

A Teacher's Guide to Clean Air

GRADE FIVE | NOVEMBER 2005



THE CLEAN AIR CRUSADERS

**PREPARED IN
PARTNERSHIP BY
THE BC CLEAN
AIR COMMITTEE:**

BC Ministry of Environment

3 - 2975 Jutland Rd
Victoria, BC V8T 5J9

Tel: 250-356-0634
Fax: 250-250-7197



Ministry of
Environment

BC Transit

520 Gorge Rd East
PO Box 610
Victoria, BC V8W 2P3

Tel: 250-385-2551
Fax: 250-995-5641



**Environment Canada
Communications**

201- 401 Burrard Street
Vancouver, BC V6C 3S5

Tel: 604-664-9100
Fax: 604-713-9517



Environment
Canada

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CLEAN AIR RESOURCES

To download this guide as a PDF, and for teacher's air quality resources and activities, visit:
<http://wlapwww.gov.bc.ca/air/cad/index.html>

For more information about air quality and climate change issues in BC, visit:
<http://wlapwww.gov.bc.ca/air/index.html>

For information about clean air issues in Canada, visit:
<http://www.ec.gc.ca/cleanair-airpur>

For information about transit in BC, visit:
<http://www.busonline.ca>

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1 INTRODUCTION

BC Clean Air Day

In 1992, the Government of British Columbia proclaimed the first Wednesday in June, every year, as Clean Air Day, which takes place during Environment Week. The purpose was to raise awareness about air quality issues, and to encourage British Columbians to make clean air choices.

The federal government proclaimed National Clean Air Day in 1999, on the same date as BC Clean Air Day. Since then, other provinces have joined the Clean Air Day celebration with activities such as commuter challenges, information events about wood-burning-stove emissions, vehicle-emissions testing, children's programs, sustainability fairs and more.

Since 1999, the BC Clean Air Committee partners (BC Ministry of Environment, BC Transit and Environment Canada) have produced a clean air poster and teacher resource to coincide with Clean Air Day. This year, the poster is being released in the fall with an enhanced teacher's guide, to allow teachers to include air quality issues in their lesson plans.

Superhero Theme

Comics featuring superheroes have been used for social causes for over 70 years. Political and cultural history has helped shape the course of comics. In the 1930s, the superheroes were rebels and vigilantes. In the World War II era,

patriotic heroes were developed. Heroes such as Wonder Woman served as role models for children, encouraging donations for the war effort. Since then, superheroes have gained prominence in raising awareness about the dangers of drugs, guns and land mines. The superhero comic characters were chosen as the medium for the Clean Air teacher's guide, to help deliver the message about clean air.

The poster design involves three Clean Air Crusaders. The look and feel of the poster is classic comic book art: futuristic backgrounds in sepia tones. Each superhero has one or more air pollution problems to fight, with specific powers. They confront pollution in three air-quality environments: industry (the Green Protector), transportation (the Winged Wonder) and neighbourhoods (Captain Air). They also help their fellow Clean Air Crusaders because air pollution sources and problems are interrelated. The crusaders' names could be replaced by new names that your students dream up.

There are four posters in your Clean Air package: three individual posters, depicting one of the three Clean Air Crusaders, and one large poster, merging the individual posters. The three individual posters are for your class. The large one is for the entire school. Please let us know if you need another set of posters and teacher's guide for your school.

2 ABOUT THE TEACHER'S GUIDE

Goals

The goals of this guide are to:

- enable teachers to educate their students about air quality issues in BC
- emphasize that each person has the power to reduce air pollution
- enable teachers to encourage students to take action for cleaner air.

Who It's For

This guide is for grade five teachers in BC, and can be used in conjunction with the Clean Air Crusaders (superheroes) poster. No matter where you live in BC, you'll find an activity or piece of information that will help you bring the clean air topic into your classroom. Much of the guide's content and clean air actions are meant to be shared with parents, so we hope the discussion topics will find their way home with the students.

We have not suggested a time period for introducing the clean air concepts to the students. It will probably be different for every teacher, depending on how much of the guide the teacher decides to incorporate into the lesson planning. The Clean Air Crusader's symbol is used in the guide, indicating to which superhero environment each section is linked.

Why Use It?

By the time the current generation of school children graduates, it is predicted that there will be significant climate change and increased air pollution. Incorporating climate change and air quality issues into lesson plans should allow students to understand the current challenges, projected impacts and how they as individuals can make a difference.

We recommend that air quality problems be discussed with a positive “We can do it!” attitude, rather than a “doomsday approach.” Governments and industries are taking many steps to address air quality issues. Individual action is also key to reducing air quality problems — from neighbourhood smoke to global atmospheric degradation. Each one of us plays a part in polluting the air. Equally, there’s so much we can do to become part of the environmental solution.

Feedback

We would like to hear your thoughts about this teacher’s guide. Complete and fax the feedback form at the back of the guide for a chance to win **\$300** for your school!

3 LESSON OUTLINE: AIR QUALITY AND CLEAN AIR

Content

Students will learn about air quality issues, and what they can do to help clear the air.

Prerequisites

Students must:

- know that humans need air to survive
- know that air pollution can harm people’s health
- have a basic understanding that air pollution comes from human activities (e.g., motor vehicles).

Instructional Objective

The student will learn about air quality by understanding:

- clean air and the atmosphere
- air pollution
- the specific air pollution problems in BC
- what happens when we burn fossil fuels
- what energy and energy conservation are
- global climate change
- particulate matter
- ground-level ozone
- air pollution in our neighbourhoods
- how we can reduce air pollution
- air pollution terminology.

Curriculum Connections: Grade Five

Sciences

Physical Science: Materials in Our World

Learn about air quality and health, local and global air quality issues.

Life Science:

BC’s Living Resources

Learn about air resources. Investigate ways of lessening the impact of resource harvesting, and reducing air pollution.

Life Science: Body Systems

Learn about respiration, circulatory systems: We need to breathe clean air and find out how we can make our air healthier to breathe.

Social Studies

Environment

Learn about effects of lifestyles and industries on the environment.

The student will learn more through follow-up activities and Internet resources. Follow-up activities are described in [section 18](#). In addition, the beginning of most sections identifies the appropriate activities for the section's topic. Images that can be used as overheads are included at the back of this guide.

The logo of each crusader that accompanies section titles indicates the specific superhero responsible for the air quality issue being discussed. Terminology used in discussing air quality and health is included in [15. Air Pollution Terminology](#).

4 INTRODUCING THE CLEAN AIR CRUSADERS



The Green Protector

has a Power Leaf that never dies. This leaf absorbs carbon dioxide, just as trees and leaves do. But it can absorb much more carbon dioxide than a usual leaf because it's amazingly strong and can grow to 10 times its size. Like all plants, the Power Leaf gives off oxygen, which we need to breathe. This amazing leaf can soak up carbon dioxide from anything that burns fossil fuels, such as industrial activities, motor vehicles, furnaces and gas-powered garden tools.



The Green Protector's main environment – the place he works – is the industrial parts of our world. He joins the other Clean Air Crusaders in their war against all kinds of air pollution. Despite the Green Protector's enormous powers, he needs the other crusaders to help him prevent air pollution and global climate change.



The Winged Wonder

has incredibly powerful wings, so she doesn't need to travel in vehicles that cause air pollution. She can fly anywhere in a flash, spreading her clean air message. The Winged Wonder's goal is to build a team of kids all across the world that can help her battle air pollution.



The Winged Wonder works with the Green Protector to reduce the pollution that comes from burning fossil fuels, but she focuses on motor vehicles. Motor vehicles cause a considerable amount of air pollution. They don't just release carbon dioxide, which is bad enough. They contribute to three major environmental problems in our province: global climate change, emissions of particulate matter and development of ground-level ozone.



Captain Air

has a helmet and tank that provide him with pure, clean air wherever he goes, no matter how much air pollution there is. This Clean Air Crusader concentrates on local air pollution — in other words, our neighbourhoods and our homes. Air pollution doesn't only occur in big cities or in industrial areas. We're exposed to it in our daily life, right where we live. It comes from our own actions, such as how we heat our homes, get around, and do our gardening.



Captain Air's mission is to tell us how we can protect our health by putting a stop to pollution-causing emissions. He is dedicated to explaining how to decrease smoke, along with vehicle exhaust and other air pollutants.

Although Captain Air's focus is our neighbourhoods and homes, he also fights to cut emissions caused by motor vehicles and industry. These emissions contribute to global climate change, increased particulate matter and ground-level ozone readings. ("Emission" means the release of pollutants from a source.)

5 CLEAN AIR AND THE ATMOSPHERE

The air we breathe near the earth's surface contains various gases. Clean air consists of about 78% nitrogen, 21% oxygen, and less than 1% of argon, carbon dioxide, and other gases — as well as varying amounts of water vapour.

Our atmosphere is a mixture of gases that surround the earth. It is the air we breathe, the wind and rain, and the clouds in the sky. It is life giving, retaining heat and blocking out harmful rays (ultraviolet radiation) from the sun.

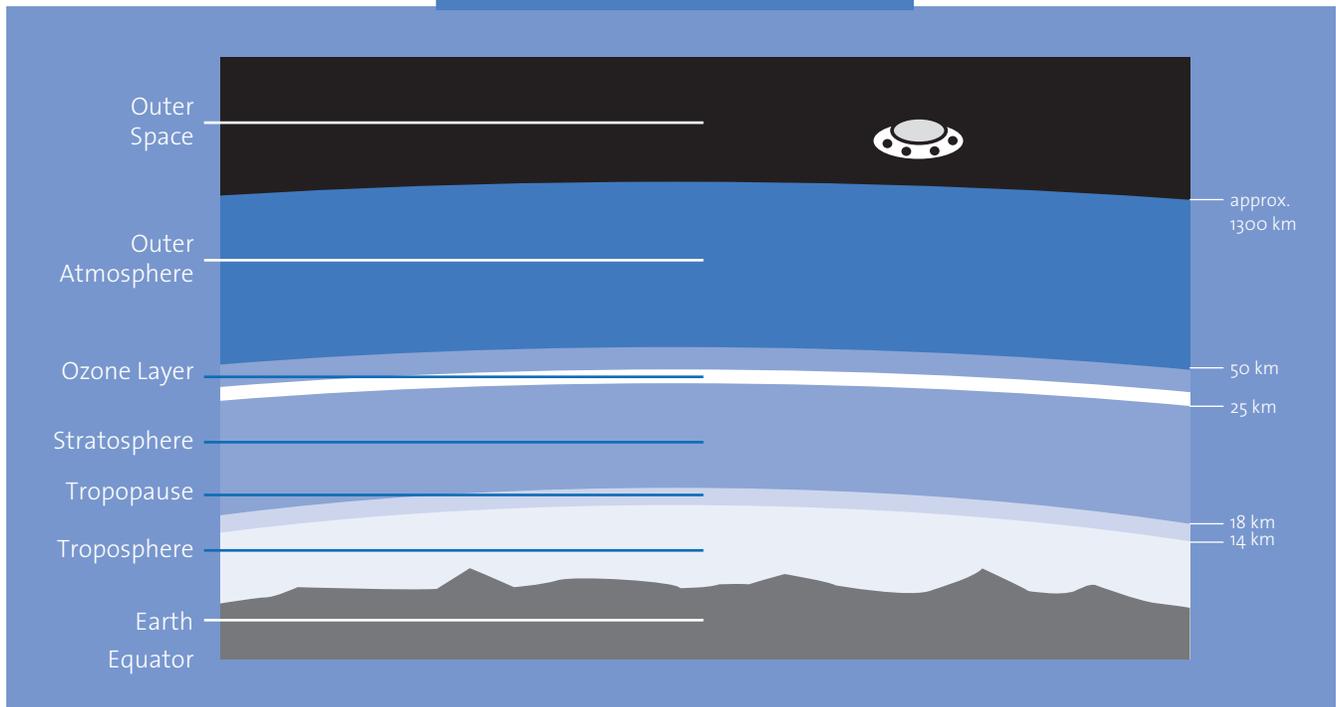
The atmosphere is about 1,000 kilometres thick, and is made up of invisible layers that circle the planet. We live in the lowest

and thinnest layer, called the troposphere, which is only about 14 kilometres thick.

The bottom two kilometres of the troposphere are really our "home." That's where most of the air and weather are, and where most of the air pollutants collect. Two kilometres aren't very much. It would take just two minutes to drive that distance, at 60 km per hour.

Above the troposphere are the other layers of the atmosphere. They vary in temperature, but eventually get colder, with less and less air. That's where the ozone layer is, and where our emissions of greenhouse gases and ozone-depleting substances go. There is no exact place where the atmosphere ends; it just gets thinner and thinner, until it merges with outer space.

The Earth's Atmosphere



6 AIR POLLUTION

FOLLOW-UP ACTIVITIES:

1. WORD SEARCH
2. CLEAN AIR QUIZ
4. POSTER DISCUSSION
5. STRAINING TO BREATHE
6. PLANT A TREE
9. HOW CLEAN IS OUR AIR?
11. ORGANIZE A WALK TO SCHOOL DAY

What Is Air Pollution?

Air pollution occurs when gases, liquid or solid substances are in high enough amounts (concentrations) in the atmosphere to be harmful to the environment and/or our health. These gases and particles are referred to as “air pollutants,” which cause air pollution.

Common air pollutants include carbon dioxide, particulate matter, wood smoke, ground-level ozone, carbon monoxide and dust. Air pollutants can be visible, (such as the yellow-brown haze of smog) or invisible. Besides affecting human health and the environment, air pollutants can also hamper our ability to see very far (visibility).

The impacts of air pollution can be local and global. Health effects can last for a short while (e.g., coughing) or become a long-term problem (e.g., lung and heart disease, cancer). Pollution can also cause death. An air pollutant can become dangerous to our health when we are exposed to it for a long time, and also when we breathe in a large amount of it.

WHAT WAS THE FIRST THING YOU DID WHEN YOU WERE BORN?

TAKE A BREATH!

The Red-Dye Example: How Air and Air Pollutants Behave

Red dye and water can help us understand air pollution. Imagine that you’re pouring a litre of red dye into the ocean. The dye will sit in a small red pool for a few seconds. As soon as the waves come, though, the dye will be mixed with the water in the huge ocean. It’s not just the amount of water that dilutes the dye. It’s also the energetic mixing by the waves.

Now think of pouring the same amount of red dye into your bathtub. The bath water will turn very red. The red dye won’t be diluted because it’s trapped in the bathtub, in a very small amount of water, and there can be no mixing with clean water.

If air pollutants are in a large area with good airflow, they will mix with the air, then quickly separate and go in different directions (disperse), like the red dye in the ocean. However, pollutants can be trapped in an area and build up, just like the dye in the bathtub. This can happen when the weather and the terrain (such as a valley) trap pollutants, preventing them from mixing with clean air and moving away. The outcome

is air pollution — or poor air quality, as defined by Canadian environmental standards.

Local Air Pollution

We come in contact with many kinds of air pollutants every day. They are being released in our neighbourhoods, our backyards, inside our homes, and are finding their way into our lungs. Outdoor pollutants seep into houses, even through closed doors and windows. Air pollution can also cover large areas, as with smoke from a forest fire, or ground-level ozone in the Lower Fraser Valley.

Global Air Quality Issues

Certain emissions are having a significant effect on the earth’s atmosphere, leading to changes in the planet’s delicate balance of life. A greater than natural amount of greenhouse gases in the atmosphere are contributing to global climate change. Carbon dioxide is a major greenhouse gas.

Ozone-depleting substances, such as chlorofluorocarbons (CFCs), are responsible for reducing the amount of ozone in the stratosphere’s ozone layer. The ozone layer acts as a huge sunscreen that surrounds the earth and protects it from too much of the sun’s ultraviolet radiation.

Ozone depletion is not covered in this teacher's guide. If you would like more information on this subject, please visit the Ministry of Environment's web site:

<http://wlapwww.gov.bc.ca/air/ozone/index.html>

or Environment Canada's web site:

<http://www.ec.gc.ca/ozone/en/index.cfm>

The quality of the air depends on the amount of pollutants, the rate at which they are released from various sources, and how quickly the pollutants disperse (or how long they are trapped in an area).

The weather and the physical features of the land have much to do with how much air pollution there is, how far it extends, and how long it lasts. Weather (wind, temperature and air turbulence) and the terrain can hinder pollutants from travelling away

from a community or region. For example, many BC communities are in valley bottoms. The valley walls naturally trap pollutants, which can build up to high concentrations. This air pollution can remain in the area for days to weeks.

Temperature inversions frequently contribute to poor air quality — again, often in valleys. In winter, a common situation can occur in which a layer of warm air sits atop a layer of cold air near the surface. The warm air naturally forms a cap that prevents the cooler air, and its pollutants, from mixing with the warmer air above. As a result, pollution becomes trapped close to the ground. The pollution increases until the inversion ends and the air can flush it from the area. Inversions also take place during the summer — when weather systems create conditions whereby even hotter upper air traps warm air beneath it.

Air gets polluted by human and natural activities, such as:

Fossil Fuel Burning (combustion)

motor vehicles, marine vessels, airplanes, power plants, industries, space heating (oil and gas furnaces) and gas-powered garden tools

Wood Burning

wood stoves and fireplaces, backyard burning, land-clearing fires; slash burning in logging (stumps, branches and other vegetation), and burning of wood leftovers in sawmills

Industrial Processes

factories; pulp and paper mills and smelters

Burning of Toxic Substances

construction materials, garbage, plastics and tires, paints, solvents, cleaning agents, hair and deodorant sprays, dust from roads, construction sites and agriculture

A Temperature Inversion in a Valley



The arrows symbolize the colder air being pushed down to the surface by warmer air. This inversion and the valley walls trap pollution.

7 SPECIFIC AIR POLLUTION PROBLEMS IN BC

FOLLOW-UP ACTIVITIES:

1. WORD SEARCH
2. CLEAN AIR QUIZ
5. POSTER DISCUSSION
6. PLANT A TREE
9. HOW CLEAN IS OUR AIR?
10. ORGANIZE A WALK TO SCHOOL DAY

What Are the Major Air Pollution Problems in BC?

In BC, the air pollutants that pose the most serious, local threat to our health are particulate matter and ground-level ozone. Carbon dioxide and other greenhouse gases are also of great concern because they are responsible for climate change, a global issue.

Also of note: Particulate matter and ground-level ozone are key components of smog.

How Does BC's Air Quality Rate?

Air quality in BC communities is quite good by Canadian and US environmental standards. However, a 2003 report on air quality by BC's Provincial Health Officer estimates that current levels of outdoor air pollution in BC cause 25-250 deaths each year (compared to 108 deaths per year from smoking).

Some BC communities may experience periods of unacceptable air quality, which may have adverse effects on human health, the environment and visibility. In the North and the Interior, particulate matter pollution from industrial and domestic sources — especially wood smoke — is the crucial air quality issue. Ground-level ozone

from transportation sources is the major air pollution problem in the Lower Mainland, and particulate matter to a lesser degree.

Even areas that meet the national standard of "good" air quality may not be good enough. Scientists have found that even low levels of particulate matter in the air can heighten the risk of lung and heart disease. BC's population is growing, especially in the Greater Vancouver area. More people will mean more motor vehicles and emissions, and increased pollution from other human activities.

Particulate matter, ground-level ozone and greenhouse gases share some of the same sources:

Particulate Matter

released by the burning of fossil fuels in motor vehicles and other sources, as well as burning wood

Ground-Level Ozone

produced through the interaction of chemicals emitted by vehicles (and other sources), through the evaporation and burning of fossil fuels

Carbon Dioxide and Other Greenhouse Gases

released by fossil fuel burning in all sorts of activities

8 WHAT HAPPENS WHEN WE BURN FOSSIL FUELS?



Fossil fuels are natural resources such as coal, oil and natural gas, formed from the remains of ancient plant and animal life. When we burn fossil fuels, we contribute to the emissions of some common air pollutants that have local and global effects on human health and the environment. These pollutants include carbon dioxide, methane, particulate matter, nitrogen oxides, sulphur dioxide and carbon monoxide.

Volatile organic compounds (VOCs) are another pollutant to be concerned about. They come from the evaporation of fossil fuels, oil-based paints, paint thinners, varnish and spray products (e.g., hair spray). VOCs also come from natural sources, such as trees (e.g., the smell from evergreens). Together with nitrogen oxides, VOCs produce ground-level ozone, in the presence of heat and sunlight. (Evaporation means the transformation of a liquid into a gas.)

The major sources of fossil fuel burning are

motor vehicles, marine vessels and airplanes

power plants (generation of electricity)

factories

space heating (oil and gas furnaces)

gas-powered garden tools

9 ENERGY AND ENERGY CONSERVATION

FOLLOW-UP ACTIVITIES:

4. POSTER DISCUSSION
7. TRANSPORTATION PLANNING
8. TRACK KILOMETRES
11. ORGANIZE A WALK TO SCHOOL DAY
12. NATURAL RESOURCES CANADA ART CONTEST

When we burn fossil fuels, burn wood for heat, and use electricity, we are using energy. Other sources of energy include “clean energy,” such as solar and wind power, fuel cells and nuclear power. We depend on energy to power our vehicles; provide heat, light and hot water; run our home appliances; and sustain businesses and industry.

In BC, most of our electricity is generated by dams, instead of the combustion of fossil fuels. Hydro-electricity is a clean source of energy in terms of air quality, but it does have other environmental impacts. Some electricity comes from the burning of natural gas at the Burrard Thermal Generating Station in Port Moody (east of Vancouver), which releases emissions.

As BC’s population grows, there will be a greater need for electricity. We don’t know yet if it will be possible to increase our sources of hydro-electricity and use more clean energy, e.g., solar power. We may have to also turn to “dirtier” processes, such as fossil fuel burning.

Our energy choices affect the air we breathe and the global atmosphere. (They also determine how much demand there is for hydro-electric power.) The most important choice we can make to decrease air pollution is to use less energy (conserve energy).

Some ways we can conserve energy are:

Use motor vehicles as little as possible.

Walk, cycle, take public transit and/or start a walking school bus.

If you need to take a car, you can use it more efficiently by sharing the ride (carpooling) with other people who are going the same way — to school or lessons, for example.

Keep the heat down, especially when you're asleep or out.

Turn off lights when you don't need them.

When possible, use a clothesline instead of a dryer.

Use a push lawnmower instead of a gas- or electric-powered one, a rake instead of a leaf blower, and clippers instead of a weed eater.

10 GLOBAL CLIMATE CHANGE



FOLLOW-UP ACTIVITIES:

3. CLEAN AIR STORY
4. POSTER DISCUSSION
6. PLANT A TREE
7. TRANSPORTATION PLANNING
8. TRACK KILOMETRES
11. ORGANIZE A WALK TO SCHOOL DAY
12. NATURAL RESOURCES CANADA ART CONTEST

Air Quality and Global Climate Change: What's the Connection?

Processes such as fossil fuel burning in motor vehicles, buildings (heating and cooling), and industry emit pollutants that cause local and regional pollution — including particulate matter, nitrogen oxides, sulphur oxides, VOCs and carbon monoxide. The same processes also release greenhouse gases, which are linked to changes in the global climate.

Not all air pollutants are greenhouse gases, and not all greenhouse gases are considered air pollutants. But because they come from the same sources, many of the actions that reduce air pollution can also reduce greenhouse gas emissions.

The Earth's Climate System

Two of the most important natural forces controlling global climate are how much of the sun's (solar) energy reaches the earth's surface and how much of that energy is retained in the atmosphere. When these forces are in balance, the global climate system is stable. The climate system involves the natural reactions between the gases in the atmosphere, the planet's water and ice, the land and living things, and solar energy.

The chemistry of the atmosphere is very important in determining how much of the incoming solar energy is retained and how much escapes back to space. Several important gases in the atmosphere act like a blanket around the earth, helping to trap some of that solar energy. These are water vapour, carbon dioxide, methane, nitrous oxide and other trace gases. They are known as greenhouse gases because they keep the planet warm, somewhat like the glass in a greenhouse keeps plants warm.

The atmosphere's ability to retain solar energy makes our planet habitable. Without it, the global average temperature would be about minus 18°C rather than the plus 15°C we enjoy. The

climate of the earth has changed dramatically over geological time, but it has been fairly stable over the last 10,000 years. This period of stability has supported the development of our complex human societies.

(Climate is the average weather — temperature, wind patterns and precipitation — that a region experiences. When we talk about global climate change, we are referring to changes in the climate of the entire planet.)

Human Influence on the Climate System

Fossil fuel burning has led to a significant increase in the amount of greenhouse gases in the atmosphere. Scientists have determined, for instance, that human activities since the Industrial Revolution in the mid-1800s have resulted in a large increase in carbon dioxide — a powerful greenhouse gas — mainly because of the burning of fossil fuels. The current global average of carbon dioxide in the atmosphere is higher than at any time in the last 420,000 years, and likely the last 20 million years. The speed of this increase is unprecedented during at least the past 20,000 years.

Scientists link the human-caused increase in carbon dioxide and other greenhouse gases with a recent warming of the global atmosphere, known as global warming. The Intergovernmental Panel on Climate Change, established by the United Nations to assess scientific information

related to climate change, has concluded that greenhouse gas emissions from human activities are altering the atmosphere in ways that are expected to affect the global climate system.

Global Warming and Global Climate Change

Global warming affects other parts of the global climate system, including the temperature of surface air, land and water; precipitation; evaporation; and wind patterns. It also affects the ocean system, such as temperature, currents and sea level.

Global climate change manifests itself differently from one region to another. Changes in regional climate drive changes in physical systems (e.g., the timing and volume of river flows), as well as biological systems (e.g., the date that buds or leaves emerge). Such changes can also have impacts on our society and economy.

Global climate change leads to: a change in average climate, such as average annual temperature; a change in climate variability; and more frequent and/or severe weather events such as heat waves, drought, and high-intensity rainfall, as well as weather-related events like flooding and coastal storm surges.

In the future, atmospheric warming may trigger severe and abrupt changes in regional climate.

THE EARTH'S AVERAGE TEMPERATURE DURING THE LAST ICE AGE WAS ONLY ABOUT 5°C COLDER THAN AT PRESENT.

Is Global Climate Change Already Happening?

Evidence of global climate changes is widespread and clear:

The increase in temperature observed in the northern hemisphere during the 20th century is the largest of any century during the past 1000 years.

Global average temperature rose by 0.6C over the 20th century.

The 1990s was the warmest decade, and 1998 the warmest year ever measured with instruments (since 1861).

Snow cover has decreased by 10% since the 1960s.

The duration of lake- and river-ice cover in northern Canada has decreased by two weeks annually in the last 100 years.

The overall average ocean temperature has increased since the late 1950s.

Global average sea level rose between 10 to 20 centimetres over the past 100 years.

Mountain glaciers in the nonpolar regions have retreated during the last 100 years.

Using computer models, scientists are able to estimate how much the earth will continue to warm over the next 100 years, depending on how much human activities continue to alter the composition of the atmosphere. Depending on the choices people all over the world take to reduce their reliance on fossil fuels, the global average temperature will likely increase from 1.4oC to 5.8oC over this century. To put these figures in perspective, the earth's average temperature during the last ice age was only 5oC colder than at present.

A rise in average global temperature doesn't mean that every region of the world will warm uniformly. The vast ocean areas will warm gradually and the continental areas more dramatically. Some areas will likely become wetter, some drier, some hotter, and some places will be cooler. We can expect more extreme warming in the northern latitudes (such as Canada) and the interior of continents (i.e., noncoastal areas) — as much as 40% greater than the global average.

The excess greenhouse gases already in the atmosphere will continue to affect the global climate for centuries. Efforts to reduce greenhouse gas emissions now and in the future will reduce but not eliminate the impacts. Societies must find ways to adapt to the long-term changes.

How Will British Columbia Be Affected?

Projected climate change will have profound effects on the environment and our way of life. It will put pressure on BC's major resource industries — forestry, fisheries, agriculture and tourism. The impacts of climate change are expected to vary from region to region, but here is a general summary of what is expected in BC, based on recent observations and computer climate modelling:

Water Resources

Rising air temperatures will reduce the amount of precipitation that falls as snow in the winter and in the mountain regions, resulting in lower river levels during the dry summer period. Higher temperatures in the summer will increase the need for water — for people, aquatic life, and irrigation in agriculture. What's more, the increased heat will heighten the evaporation of water, leading to water loss. This will make it even harder to ensure adequate water supplies.

Floods and Landslides

BC is expected to receive increased annual precipitation and more frequent extreme precipitation events. The outcome will be more floods and landslides, which will endanger sensitive ecosystems, people's lives and property. Existing flood-protection structures might not be adequate in the future.

Fisheries

Warmer stream temperatures and lower water levels will make it difficult for salmon to successfully

migrate and spawn. During recent warm periods, 50% of Fraser River salmon died during migration. Further warming will increase deaths and may eventually threaten the survival of less-tolerant species.

Forests and Ecosystems

Hotter, drier summers increase evaporation, drying the soil and ground-fuel materials. These conditions would pave the way for more forest fires. Besides destroying forests, fires can be financially costly. As an example, in 2003, wildfires destroyed hundreds of homes in the Kamloops and Kelowna area. The total cost of fire fighting, rehabilitation and insurance claims approached \$500 million.

Warmer conditions will force plants to move northward and up -slope to remain in the growing conditions they need. In areas that become too dry for trees, grasslands will flourish. Tree diseases and insect infestations (such as the Mountain Pine Beetle) may increase as warmer winters allow pests to survive. These changes could have a considerable impact on our ecosystems and the forest industry.

Sea Level

The sea level rises in response to temperature, which then expands the volume of the ocean, and causes the melting of glaciers, ice caps and polar ice sheets. Sea level is also affected by regional geological processes that cause land to rise or sink.

Considering all these processes together, scientists have observed that average sea level along the BC coast has increased by four centimetres per century near Vancouver, and 12 centimetres per century near Prince Rupert. Remarkably, sea level around Tofino has declined by 13 centimetres per century because that portion of Vancouver Island is rising relative to the sea. It's estimated that over the next 100 years, global sea level could rise by between 9 to 88 centimetres.

A further rise in sea level could cause flooding and erosion in BC coastal areas. Very high water levels will occur if extreme weather and associated storm surges become more frequent or severe as a result of climate change. As sea level rises, habitat in the coastal wetlands will be lost.

We Can Work Together to Prevent Global Climate Change

On average, each Canadian generates around five tonnes of greenhouse gases per year. That's more than one-quarter of the country's total greenhouse gas emissions. If we all take action to reduce greenhouse gases, we can make a huge difference. Cutting down on fossil fuel burning is the most important step.

"Just say no" to the car whenever you can, and use such clean air alternatives as walking, cycling, carpooling and public transit. Combine errands when you need to drive.

Turn down the furnace when you don't need the heat.

Use manual garden tools instead of gas or electric ones.

Stop idling. Idling is running the vehicle for more than about 10 seconds when you're parked, and it spews out a lot of vehicle exhaust.

Consider switching to cleaner (alternative) fuels, such as ethanol, methanol, natural gas and electricity.

If you're buying a new vehicle, consider getting a smaller one that uses less fuel.

There are many other ways we can conserve energy. For more actions, see [9. Energy and Energy Conservation](#) and [14. How We Can Reduce Air Pollution](#).

For more ideas on addressing climate change, and a wide range of teacher resources, visit these sites:

BC Climate Exchange:
www.bcclimateexchange.ca/index.php

One-Tonne Challenge:
<http://www.climatechange.gc.ca/onetonne/english/educators.asp>

Wild BC Teacher Training Network:
<http://www.hctf.ca/wild.htm>

***EVEN IF WE DON'T
DRIVE TO SCHOOL
JUST ONCE A WEEK,
WE'LL BE TAKING
A BIG BITE OUT
OF CAR EMISSIONS
AND AIR POLLUTION.***

11 PARTICULATE MATTER (PM)



FOLLOW-UP ACTIVITIES:

1. CLEAN AIR STORY
4. POSTER DISCUSSION
5. STRAINING TO BREATHE
7. TRANSPORTATION PLANNING
8. TRACK KILOMETRES
9. HOW CLEAN IS OUR AIR?
11. ORGANIZE A WALK TO SCHOOL DAY

What Is Particulate Matter?

Particulate matter (PM) is the term for tiny solid or liquid particles that float in the air. Some particles are large or dark enough to be seen as smoke, soot or dust. Others are so small that they can only be detected with a powerful, electron microscope. Particulate matter is one of the main, harmful ingredients of smog, the hazy air pollution that usually occurs in or near cities. The other key ingredient of smog is ground-level ozone, the topic of [section 12](#).

We measure particulate matter in micrometres. One micrometre is a millionth of a metre. Particulate matter that is 10 micrometres in diameter or less is called PM₁₀. That's about seven times smaller than the width of a human hair. It is invisible to the naked eye and small enough to inhaled into our nose and throat.

Even smaller than PM₁₀ is the particulate matter that's 2.5 micrometres and less: PM_{2.5}. This is the particulate matter that we are most concerned about because it can travel deep into the lungs and become lodged there, causing illness.

Where Does Particulate Matter Come From?

Particulate matter is produced from a wide variety of sources — natural and human-caused, large and small. Wood and fossil fuel burning are the two main sources. Cigarette smoke and dust are also key contributors.

The major sources of particulate matter are:

Wood Burning (and other materials)

- wood stoves and fireplaces
- backyard burning of gardening leftovers such as branches and leaves (e.g., in burn barrels)
- open burning of big piles of unwanted stumps, branches and leaves in land-clearing and logging
- burning of agricultural stubble (the leftover crop after harvesting) to clear the land for planting
- beehive burners in sawmill operations (Sawmills get rid of wood pieces and sawdust by burning them in large, smoky burners, shaped like a big beehive.)
- forest fires
- burning of materials like plastics, rubber and painted wood that release toxic substances
- burning of materials used in making houses and other buildings

Fossil Fuel Burning

- diesel-burning vehicles such as buses and trucks
- factories, power plants, pulp and paper mills
- oil and gas furnaces used for space heating

Stirred-up Dust

- construction
- mining and quarrying
- cement manufacturing
- agriculture
- wind-blown dust from open lands
- dusty roads

Particulate matter can also be produced indirectly, when gases from burning fuels react with sunlight and water vapour. They then go through chemical changes that form particulate matter.

Where do many of the gases come from? Motor vehicles, power plants and industrial processes.

Where Does Particulate Matter Occur in BC?

Pollution from particulate matter can be found in urban and rural areas. The Interior and the northern regions are exposed to the most particulate matter, mainly from wood stoves, pulp and paper mills, and open burning.

The Lower Fraser Valley, where Greater Vancouver and other communities are located, also has particulate matter, but not to the same degree as in rural BC. In the Lower Fraser Valley, some particulate matter comes from smoke, but fossil fuel burning in diesel and gasoline vehicles is the major source.

Smoke can extend for miles and last for days or weeks, as you might see when a huge blanket of smoke lies over a region hit by a forest fire. Smoke can also pollute our own neighbourhood and home. This kind of particulate matter usually comes from small sources, such as wood stoves or fireplaces.

Even one smoky wood stove or backyard burn can pour heavy smoke into the surrounding air — where we live and breathe. Because we are often caught in

the smoke plume before it's been diluted, we're exposed to high concentrations of pollutants. In cold winters, wood stoves can be running full blast in an entire community, and the amount of particulate matter in the air can reach dangerous levels. Running inside and closing the doors and windows won't protect you, since smoke easily seeps through small cracks and holes.

How Does Particulate Matter Affect Our Health?

At current levels, particulate matter is the most serious kind of local air pollution in BC. It poses more danger to human health than ground-level ozone (in smog), and other common air pollutants like carbon monoxide.

From our lungs' point of view, bigger particulate matter is less harmful. Because of its weight, the larger particulate matter — usually around 10 micrometres or more (PM₁₀) — settles to the ground quickly. If we do inhale it, this particulate matter collects in our nose and throat. Then our body eliminates it through such processes as sneezing and coughing.

In contrast, smaller particulate matter (PM_{2.5}) can remain in the air for days to weeks. It can penetrate deep into our lungs, collecting in tiny air sacs (alveoli) where oxygen enters the bloodstream. Health problems begin when the body starts to react to these foreign invaders. Another danger is that PM_{2.5} can contain a number of potentially

harmful substances, such as cancer-causing chemicals.

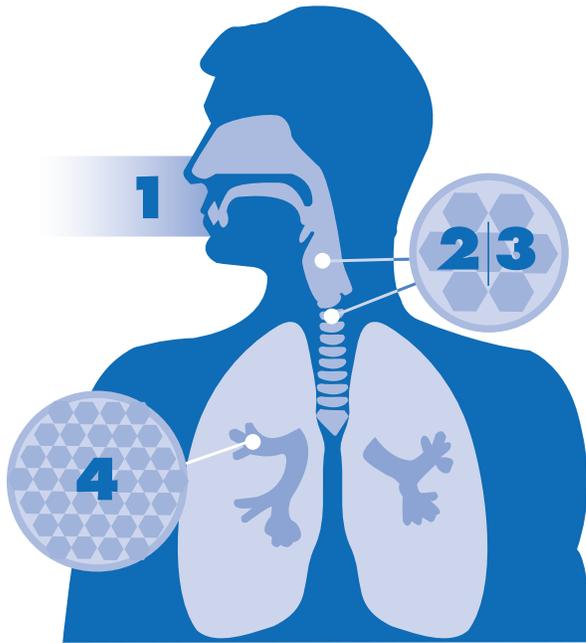
Coughing and wheezing are two of the mild problems associated with inhaling PM_{2.5}. However, this type of air pollution can cause or worsen serious illnesses such as asthma, heart disease, chronic bronchitis, emphysema and pneumonia. Sometimes it can even lead to death.

Senior citizens, infants, and people who already have lung and heart illnesses are the most vulnerable, especially if they are exposed to high levels of PM_{2.5} (e.g., from wood stove smoke or industrial sources). Healthy adults and children can be affected, too.

PM_{2.5} and asthma are a bad mix. PM_{2.5} can increase the number of asthma attacks, and make them more severe. Over 1.2 million Canadians suffer from this condition, and asthma is the most common cause of medical emergencies in children.

A 2002-3 BC Lung Association study of air quality in the Lower Fraser Valley found that even low amounts of PM_{2.5} in the air can harm our health. In fact, the study pointed out that a safe level of fine particulates (below which there are no health impacts) has not been found. As PM_{2.5} increases, so do the health problems. Long-term exposure to PM_{2.5} is an added health hazard.

How Particulate Matter Enters Our Body



- 1** Particulate matter enters our respiratory (lung) system through the nose and throat.
- 2 | 3** The larger particulate matter (PM₁₀) is eliminated through coughing, sneezing and swallowing.
- 4** PM_{2.5} can penetrate deep into the lungs. It can travel all the way to the alveoli, causing lung and heart problems, and delivering harmful chemicals to the blood system.

Share the ride: take public transit or start a carpool when your friends are going the same way (for lessons, school, parties, etc.). Combine errands when you have to drive.

Stop idling (running your vehicle longer than 10 seconds when you're parked). Idling causes considerable air pollution.

Use wood stoves and fireplaces only when you have to, and make sure they produce only a small amount of smoke.

Don't backyard burn. Instead of sending your leafy leftovers up in smoke, use them for compost or wood chips.

Drive slowly on unpaved roads and other dirt surfaces so that your vehicle doesn't kick up dust.

How Does Particulate Matter Affect the View?

Particulate matter can reduce visibility by scattering light and causing haze. When the light is scattered it decreases visibility, so we can't see distant objects as clearly. Visibility reduction can hamper road and air travel. It can also spoil beautiful views, which can harm tourism and our own enjoyment of beautiful BC.

Put the Lid on Particulate Matter!

Below are a few important things you, your family and your neighbours can do to clear the air. For many more suggestions, see [14. How We Can Reduce Air Pollution](#).

Avoid driving (which burns fossil fuels) when you can travel another way. Use your own power: walk, cycle, rollerblade, etc.

12 GROUND-LEVEL OZONE



FOLLOW-UP ACTIVITIES:

3. CLEAN AIR STORY
4. POSTER DISCUSSION
5. STRAINING TO BREATHE
6. PLANT A TREE
7. TRANSPORTATION PLANNING
8. TRACK KILOMETRES
9. HOW CLEAN IS OUR AIR?
10. PREVENTING EMISSIONS OF VOCs
11. ORGANIZE A WALK TO SCHOOL DAY
12. NATURAL RESOURCES CANADA ART CONTEST

What Is Ground-Level Ozone?

Have you ever noticed the sharp kind of smell after a thunderstorm? That's ozone, a bluish gas that occurs in nature. A whiff of it on a summer breeze is a very short-term exposure. But too much ozone can be harmful to our health and the environment.

You could say that there are two kinds of ozone: good and bad. The good ozone is in the stratosphere,

floating 25 kilometres above our head. This "ozone layer" protects life on Earth. It is the planet's natural sunscreen, shielding it from the sun's harmful ultraviolet (UV) rays.

The bad kind of ozone is ground-level ozone. As the name implies, this ozone is produced in the air closest to the earth's surface (the troposphere). It is caused by human activities, and is a health hazard. Ground-level ozone is one of the two main unhealthy components of smog, along with particulate matter.

How Is Ground-Level Ozone Formed?

Ozone is formed by the reaction of two types of chemicals — volatile organic compounds (VOCs) and nitrogen oxides (NOx) — in the presence of sunshine and warm temperatures. When the air is still (stagnant), the ozone will build up. In Canadian cities, ground-level ozone usually occurs in the warmer months of the year.

Ground-level ozone collects over urban areas that produce large amounts of VOCs and NOx. Rural areas can be affected, too, though. That's because the ozone can travel up to several hundred kilometres away, carried by the wind.

The Sources of Ground-Level Ozone

The major sources of VOCs and nitrogen oxides are:

Volatile Organic Compounds (VOCs)

VOCs are a family of chemical compounds that evaporate, which means they change from a liquid into a gas.

They come from:

evaporation of gasoline in motor vehicles (gas fumes)

oil-based paints; paint thinners; varnish; car wax; antifreeze; and paint, deodorant and hair spray

emissions from the oil and gas industry

trees: they contribute a lot of VOCs

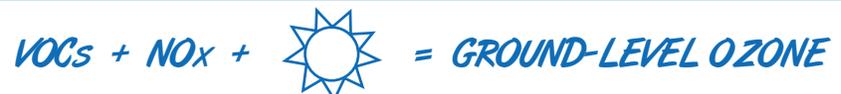
Nitrogen Oxides (NOx)

NOx are gases that form when nitrogen and oxygen in the atmosphere are burned with fossil fuels at high temperatures.

They come from:

fossil fuel burning in motor vehicles

fossil fuel burning in homes, businesses, factories and power plants



Ground-Level Ozone Is Not Just a City Problem

In general, the Lower Fraser Valley experiences the most ground-level ozone in BC. Strange as it may seem, though, downtown Vancouver does not experience the highest ozone levels in the area. The middle and eastern portions of the Lower Fraser Valley suffer more.

The reason is that it takes time for Vancouver's nitrogen oxides and VOCs to be transformed into ground-level ozone. While sea breezes blow eastward, this process of transformation takes place and ozone is gradually produced. The mountains then trap the pollution in the eastern part of the valley (e.g., Hope).

As other communities in BC grow and their emissions of VOCs and nitrogen dioxide emissions increase, they may develop ground-level ozone problems — especially if they are in valleys, and have sunny, warm summers.

How Does Ground-Level Ozone Affect Our Health?

Low concentrations of ground-level ozone can irritate the eyes, nose and throat. Ozone can also irritate the lung airways, and make them red and swollen (inflammation). People with lung problems are most at risk, but even healthy people who are active outdoors can be affected when ozone levels are high.

As the amount of ground-level ozone increases, it can trigger more serious illnesses:

- asthma, bronchitis, coughing and chest pain
- breathing difficulties during outdoor exercise
- greater susceptibility to lung illnesses like pneumonia
- permanent lung damage after long-term exposure.

How Does Ground-Level Ozone Affect the Environment?

Ground-level ozone can damage leaves, and stunt growth, productivity and reproduction. It can make plants vulnerable to insects and disease. When ozone levels are fairly high over a long period, agricultural crops can suffer considerable harm. In the Lower Fraser Valley, for example, the agricultural production that could be lost to ground-level ozone damage is estimated to be worth several million dollars, each year.

The Solution is in Our Hands!

Every person can help bring the fresh air back to our land. That's because we each contribute to creating it in the first place: the exhaust from our automobiles is the number-one cause.

In the Lower Fraser Valley, 75% of local air pollution (containing the chemicals that lead to ozone formation) is caused by motor vehicles. Rush-hour commuters are the major contributors to vehicle emissions. Most of the cars hold only one person. (They're called single-occupant vehicles, or "SOVs.")

Almost half of BC's children travel to school by car. Most of these trips are less than one kilometre. Driving produces unhealthy emissions, and it's not good for children's health. Walking or cycling in the fresh air is good exercise. It can be a nice way to see friends and ease into the school day. "Going green" can also cut down on traffic congestion around schools — a growing environmental and safety issue.

Even if each of us leaves the car at home just once a week, we'll take a big bite out of pollution. We'll save money, too. Cutting down on our smog-producing activities is especially important on days when the potential for smog formation is high — during hot, sunny and calm weather.

Here are a few ways you can do your part. Get more ideas in [14. How We Can Reduce Air Pollution](#).

Use public transit or become part of a carpool. Better yet, use your own two feet, ride your bike or rollerblade!

Start a walking school bus. For details on how, see [14. How We Can Reduce Air Pollution](#).

Don't idle the car (running it longer than 10 seconds when it's parked).

Think about switching to cleaner fuels (e.g., ethanol, methanol, natural gas and electricity).

Looking for a new vehicle?
Consider getting a smaller one
that uses less fuel.

To cut down on VOCs, paint with
water-based (latex) paint rather
than the oil-based variety.

Avoid using paint thinner, varnish
and spray products such as paint,
hair and deodorant spray.

Put the lid tightly on products
that contain VOCs.

Buy products with less
packaging. It takes a lot of energy
to make packaging, and VOCs
are generated during the
printing process.

13 AIR POLLUTION IN OUR NEIGHBOURHOODS



FOLLOW-UP ACTIVITIES:

1. WORD SEARCH
2. CLEAN AIR QUIZ
3. CLEAN AIR STORY
4. POSTER DISCUSSION
5. STRAINING TO BREATHE
6. PLANT A TREE
7. TRANSPORTATION PLANNING
8. TRACK KILOMETRES
9. HOW CLEAN IS OUR AIR?
10. PREVENTING EMISSIONS
OF VOCS
11. ORGANIZE A WALK TO
SCHOOL DAY
12. NATURAL RESOURCES
CANADA ART CONTEST

Neighbourhood (or local) air
pollution begins at home, inside
and outside. We're exposed to
it every day. Let's take a look at
outdoor air pollution, which can
also make its way inside the home.

Particulate matter and ground-
level ozone, from burning fossil
fuels and wood, are serious health
threats. See [11. Particulate Matter](#)
and [12. Ground-Level Ozone](#).

An inefficient wood stove or a
backyard burn can spew out
smoke that surrounds the houses
in your neighbourhood. People
have to breathe, so they're forced
to inhale the particulate matter
and other unhealthy substances in
the smoke.

IS YOUR WOOD STOVE UP TO SNUFF?

*SOME CHIMNEY SMOKE
LIKELY WILL BE VISIBLE
WHEN YOU LIGHT YOUR
FIRE. BUT THE REST OF THE
BURN SHOULD BE ALMOST
INVISIBLE, WITH ONLY HEAT
WAVES SHOWING. IF MORE
SMOKE IS COMING FROM
YOUR CHIMNEY, YOU AND
YOUR NEIGHBOURS ARE
GOING TO BE BREATHING
IN POLLUTED AIR.*

Exhaust from burning fossil fuels is another important source of neighbourhood pollution. Idling (running your vehicle while you're sitting still for more than about 10 seconds) can release a substantial amount of pollutants. The same is true for using gas-powered garden tools like lawn mowers and leaf blowers, and barbecues.

Carbon monoxide is hazardous, as well. It is an invisible gas that is a fast-acting poison. When you inhale carbon monoxide, it gets into your bloodstream. Then it attaches itself to the oxygen-carrying red cells and stops them working. Without oxygen your body cannot function properly.

It doesn't take much carbon monoxide to make people sick. At low amounts, carbon monoxide can make healthy people feel tired, and cause chest pain in people with heart disease. Higher concentrations can cause

Major sources of carbon monoxide are:

- gas furnaces, stoves, water heaters, and other gas-powered equipment
- motor vehicles
- wood stoves and fireplaces
- vehicle exhaust
- tobacco smoke

impaired vision and coordination, headaches, dizziness, confusion, nausea, and flu-like symptoms that clear up after leaving the polluted area. Carbon monoxide is fatal at very high concentrations.

Other substances in the air around us include: polyaromatic hydrocarbons (PAHs), benzene, and dioxins and furans. They can cause a wide range of effects, including cancer, lowered immunity, disorders of the nervous system, and interference with child development. Dioxins and furans are among the most toxic chemicals in the world.

Sources of these substances are:

Polyaromatic Hydrocarbons (PAHs)

burning of organic material, such as wood

Benzene

vehicle emissions, gasoline fumes, tobacco smoke, and the chemical industry

Dioxins and Furans

burning of driftwood (dioxins), household garbage and plastics

diesel engines, power plants, pulp and paper mills

Neighbourhood Air Care

Here are a few actions you can take to minimize the air pollution around you and your neighbours. There are more actions in [14. How We Can Reduce Air Pollution](#).

Don't idle your vehicle (running it for more than 10 seconds when you're parked).

Avoid driving whenever you can: walk, cycle, rollerblade, take public transit or carpool.

Use your wood stove only when you need to, and make sure you're burning efficiently.

Don't backyard burn.

Use a push mower instead of a gas-powered one, a rake instead of a leaf blower, and clippers instead of a weed eater.

Please photocopy section 14 for each student to bring home.

14 HOW WE CAN REDUCE AIR POLLUTION

Here's how to be part of the solution to pollution.

Cut Down on Burning Fossil Fuels

Walk

Walking is the most sustainable transportation mode. It's good for the environment and is also part of a healthy lifestyle.

Cycle

Cycling 10 kilometres per week for eight months prevents 50 kg of air pollution. It's fun, too! BC has one of the highest cycling populations in the world. Taking a safe cycling course is a good idea. Remember to get a good helmet, wear clothes drivers can see, and use your lights when it's dark out.

Carpool

Whenever possible, carpool with friends, school or team mates, or your family. You could work out a carpool schedule for regular trips to school, sporting events or other lessons.

Create a Walking School Bus

A walking school bus is a group of children walking to school with one or more adults. It can be as informal as two families taking turns walking their children to school. Or it can be structured as a route with meeting points, a timetable and trained volunteers who take turns. A variation on the walking school bus is the bicycle

train, in which adults supervise children riding their bikes.

For more information on how to start a walking school bus, visit ICBC's Way to Go web site: www.waytogo.icbc.bc.ca

Organize a Walk to School Day at Your School

The goal of a Walk to School day is to get as many students taking alternative kinds of transportation as possible. Walking is one way, but cycling, rollerblading, etc., are also good. For details, see follow-up activity #11: Organize a Walk to School Day.

Take Public Transit

Public transit can be a form of independence as you get older. You can ride with friends and go on your own schedule instead of waiting for someone to drive you.

Don't Idle

Idling is running the vehicle, instead of turning it off, when it's sitting still or parked longer than 10 seconds (e.g., when you're waiting for someone). Idling is a big source of vehicle exhaust. If all Canadians avoided idling for just five minutes every day, we could prevent more than two million tonnes of carbon dioxide from entering the atmosphere. That's like taking 380,000 cars off the road! You might tell your family that idling is not an effective way to warm up a vehicle. The best way to do this is to drive the vehicle slowly for the first five kilometres or so.

Choose a Fuel-Efficient Car or Truck

Is your family looking for a new vehicle? You could consider buying a smaller model that needs less fuel. A fuel-efficient vehicle cuts down on pollution, and it saves money.

Switch to Cleaner Fuels

Cleaner fuels (alternative fuels) are low-polluting fuels that can be used in motor vehicles instead of gasoline or diesel. Examples include ethanol, methanol, natural gas and electricity.

Take the One-Tonne Challenge!

A family of four is responsible for releasing 20 tonnes of greenhouse gases into the atmosphere, each year. The One-Tonne Challenge asks Canadians to cut their yearly greenhouse gas emissions by one tonne. Together our contributions will add up and make a difference. To sign up, visit the One-Tonne Challenge web site: <http://www.climatechange.gc.ca/onetonne/english/index.asp>.

Keep the Heat Down

Keep the heat no higher than 20°C during the day, and turn it down when you're out or asleep.

Insulate Your Home, to Keep It Warm in Winter and Cool in Summer

Fill in cracks and holes, especially around windows and doors. Install windows that prevent heat loss, or put plastic insulating sheets on old windows in cold months.

Reduce the Use of Gas-Powered Tools

The engine in a gas-powered lawn mower produces eight times the pollution that a car engine does. Use a push lawnmower instead, a rake instead of a leaf blower, and clippers instead of a weed eater. You'll get more exercise, and less noise!

Use Less Electricity

Turn Off Lights when You Don't Need Them

You can save a lot of electricity by turning off the lights when no one is using them. Your family will save money, too. Money you could spend on other things, like movies!

Use Energy-Efficient Light Bulbs

If every BC household replaced two regular (incandescent) light bulbs with compact fluorescent bulbs, the energy saved could power 30,000 homes.

Hot Water

A leaky hot water tap can waste up to 13,000 litres of water a year. If the faucets are fixed, they'll save energy used to heat the water in the hot water tank.

Keep Your Clothes Clean and Green

When possible, hang clothes out to dry instead of using a dryer. Wash your clothes in cold water. When you're buying a new washer or dryer, consider buying low-energy ones.

Turn Off Your Machines

Turn off your computer and your television when they're not in use. Program your computer to power down into sleep mode when you're not on it. By the way, screen savers don't save energy. In fact, they can prevent the sleep mode feature from working.

Keep Smoke to a Minimum: Avoid Burning

Instead of burning your leaves and clippings, start a backyard compost. The air and your garden will benefit! If your town has a community compost, you can take your organic leftovers there.

Never burn plastics, tires, painted wood and other garbage. They release toxic substances. Reduce waste at its source by avoiding overpackaging. And recycle everything you can.

When using a wood stove or fireplace, make sure the burning is efficient so that it releases the least possible amount of smoke.

Here are some burning tips:

Make sure your wood is properly seasoned in a dry place for at least six months. Wet wood produces lots of smoke.

Don't burn wood that's treated or painted. The same goes for driftwood. Driftwood smoke includes dioxins, which are highly toxic.

Don't overload your stove with too much wood or starve the fire of air.

Don't burn when the smoke won't leave the area (e.g., during a temperature inversion). Be aware of the no-burn periods in your community, and follow the rules.

Plant a Tree or Garden

Plant a tree or garden at home or school. Trees and plants absorb carbon dioxide, a powerful greenhouse gas, and convert it to oxygen, which we need to breathe. (This process is called photosynthesis.) They are also natural air filters, breaking down pollutants and reducing dust. In addition, trees are energy-free providers of shade in summer, and a windbreak in winter.

For more information, visit the following web site, hosted by the Virginia Cooperative Extension: *Plants Actually Clean the Air!* <http://www.ext.vt.edu/departments/envirohort/articles/misc/plntclar.html>.

Be an Environmentally Friendly Shopper

Buy products that don't have a lot of packaging and can be recycled.

Buy local products. The average meal travels 2,500 km to our plate. To get there, the elements of the meal probably travelled by fossil-fuel-based transportation, such as motor vehicles, planes, trains and marine vessels. When we buy local products, we cut down the travel time of that product, which helps to decrease air pollution.

15 AIR POLLUTION TERMINOLOGY

Air Pollution

Unwanted chemicals or other materials found in the air, at high enough concentrations to endanger the environment and people's health. Many air pollutants occur as gases or vapours, but some are very tiny solid particles: dust, smoke or soot. Common pollutants are wood smoke, ground-level ozone and particulate matter.

Asthma

When people have asthma, the airways in their lungs get inflamed (red and swollen). They become extremely sensitive to dust particles and other airborne substances like pet dander. When these substances come in contact with the already inflamed and sensitive airways, the airways tighten and narrow, making it hard to breathe.

Atmosphere

The layer of gases surrounding Earth. It is about 480 kilometres thick, and mainly composed of nitrogen, oxygen, carbon dioxide, and a few other trace gases.

Benzene

A colourless member of the VOCs (volatile organic compounds) family. It is used widely by the chemical industry, and is also found in tobacco smoke, vehicle emissions, and gasoline fumes. Exposure to benzene may increase the risk of developing cancer.

Carbon Dioxide (CO₂)

A colourless, odourless gas. It is formed during breathing, combustion, and decaying of organic materials (e.g., plants, animals). Carbon dioxide is a major greenhouse gas.

Carbon Monoxide (CO)

A colourless, odourless, poisonous gas produced when carbon-containing substances such as coal, oil, gasoline, wood or natural gas do not burn completely.

Climate

The climate of an area is its local weather conditions — such as temperature, precipitation (rainfall, snow, etc.), humidity, sunshine, cloudiness, wind and air pressure. It is the weather averaged over a long period of time. Some people say climate is what you expect, and weather is what you get.

Climate System

Involves the natural reactions between the gases in the atmosphere, the planet's water, ice, the land and living things, and solar energy. Together, they determine the earth's climate.

Concentration

The amount of a pollutant in the air at a given location.

Conserve Energy

See "Energy Conservation."

Combustion

Burning or the production of heat and light energy through a chemical process.

Dioxins and Furans

A group of chemicals that are among the most toxic chemicals currently known to science, causing cancer, among other things.

Disperse

Separate / break up and go in different directions.

Dosage

The amount of a pollutant a person inhales over a certain period of time.

Emissions

The release of substances (pollutants) into the atmosphere from natural or human sources.

Energy

The fundamental substance of everything in the universe. When we are talking about the environment, energy is the power we get from burning fossil fuels, electricity, and nuclear power — along with the more green options: solar and wind power.

Energy Conservation

Cutting down on energy use to reduce emissions caused by such energy-generating processes as the combustion of fossil fuels and wood, and power plants.

Environment

The combination of all external conditions and influences relating to the life, development and survival of all living things.

Evaporation

The process by which a liquid is turned into a gas.

Exposure

A combination of the amount of a pollutant in the air and the amount of time a person stays in the presence of a pollutant. Exposure determines the level of risk associated with different levels of pollutants.

Fossil Fuels

Fossil fuels, also known as mineral fuels, are natural resources such as oil and natural gas. They are called fossil fuels because they are formed from the remains of ancient plant and animal life.

Global Climate Change

Changes in the climate of the earth as a whole, caused by human activities that release greenhouse gases.

Global Warming

The progressive rise of the earth's surface temperature thought to be caused by the enhanced greenhouse effect. Global warming may be responsible for changes in global climate patterns.

Green

A popular term, describing an action, process or product that causes less harm to the environment (environmentally friendly).

Greenhouse Effect

The heating that occurs when greenhouse gases such as carbon dioxide trap heat escaping from the earth and radiate it back to the surface. The gases are transparent to sunlight, but not to heat, and thus act somewhat like the glass in a greenhouse.

Greenhouse Effect: Enhanced

The enhancement of the greenhouse effect. The enhanced greenhouse effect is probably being caused by human activities – especially the burning of fossil fuels – that are increasing greenhouse gas concentrations in the atmosphere. This is making the atmosphere warm beyond its natural level.

Greenhouse Gases (GHG)

Several important gases in the earth's atmosphere: carbon dioxide, methane, nitrous oxide, ozone, other trace gases and water vapour. Surrounding the earth like a giant greenhouse, they maintain the earth's climate.

Ground-Level Ozone

A colourless and highly irritating gas. Ground-level ozone is produced from reactions involving nitrogen oxides (NOx) and volatile organic compounds (VOCs) in the presence of sunlight and warm temperatures. Nitrogen oxides are released by fossil fuel burning. Volatile organic compounds come from fossil fuel and solvent evaporation, and vegetation. Ground-level ozone is harmful to human health and the environment.

Habitat

An area where plants and animals grow, live and reproduce.

Methane (CH₄)

A colourless, odourless gas used as a fuel. Methane is a powerful greenhouse gas.

Micrometre (Micron)

A millionth of a metre.

Nitrogen Oxides (NOx)

Gases that form when nitrogen and oxygen in the atmosphere are burned with fossil fuels at high temperatures. Nitrogen oxides react with volatile organic compounds when it's sunny and warm, producing ground-level ozone.

Ozone

A colourless gas that is formed when pollutants react with sunlight. Ozone is a major part of smog, which can make people sick. Ozone is also found in the stratosphere, where it forms a protective band of gases around the earth.

Ozone Depletion

Thinning (depletion) of the protective ozone layer, a fragile band of gases floating in the stratosphere, about 25 kilometres above the earth. This thinning is caused by ozone-depleting chemicals such as chlorofluorocarbons (CFCs), which are released by human activities and products. The ozone layer acts like a giant sunscreen enveloping the earth. It filters out most of the sun's harmful ultraviolet (UV)

radiation. Depletion of the ozone layer is allowing more UV rays to reach the earth.

Particle

A very small piece or part of something bigger.

Particulate Matter (PM)

Small gas and liquid particles in the atmosphere. Particulate matter that is 10 micrometres in diameter or less is called PM₁₀. Of major concern are particles that are 2.5 micrometres or smaller in diameter (PM_{2.5}).

Polyaromatic Hydrocarbons (PAHs)

A family of chemicals that come from the burning of wood, fossil fuels, garbage and other materials. PAHs can make breathing more difficult and cause cancer.

Respiratory

Refers to the lungs and the act of breathing.

Smog

The yellow-brown haze that is a mixture of pollutants, principally ground-level ozone and particulate matter. Smog can harm health, damage the environment and cause poor visibility.

Sources

Sources of air pollution are identified by the activities that cause emissions. They can be natural or created through human activities. Natural sources include dust and forest fires. Human sources include fossil fuel burning and wood burning.

Terrain

The physical features of the land.

Toxic

Something that can be poisonous or deadly if it is eaten, touched or inhaled in large enough amounts.

Turbulence

An instability in the atmosphere that disrupts the wind flow, causing gusty, unpredictable air currents.

Visibility

The distance at which an object can be seen. Visibility is reduced by air pollution, so that mountains and other views are blotted out.

Volatile Organic Compounds (VOCs)

Pollutants that can help form ground-level ozone and can be harmful to health.

16 SUGGESTED INSTRUCTIONAL PROCEDURES

Put the clean air posters up in your classroom.

Have a class discussion about air and how we need it to survive.

Discuss local air and the atmosphere.

Teach the concept of clean air and air pollution.

Discuss air quality issues specific to BC.

Discuss fossil fuels.

Discuss energy and energy conservation.

Discuss global climate change.

Discuss particulate matter.

Discuss ground-level ozone.

Discuss air quality and our health.

Discuss air quality and our environment.

Discuss air pollution in our neighbourhoods.

Discuss what we can do to reduce air pollution: Talk about how the Clean Air Crusaders fight air pollution, and how we can all become clean air crusaders.

Introduce air pollution terminology throughout, followed by a simple quiz or spelling test.

Intersperse the suggested activities throughout the instruction.

Follow-up Activities

1. Word Search
2. Clean Air Quiz
3. Clean Air Story
4. Poster Discussion
5. Straining to Breathe
6. Plant a Tree
7. Transportation Planning
8. Track Kilometres
9. How Clean Is Our Air?
10. Preventing Emissions of VOCs
11. Organize a Walk to School Day
12. Natural Resources Canada Art Contest (see attachment)

17 ASSESSMENT

We suggest using the quiz, word search, activities and class discussions to assess whether the students learned about air quality issues, how they affect us and what actions we can take to prevent air pollution.

18 FOLLOW-UP ACTIVITIES

1. Word Search

Objective: Help students recognize important words used in discussing air quality issues.
Instructions: Look in all directions for these air quality clues:

air pollution
 atmosphere
 be smart
 breathe
 burning

bus
 carbon dioxide
 clean air
 climate
 crusader
 cycle
 do your part
 emission
 environment
 fossil fuel
 good luck
 greenhouse gas

ground level ozone
 health
 heart
 lungs
 neighbourhood
 one tonne challenge
 oxygen
 particulate
 poor visibility
 smog
 smoke
 walk

g	i	s	v	o	p	o	s	c	a	r	b	o	n	d	i	o	x	i	d	e	a	s	t	n
s	r	q	a	b	l	u	c	l	e	a	n	a	i	r	x	r	x	p	m	b	d	t	r	e
s	m	o	g	a	n	o	t	o	m	c	s	n	r	t	a	r	a	d	f	g	v	e	i	i
m	r	g	u	p	i	r	e	b	l	s	i	o	t	r	p	o	n	f	c	a	t	s	m	g
o	n	s	u	n	l	y	t	i	l	i	b	i	s	i	v	r	o	o	p	t	r	q	w	h
k	e	l	t	e	d	h	o	s	t	o	d	a	p	l	e	s	f	r	a	e	c	a	p	b
e	u	n	g	g	u	l	m	b	y	p	o	k	b	u	c	h	e	a	r	t	q	u	i	o
s	a	p	s	u	k	e	e	t	r	n	k	l	a	d	u	y	s	o	t	p	l	r	n	u
s	u	m	b	r	m	o	o	v	n	i	v	r	e	t	h	n	a	d	i	r	a	g	t	r
i	x	k	n	i	a	g	a	q	e	m	i	s	s	i	o	n	i	m	c	a	f	n	l	h
x	e	l	c	y	c	b	s	t	o	l	w	o	d	r	w	i	m	n	u	h	g	i	r	o
c	o	a	n	t	i	d	s	p	i	f	o	s	s	i	l	f	u	e	l	t	r	n	p	o
r	v	w	l	a	n	m	s	u	c	i	a	z	o	r	e	u	l	f	a	s	s	r	o	d
u	n	e	t	o	g	v	y	e	s	w	r	d	o	l	d	e	n	a	t	t	k	u	h	a
s	o	f	a	i	r	p	o	l	l	u	t	i	o	n	p	p	a	i	e	a	t	b	i	r
a	m	p	t	r	e	s	t	v	j	o	j	u	b	x	e	y	s	t	x	l	j	z	i	p
d	u	p	m	c	e	l	d	e	d	o	u	t	n	p	w	c	h	a	v	h	i	a	o	w
e	r	a	o	g	n	i	b	k	r	s	m	e	g	n	a	h	c	e	t	a	m	i	l	c
r	t	n	s	e	h	p	r	e	h	e	c	t	h	r	s	j	u	p	y	a	h	o	n	s
t	a	t	p	r	o	n	e	t	o	n	n	e	c	h	a	l	l	e	n	g	e	s	o	n
a	n	d	h	s	u	p	a	h	x	t	r	a	n	s	d	e	r	d	o	o	a	g	n	i
b	a	s	e	e	s	t	t	e	y	o	l	o	k	i	n	t	s	g	n	u	l	p	r	t
v	u	i	r	x	e	c	h	v	g	a	d	r	j	k	v	o	d	n	e	r	t	e	a	s
e	n	s	e	h	g	o	e	y	e	n	v	i	r	o	n	m	e	n	t	d	h	s	s	o
r	m	t	s	o	a	f	n	d	n	s	h	w	h	w	d	o	w	d	r	s	l	o	p	s
y	a	e	l	s	s	t	o	n	e	y	o	g	o	l	k	e	s	k	y	w	l	k	r	e
g	o	o	d	l	u	c	k	b	e	s	m	a	r	t	d	o	y	o	u	r	p	a	r	t

Word Search Key

g								c	a	r	b	o	n	d	i	o	x	i	d	e					n	
	r							c	l	e	a	n	a	i	r											e
s	m	o	g																						i	
m			u																						g	
o				n		y	t	i	l	i	b	i	s	i	v	r	o	o	p						h	
k					d																				b	
e						l											h	e	a	r	t				o	
							e	m	i	s	s	i	o	n											u	
								v																	r	
		k							e																g	
	e	l	c	y	c					l															n	
c		a									f	o	s	s	i	l	f	u	e	l				i	o	
r		w											z												n	
u					g									o											o	
s			a	i	r	p	o	l	l	u	t	i	o	n											u	
a			t	e												e									b	
d			m	e																						
e			o	n		b														e	t	a	m	i	l	
r			s	h		r																			c	
			p	o	n	e	t	o	n	n	e	c	h	a	l	l	e	n	g	e						
			h	u		a		x																	a	
b			e	s		t		y											s	g	n	u	l			
	u		r	e		h		g																	t	
		s	e	g		e		e	n	v	i	r	o	n	m	e	n	t							h	
				a				n																		
				s																						
g	o	o	d	l	u	c	k	b	e	s	m	a	r	t	d	o	y	o	u	r	p	a	r	t		

2. Clean Air Quiz

Reinforce and assess the students understanding of air quality issues.

Questions:

1. What are the names of the Clean Air Crusaders?

2. What are their powers?

3. Why are their powers important?

4. Fill in the blanks:

_____ **Crusaders.**

Be a _____ **Hero.**

Use your clean air _____.

5. What are the three main air quality problems in BC. (Hint: One of them is a global problem.)

6. Can you think of four sources of air pollution in BC?

Quiz Answer Key

1. What are the names of the Clean Air Crusaders?

Answers: The names used in this teacher's guide are the Green Protector, Winged Wonder and Captain Air. However, if your class has made their new names, then those will be the answers.

2. What are their powers?

Answers: Please see [4. Introducing the Clean Air Crusaders](#) for answers to this question.

3. Why are their powers important?

Answers: Please see [4. Introducing the Clean Air Crusaders](#) for answers.

4. Fill in the blanks:

_____ Crusaders.

Answer: Clean Air Crusaders.

Be a _____ Hero.

Answer: Be a Clean Air Hero.

Use your clean air _____.

Answer: Use your clean air powers.

5. What are the three main air quality problems in BC?

Answer: Global climate change, particulate matter and ground-level ozone

6. Can you think of four sources of air pollution in BC?

Answers (more than four choices here):

Burning of fossil fuels in:

- cars and other vehicles
- gas-powered garden tools
- oil and gas furnaces
- industrial activities

Smoke from burning wood and other materials in:

- wood stoves and fireplaces
- backyard burning (gardening leftovers and, even worse, garbage and other toxic materials)
- slash burning (large piles of leftover wood, leafy debris in forestry, land clearing, and stubble burning in agriculture)
- construction burning (waste)
- beehive burners (burning of leftover wood from sawmills)

Emissions from:

- gasoline (fumes), oil-based paints, spray products and cigarettes

3. Clean Air Story

Objective: Reinforce and assess the student's understanding of air quality issues, and the steps they can take to cut emissions.

Questions:

1. Would you like to be a Clean Air Crusader? Why?
2. What powers would you have?
3. How would these powers fight air pollution?
4. How could you spread the word that we can all reduce air pollution?
5. What steps can you take to reduce air pollution yourself?

4. Poster Discussion

Objective: Help students understand how they and their families can get involved in decreasing air pollution.

Supplies: the three clean air posters (or the one large poster, containing all three smaller posters)

**USE YOUR
CLEAN AIR
POWERS!**



Instructions:

- Break your class into groups.
- Ask them to count the sources of air pollution in the poster.
- They should come up with six sources: smoke from burning barrels, chimney smoke, vehicle exhaust, gas-powered speed boat, gas-powered leaf blower and gas-powered lawn mower.

Discussion:

Ask the students to talk in their group about ways to cut down on these typical neighbourhood sources of pollution.

BE A CLEAN AIR HERO!

**Instructions:**

- Break the class into groups. Have the groups look at the poster.

Discussion:

Ask the students to talk about the vehicles in the poster: Which kinds of vehicles need to be on the road (delivery trucks, buses, emergency vehicles)? How can we eliminate most of the other vehicles? (by walking, carpooling, taking public transit, cycling, skateboarding, rollerblading, etc.)



JOIN THE CLEAN AIR CRUSADER!

Instructions:

- Put the poster where the students can study it.

Discussion:

Facilitate a discussion about emissions from industrial sources (and power plants) and what kinds of air pollution they cause.

5. Straining to Breathe

Objective: Enable students to experience what it feels like to strain for breath. (If you have asthmatic students in your class, it's probably best if they don't blow up the balloon.)

Supplies:

- one medium- to small-width straw for each student in your class
- one balloon each for half the students in your class (bring extras in case a balloon breaks)
- one elastic band each for half the students in your class

Instructions:

- Have students count how many breaths they take in one minute. Then have them breathe through a plastic straw for another minute. Discuss their observations.
- Divide the class into pairs. Give

- each pair a balloon and a rubber band. (They should all still have their straws. Only one student will be blowing up the balloon.)
- Have students insert the straw into the neck of their balloon, secure it there and make it airtight, with the rubber band.
- Have one student blow up the balloon and the other student record how long it takes. Have groups compare the times.

Discussion:

Ask students what conditions or illnesses make it hard for a person to breathe. Have a class discussion about poor air quality, and how it contributes to breathing difficulties.

6. Plant a Tree

Objective: Discuss how trees and plants can help reduce air pollution by absorbing carbon dioxide and releasing oxygen, and breaking down pollutants and reducing dust.

Instructions:

- Make an appointment to visit a local nursery.
- Ask a nursery representative to talk to the class about different kinds of trees, and what conditions they like to grow in.
- Ask the representative where the best place to plant a tree is, and what it needs to survive.
- Perhaps you can buy a tree seedling or ask the nursery to donate a tree that your students can plant at the school.

Discussion:

Talk about why trees and plants are valuable in protecting air quality. See “Plant a Tree”, in [14. How We Can Reduce Air Pollution](#).

7. Transportation Planning

Objective: Raise students’ awareness of when they use their vehicle, and why. Help them choose clean-air alternatives.

Instructions:

- Have the students list three places they go by vehicle.
- Help them figure out how to get there by public transit, walking, skateboarding, cycling, rollerblading, carpooling, etc. If you include transit in your planning, you will need a local transit schedule. To contact your local transit system, visit www.busonline.ca, or look in the telephone book for the transit phone number.

8. Track Kilometres

Objective: Enable the students to figure out how far they travel by motor vehicle, and how they can reduce vehicle exhaust by going green.

Instructions:

Have students keep track of how many kilometres their parents drive to take them to school, lessons, friends’ homes, stores and other places.

Discussion:

Discuss how the students and their parents can switch to clean transportation alternatives, such as walking, cycling, carpooling,

starting or joining a walking school bus, taking public transit, etc.

9. How Clean Is Our Air?

This exercise is from the web site of the US Environmental Protection Agency: <http://www.tnrcc.state.tx.us/air/monops/lessons/partlessonK.html>.

Objective: Check the air for visible pollutants.

Supplies:

- three sheets of white paper,
- cardboard or index cards
- petroleum jelly

Instructions:

- Smear two sheets of paper on one side with petroleum jelly.
- Put the sheets next to each other, smeared-sides up, on a windowsill, and clamp the sheets in place with the closed window (or tape them to the outside of the window). Do this when it isn’t raining or snowing.
- Take one sheet in at the end of one day and see how dirty it looks — compare it to a clean sheet of paper. Save the dirty sheet.
- Take the other sheet in after one week. See how dirty it is compare it to the first dirty sheet and to the clean sheet.

Discussion:

Talk about the results of experiment. Ask the students, “Is our air clean or is it dirty?” What might be the sources of this pollution? (Remind the students that this is a test for visible pollution only.)

Extended Experiment:

- Coat index cards with petroleum jelly and tape them to surfaces in different areas of the community.
- Leave the cards there for a week
- Collect them, and compare them to each other and a clean index card. Discuss what locations were the “dirtiest,” and why.

10. Preventing Emissions of VOCs

Objective: Help students identify the products containing volatile organic compounds (VOCs) in their home, and encourage them to consider environmentally friendly alternatives to using them.

Background:

The volatile organic compounds (VOCs) that help produce ground-level ozone can be found in chemicals made to dry out, or evaporate, very quickly. VOCs are also in chemicals that clean or dissolve grease. Household products containing VOCs include the following:

- oil-based paints, paint thinners and cleaners, and varnish
- spray products (spray paint, hair spray and spray deodorants)
- lighter fluid for cigarettes and charcoal (in barbecues)
- products for vehicle care, (car wax, antifreeze)

Instructions:

Ask the students to make a list of the products in their home that contain VOCs. Have them write an action plan that describes how they can avoid using them or switch to air-friendly products.

Discussion:

Discuss the students' findings and action plans.

11. Organize a Walk to School Day

Objective: Raise awareness about the importance of reducing vehicle use and using transportation alternatives — to protect air quality and get healthy exercise. Encourage students to turn that awareness into action.

Instructions:

- Have students make a plan to have a Walk to School Day. (Cycling and other transportation alternatives are also included.)
- Have students discuss the plan with the principal, teachers and parents at a meeting, and designate a day — perhaps during International Walk to School Week (early October), Earth Day (April 22) or Clean Air Day (first Wednesday in June). In 2004, 36 countries and 3 million walkers participated in the international event!
- The school could have a friendly challenge with another school.
- Get some parents to help greet the students who walk, etc., take pictures and perhaps give out stickers or ribbons.
- Identify safe routes to school and discuss essential rules for walking safely.
- Ask the students to make posters, banners and take-home flyers announcing and explaining Walk to School Day. If your school has daily announcements, the students could announce Walk to School Day to the whole school. The students could advise the local media, as well.

- In all communications, students should point out safe school routes, and emphasize how to walk, cycle, etc., safely. They should make it clear that young children must be accompanied by an adult.
- Consider giving stickers to every student who walked, etc., and a prize to the class that has the most students who don't travel by vehicle.
- Be ready to count how many students got to school without driving, and how many students per class. Designate students to do the tally.
- Get out there and walk! Parents will greet the students at the schoolyard.
- Add up how many students walked, etc. to school, and identify the class with the most participation. If the school competed with another school, figure out which school won.
- Announce the results, perhaps in a school assembly. Give a prize to the class with the most participation. If another school participated, give a prize to the winner.
- If the media was involved, inform them about the results.

For more information on Walk to School days, see ICBC's Way to Go web site:

www.waytogo.icbc.bc.ca.

Discussion:

Talk about how successful the Walk to School Day was. Discuss what could be done to make it better, and what the barriers are to using clean-air transportation choices. Also, focus on how

students could go green every day. Consider running more Walk to School Days, such as a weekly "walk and roll."

Extension:

As a writing activity, students might take photographs or draw pictures, interview participants, and prepare articles about the environmental and health benefits of walking, cycling, etc., to school. Feature these articles in a special edition of the school newspaper or newsletter.

12. Natural Resources Canada (NRCAN) Art Contest: Energy and the Environment Calendar

Students between 6 and 13 years old, create artwork for the calendar about clean air actions, in teacher-supervised, school-run contests. Schools then submit artwork to a province/territorial coordinator who is responsible for choosing the winner for that province or territory.

The provincial/territorial coordinator sends the winning drawing to Natural Resources Canada's Office of Energy Efficiency (OEE) for publication in the calendar.

All aspects of the contest, including the distribution of prizes, will be completed by the spring of 2006. In autumn 2007, free copies of the NRCAN calendar will be available for distribution through your provincial/territorial coordinator and through the OEE's web site.

How the Winners are Chosen

The provincial/territorial coordinator chooses the winner from among submissions received in his/her region. Natural Resources Canada does not participate as a judge in these contests.

Artistic ability is not the only criteria used to judge artwork. Relative age of the artist, subject matter, use of colour and originality are all factors used when choosing the winners.

Artwork Specifications

Drawings should be simple in concept with an easy-to-understand message.

Drawings should strive to illustrate one, or more, of the following:

- transportation alternatives to the single-occupant vehicle (SOV)
- energy efficiency actions at home, school, and play
- links between wise energy use and climate change
- alternative energy sources (e.g., wind power, solar power, fuel cells).

Artwork must be created on white, unlined, 11" x 8.5" paper (landscape format only).

Artwork should be bright and colourful. Don't use fluorescent or neon colours because they don't reproduce well in the printing process.

Artwork may not contain any corporate logos or corporate names.

Artists may not copy the winning artwork from previous calendars.

Computer-generated artwork is not eligible.

Titles or captions should be printed clearly on the front or back of the artwork.

Do not roll or fold the artwork.

Specific Rules for the Art Contest

Open to students between 6 and 13 years old participating in a school-run contest.

All artwork submitted to the provincial/territorial coordinator must be accompanied by a completed Entrant's Registration form.

One winning drawing will be chosen from each province and territory.

Deadlines

January 2006: Contest begins

April 2006: Schools submit artwork to their provincial coordinator

Fall 2007: Calendars are released

Prizes

All students entering their school contest will receive a participation prize. Provincial winners will: get their artwork published in the Energy and Environment calendar; receive a prize package; and have two copies of their winning

artwork laminated and mounted: one for the artist and one for their school.

Provincial Coordinator Contact

If your class would like to participate in the 2006 Art Contest, please contact the BC Art Contest Coordinator directly:

Janice Larson

Ministry of Energy and Mines
P.O. Box 9318, Stn. Prov Govt
Victoria, BC V8W 9N3

Tel: (250) 952-0706

E-mail: Janice.Larson@gov.bc.ca



Entrant's Registration Form

Fiche de renseignements du participant

A cartoon rabbit character with large ears, a wide smile, and a small body, standing on its hind legs and holding a pencil.

TEACHERS: This form must accompany all school entries sent to your coordinator by *April 1, 2006*

ENSEIGNANTS : ce formulaire doit accompagner chaque dessin envoyé au coordonnateur pour le *1^{er} avril 2006*

Entrant's Information / Coordonnées du participant ou de la participante

Province or Territory / Province ou territoire :	
Name / Nom :	
Age / Âge :	
Street Address / Adresse postale :	
City/Town / Ville :	Postal Code / Code postal :
Home Phone Number / N° de téléphone à domicile : ()	

School Information / Coordonnées de l'école

School Name / Nom de l'école :	
Teacher's Name / Nom de l'enseignant :	Grade / Année :
Street Address / Adresse postale :	
City/Town / Ville :	Postal Code / Code postal :
Title of Artwork / Titre du dessin :	



Parental Consent Form

Natural Resources Canada's Energy and the Environment Calendar

Parental Consent Form

I, _____ (your full name), am the parent or legal guardian of _____ (your child's full name). I have the legal right to, and hereby give permission to the Minister of Natural Resources as represented by the Department of Natural Resources (NRCan) to use, reproduce, publish, and republish, individually or in conjunction with other original work, my son/daughter's winning drawing in the 2006 edition of Natural Resources Canada's Energy and the Environment Calendar.

I, hereby, also give permission to NRCan to use, reproduce and publish, individually or in conjunction with other original work, my son/daughter's drawing on Natural Resources Canada's web site.

I understand that any use of my child's drawing will include personal information to identify the author of the work. I, hereby, do give permission to NRCan to publish in the 2007 edition of Natural Resources Canada's Energy and the Environment Calendar, and on Natural Resources Canada's web site my son/daughter's full name, age, school and province of residence.

I understand that parental consent is required for the use, and/or disclosure of such information.

I hereby release and hold harmless NRCan from any and all claims and demands arising out of or in connection with the use of the original work including any claims of infringement of moral rights or copyright.

_____ (parent or legal guardian)

_____ (date)

19 FEEDBACK FORM

You have the chance to win **\$300.00** for your school if you fax this completed form by 6 March 2006! (The winner will be determined by random draw.)

Fax your completed form to **Tara Steigenberger**,
BC Clean Air Day Coordinator, at 250-995-5641.

1. On a scale of 1-5, how appropriate to your grade level is the content of this guide? (1 is the lowest; 5 is the highest.)

1 2 3 4 5

Comments:

2. On a scale of 1-5, how well did the students respond to the poster art? (1 is the least favourable; 5 is the most favourable.)

1 2 3 4 5

Comments:

3. On a scale of 1-5, how easy was it to incorporate this clean air content into your lesson planning? (1 is the most difficult; 5 is the easiest.)

1 2 3 4 5

Comments:

4. Circle which “understanding” lessons you introduced to your students:

- clean air and the atmosphere
- air pollution
- the specific air pollution problems in BC
- what happens when we burn fossil fuels
- energy and energy conservation
- global climate change
- particulate matter
- ground-level ozone
- air pollution in our neighbourhoods and homes
- how we can reduce air pollution
- air pollution terminology

Comments:

5. Circle the activities you did with your students.

- Word Search
- Clean Air Quiz
- Clean Air Story
- Poster Discussion:
 - Use Your Clean Air Powers
 - Be a Clean Air Crusader
- Join the Clean Air Crusaders
- Straining to Breathe
- Plant a Tree
- Transportation Planning
- Track Kilometres
- How Clean Is Our Air?
- Preventing Emissions of VOCs
- Organize a Walk to School Day
- Natural Resources Canada Art Contest

Comments:

6. Did you learn anything that surprised you?

Yes No

Comments:

7. Have you heard any feedback from your students about changed behaviour in their family?

Yes No

Comments:

8. Would you use this teacher's guide again/next year?

Yes No

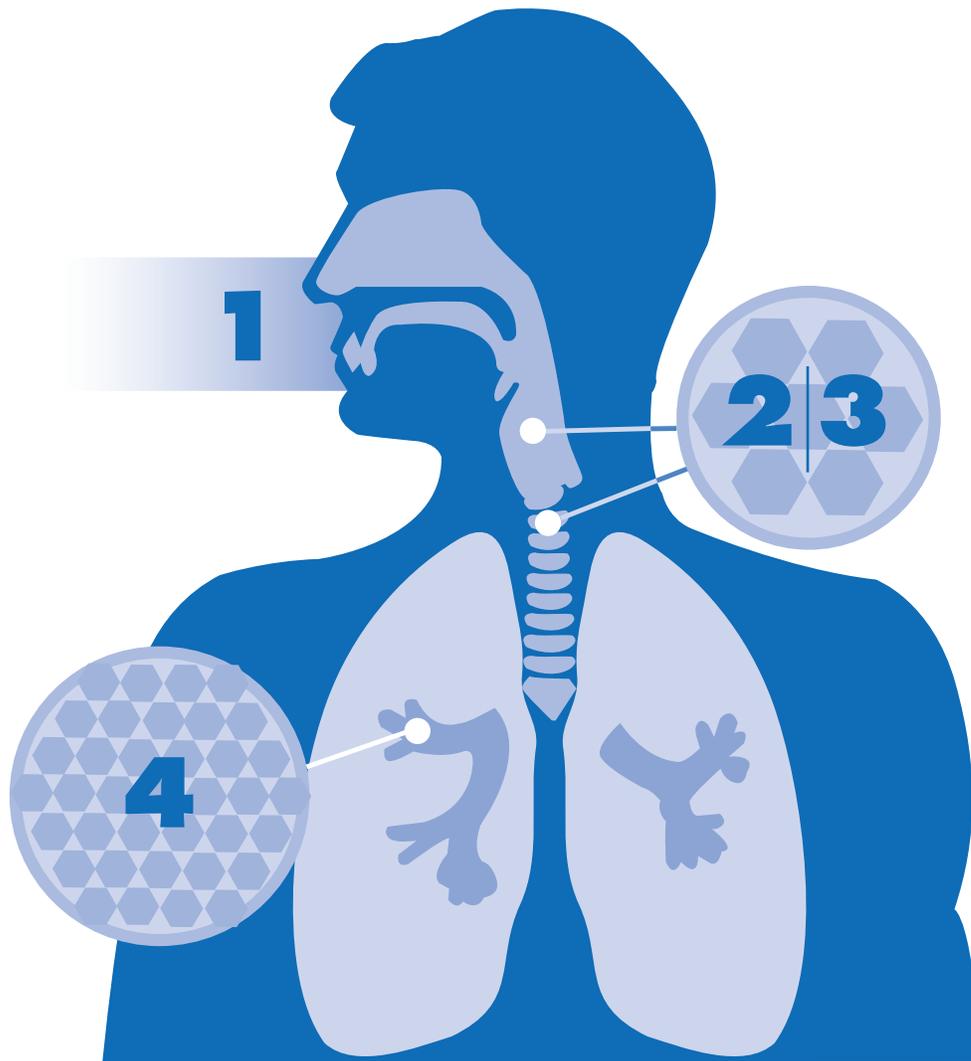
Comments:

9. Please let us know how we can make this guide more effective for you in teaching the clean air subject.



*THANK YOU FOR EDUCATING YOUR STUDENTS ABOUT AIR QUALITY ISSUES IN BC!
TOGETHER WE CAN MAKE A DIFFERENCE.*

How Particulate Matter Enters Our Body

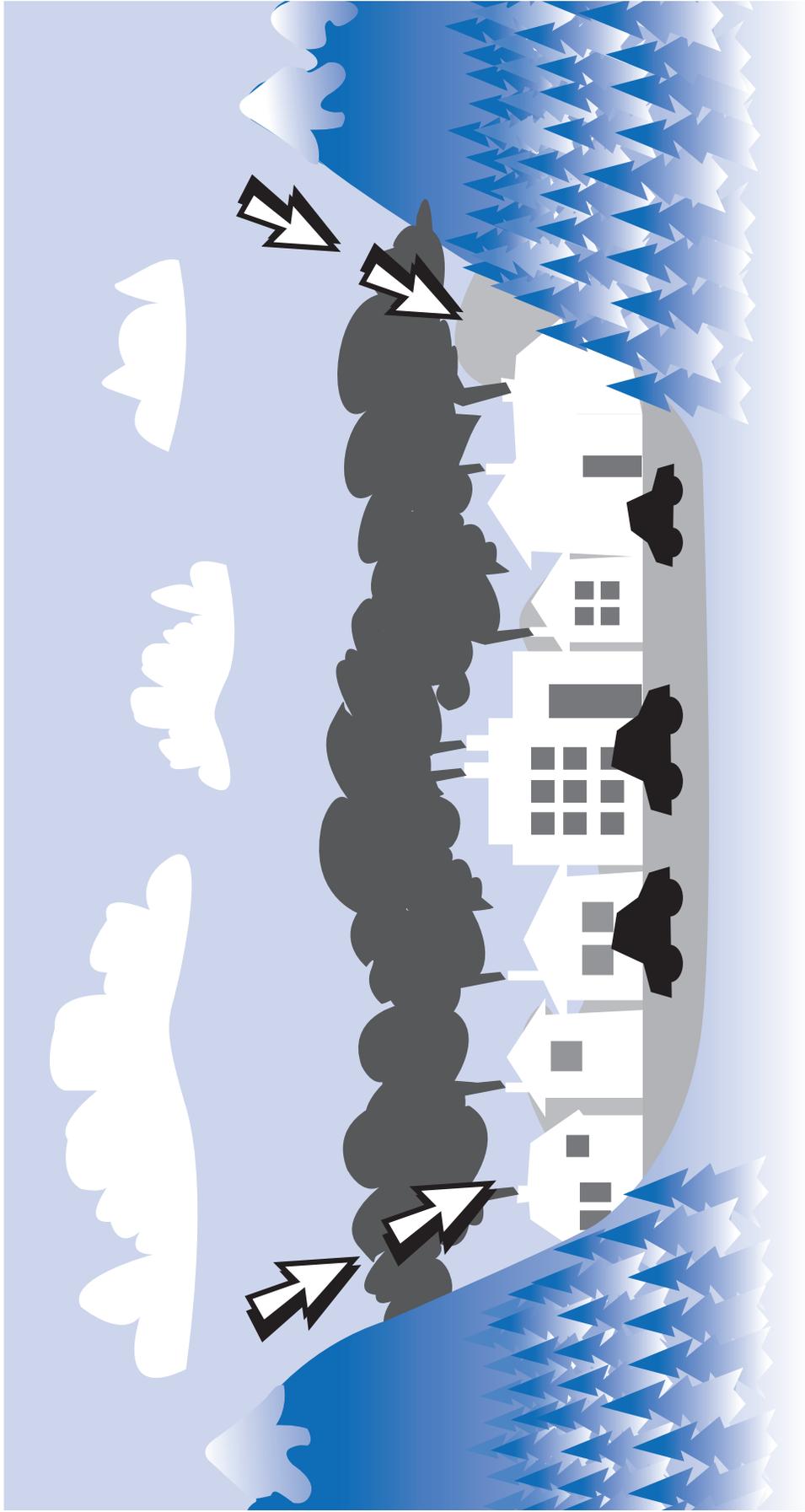


1 Particulate matter enters our respiratory (lung) system through the nose and throat.

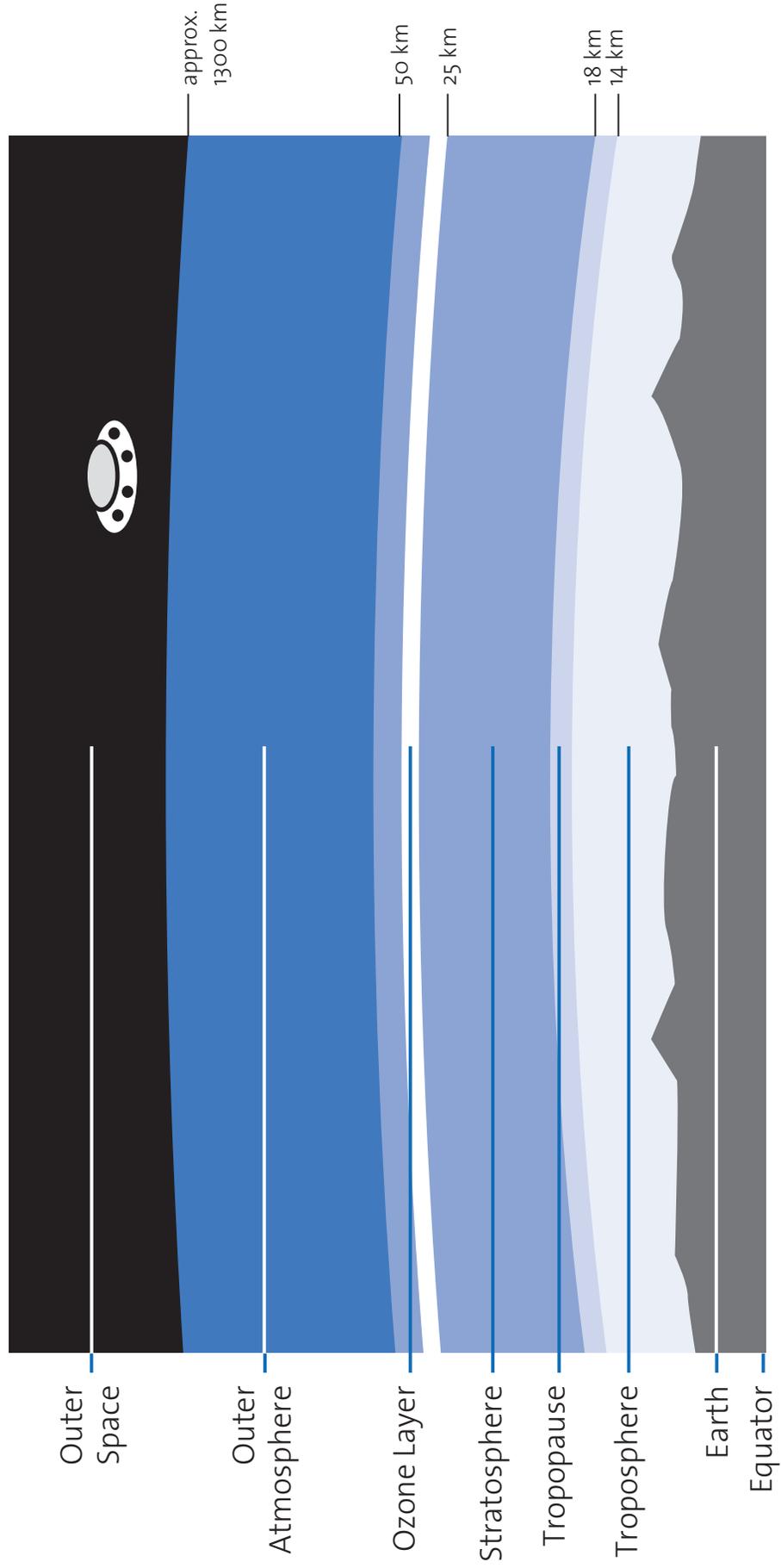
2 | 3 The larger particulate matter (PM₁₀) is eliminated through coughing, sneezing and swallowing.

4 PM_{2.5} can penetrate deep into the lungs. It can travel all the way to the alveoli, causing lung and heart problems, and delivering harmful chemicals to the blood system.

A Temperature Inversion in a Valley



The Earth's Atmosphere





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