normally warmer. A “temperature inversion” occurs when the reverse takes place; the temperature gets warmer as you move up, away from Earth’s surface. An inversion can “trap” smog near to or at ground-level by creating a stable layer of air with little mixing. In the winter, when air is colder and “still,” meaning it does not move around as much, smog can build up in a particular area and hang around longer, possibly resulting in poor air quality.



Inversion Layer

Summer-time Smog.

Summer time smog is produced as a result of a chemical reaction in the atmosphere.
Ozone is a major component of smog during hot summer weather. When winds are light and temperatures are high, smog can build up at ground level and be harmful to the environment and human health.

The Landscape.

In addition to weather, the way the land is shaped, also known as topography, can have an effect on how pollutants, such as the ones that contribute to smog, can become concentrated. For example, in a valley or even on rolling plains, the landscape can act as a barricade to air movement, causing the air and pollutants to remain in an area.

For More Information:
www.ec.gc.ca/cleanair-airpur/Pollution_Issues/Smog-WS13D0EDAA-0_En.htm

Government of Alberta

enviro matters

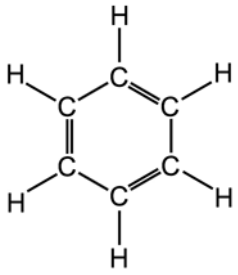
education energy environment
Calgary Board of Education

The Air We Share

Background Information

What is Benzene?

Benzene is an organic chemical compound, which means it contains carbon and hydrogen. Benzene is grouped into a category called Volatile Organic Compounds, or VOCs.



Benzene Ring

Benzene can be found naturally, or can be synthesized, which means it can be made in a laboratory, from other petroleum compounds. Benzene is naturally found in crude oil, and can also be formed during oil refining processes. Motor vehicle emissions are the main source of benzene in Alberta. Other sources include industrial emissions, handling and storing fuels, forest fires and the burning of other products, as well as cigarette smoke.

Effects of Benzene.

Benzene can have an effect on the environment, particularly to aquatic plants and animals. Benzene can damage or even kill plants, it can be fatal to aquatic animals, affect animal reproductive health, or possibly contribute to behavioral issues in animals.

Long term and short-term exposure to benzene can lead to serious health effects in humans as well. Benzene is a known carcinogen; longer-term exposure to benzene has been linked to causing some cancers. Short-term exposure to benzene can cause respiratory problems, dizziness or headaches.

For More Information:

www3.gov.ab.ca/env/soe/air_indicators/10_benzene.html
www.bt.cdc.gov/agent/benzene/basics/facts.asp

Government of Alberta

enviro matters

education energy environment
Calgary Board of Education

The Air We Share

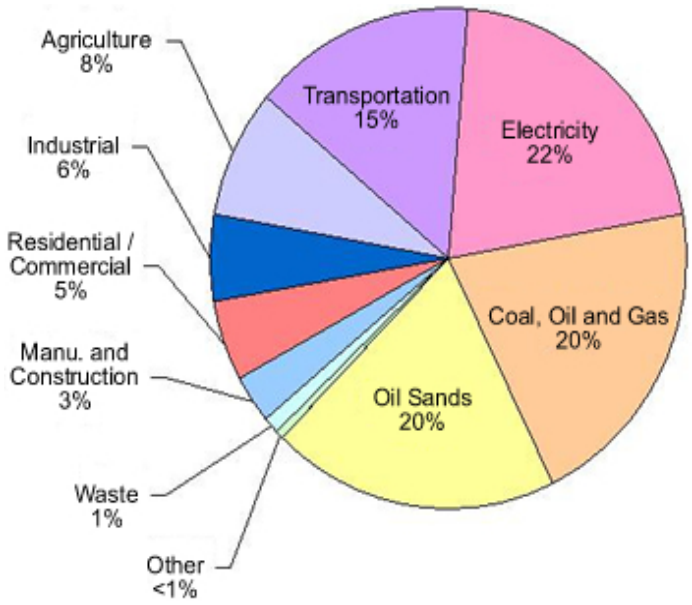
Background Information

Transportation, Emissions and Air Quality.

The vehicles we use in daily life are often necessary; our cars, trucks, motorcycles, ATV's, and buses help us travel to and from work, school, to visit family and friends, and enable us to explore our beautiful country. Using our vehicles for these purposes is not necessarily a negative thing – however, keeping our vehicles running when we are not driving them (idling) releases pollutants into the air while the vehicle is not in use. Idling a vehicle can become problematic, especially if we consider the effects that vehicle emissions can have on the environment and potentially on human health.

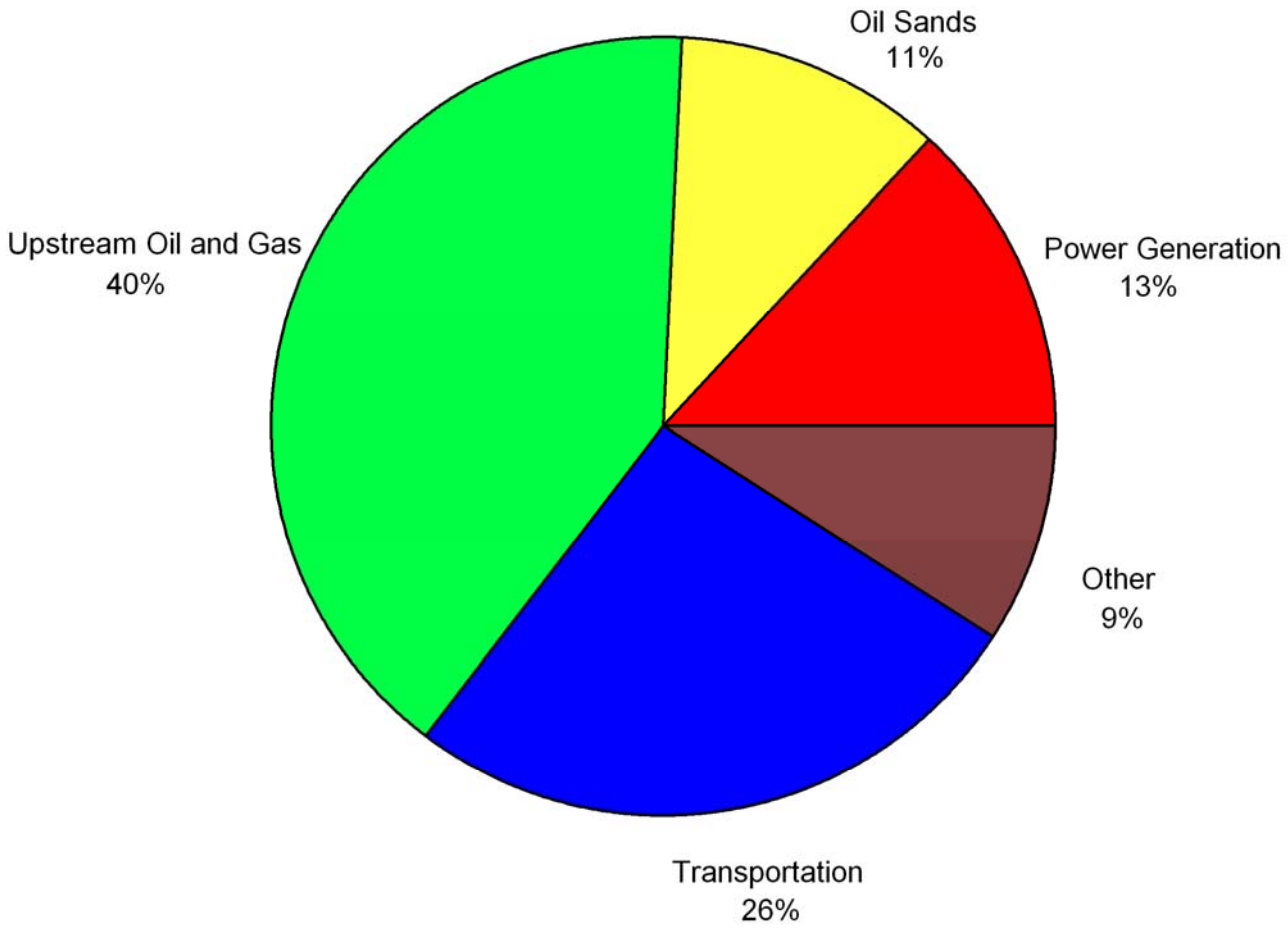
Pollutants released to the air from a source, such as from our vehicles or from industry "stacks", can include nitrogen oxides, sulphur dioxide, benzene, particulate matter and carbon dioxide. These chemical compounds can cause damage to plants, wildlife, water and soil quality, and may have potential impacts on human health. Carbon dioxide, while not impacting human health, can contribute to climate change and be linked to other various issues such as drought, poor soil quality, and potential loss of biodiversity. The chart below illustrates Alberta's 2006 Greenhouse Gas Emissions.

2006 Alberta Greenhouse Gas Emissions - 234 Megatonnes total



Sulphur dioxide, nitrogen oxides, benzene, and particulate matter, are chemicals found in vehicle emissions and can contribute to a variety of environmental issues, such as damage to plants, soil or water and interference with animal reproduction. These emissions may also pose human health risks, such as contributing to the formation of smog or ground-level ozone, potentially contributing to respiratory or cardiovascular issues, or possibly causing some cancers. Depending on weather conditions outside, pollutants can build-up or accumulate in an area, for example, where several cars are idling (pick-up/drop-off points, drive-thru's, stop-lights). The chart below illustrates where oxides of nitrogen emissions in Alberta come from; note the transportation sector.

Alberta Oxides of Nitrogen Emssion by Sector



Data from Environment Canada Criteria Air Contaminants Provincial Summary, June 7 2007

What Can We Do to Reduce Emissions?

The release of the above chemical compounds can be reduced when we are not driving our vehicles, especially if we choose to turn off the engine when we are idling while, for example, waiting to pick-up passengers, waiting in drive-through lines, running a few "short" errands, waiting for a train to pass, or are "warming-up" our vehicle in the winter. We *can* reduce our idling time when it is safe to do so and when idling is not necessary. We can also support the development and purchasing of cleaner fuels and vehicles if possible, participate in vehicle inspections to ensure our
vehicle is running efficiently, or use alternative transportation, such as walking, biking, transit, carpooling, and so on.

How Will It Benefit Me?

Idling can contribute to poor air quality and affect environmental health, as well as contribute to climate change. Components in vehicle exhaust may also affect human health. If we choose to turn off our vehicles when it is not necessary to idle, we are taking the steps toward improving our air quality, which can help to improve the environment and human health.

Will I Save Money If I Turn Off My Engine?

Yes! For a min-van or small SUV, if you choose NOT to idle for 5 minutes each day, *you can save $30 or more a year!* You actually *use more fuel* if your vehicle is idling for more than 10 seconds! So turning off our engines not only help the environment and human health, but can help our pocketbook too!

For More Information:

www.onesimpleact.alberta.ca/
www.env.gov.bc.ca/epd/bcairquality/topics/vehicle-pollutants.html
www.environment.alberta.ca/3293.html

Government of Alberta

enviro matters

education energy environment
Calgary Board of Education

The Air We Share

Background Information

What is Climate Change.

Climate change is a wide-scale change in average weather over a period of time, for at least 30 years. Climate change can naturally occur due to a number of factors, such as changes in the Earth's orbit, volcanic eruptions, or changes in energy from the sun.

What are Greenhouse Gases?

Greenhouse gases can include:

- Carbon dioxide
- Methane
- Nitrous oxide
- Water vapour
- Perfluorocarbons (PFCs)
- Sulphurhexafluoride (SF_6)
- Hydrofluorocarbons

Greenhouse gases (GHGs) have an important effect on Earth's temperature. They trap heat in the atmosphere and cause global temperatures to rise. This is called "the greenhouse effect." The first four gases in the list above occur naturally in our environment and make up less than one per cent of the Earth's atmosphere. Naturally occurring GHGs are essential for our survival; they act like a blanket around Earth, trapping heat in the lower layer of our atmosphere and prevent most heat from escaping. The issue is that humans have substantially increased the amount of naturally occurring GHGs by burning fossil fuels, including coal, oil and natural gas. Scientists now agree that human activity is most likely responsible for most temperature increases over the past 250 years. The biggest concern is the *speed* at which these changes are happening.

Carbon Dioxide.

Carbon dioxide is a chemical compound composed of two oxygen atoms and a single carbon atom It is a gas that exists in Earth's atmosphere. Carbon dioxide is the main concern in climate change. Atmospheric levels of carbon dioxide are increasing by more than 10 per cent every 20 years. If our emissions continue to grow at current rates, the level of atmospheric carbon dioxide will almost double during the 21st century; it is possible it could even triple!

Alberta's Climate Change Strategy.

As a global energy producer, Alberta's challenges are perhaps bigger than those of other jurisdictions, but so too are the opportunities to find real and positive solutions to climate change. Alberta's C*limate Change Strategy* addresses not only how much energy we use, but also how we can combine technology and expertise to capture emissions and produce cleaner energy for Alberta and the world. The strategy is divided into three areas of focus:

- Conserving and Using Energy Efficiently, ranging from in the home to businesses, institutions and government.
- Implementing Carbon Capture and Storage, a technology to store carbon emissions deep underground, in Earth's geological formations.
- Greening Energy Production, by expanding our use of alternative energy sources such as wind and solar, water and geothermal energy.

There are also many other important initiatives working to reduce carbon emissions, such as the City of Edmonton's CO2RE program, the City of Calgary's Climate Change Action Plan, and Climate Change Central's energy efficiency rebates program, in partnership with the Government of Alberta.

Adapting to Climate Change.

Scientists agree climate change caused by human actions will continue for centuries to come. Strategies to adapt to climate change must go hand-in-hand with actions to reduce current and future greenhouse gas emissions. It is important to understand that we *can* mitigate the effects of climate change by protecting, conserving, and enhancing our wetlands, forests, and other natural spaces. These spaces act as carbon sinks, which store carbon dioxide. We can also *reduce* our energy consumption, and commit to actions that help *conserve* our natural resources. This will impact how much carbon dioxide is emitted into the atmosphere.

Reducing Our Footprint.

"Footprint" refers to the impacts our actions have on the Earth. Everything we do has an effect on the natural resources in our province – the goods we buy, the energy and water we use, and the waste we throw away. What is important is how we manage and reduce these effects by choosing to make small changes. By reducing our energy consumption, as well as conserving our natural resources, we can make big changes for future generations! Committing to *One Simple Act* is one way to help reduce our footprint; through this program we can reduce waste, conserve water and reduce energy consumption!