

Unit 5  
THE ATMOSPHERE AND THE  
ENVIRONMENT

**Suggested Time: 26 hours**



## Introductory Comments

The following websites provide access to a variety of topics and resources related to this unit: <http://camillasenior3.homestead.com/watersystems4.html>

[http://www.ec.gc.ca/water\\_e.html](http://www.ec.gc.ca/water_e.html).

There are a great number of activities such as portfolios, journals, newsletters, website postings, etc, that can be integrated throughout this unit and following units. It is not intended that students would do every suggested activity. For example, where it is suggested that students be divided into groups to research and present on a topic, not all students would need to be involved in that activity. Groups could be assigned specific topics to research so that over the course of the unit, all students would have an opportunity to work as a group to research and present of various topics. Teachers could identify the particular activities and projects in which they would like their students to engage and determine a set number of these written activities for each student to engage in over the course of the unit. (Likewise, individual students could be assigned topics to research and then present to the class.) Thus, rather than have every student complete each of the written activities, part of the student's assessment could require that each student/group complete a set number of tasks that could be included in a portfolio/newsletter/website. This could then be compiled for the entire class in the form of a newsletter, website, class display, etc. Where possible, students should be engaged in at least one long term project or activity throughout the unit or the whole course. This could be an individual or group project.

For topics that contain a great deal of factual information, it would be very helpful for students to use the "mind mapping" technique (refer to Appendix) to help them summarize and consolidate this information. References and suggestions for how students could create the mind map will be made throughout this unit. As students become more proficient with the use of mind maps they should be encouraged to create their own without teacher suggestions. Teachers could have students create one mind map for the entire unit or a series of small maps for discrete sections. It is important that students refer to their notes and text when completing their mind maps to ensure the map is completely accurate (i.e. this is a learning strategy and is not appropriate for use as an assessment technique). Teachers should note that mind maps are most effective when students create them from scratch and when color and sketches/picture are used along with their written text. In the absence of colored pencils, etc, teachers could supply students with one of several different colored highlighters. While individual students would create their own mind maps, the teacher could a "class mind map". Several sheets of large paper or poster board could be posted on the wall. The teacher could add to the class mind map each day as a summary of the day's lesson or at the beginning of the next class as a bridge between the current and previous lesson. Student mind maps could be used in Think-Pair-Share activities in which each student explains their mind map to their partner

### Student Careers

Teachers could use rubrics and/or checklists to assess student products and learning. Refer to Appendix for samples.

## Introduction to the Atmosphere

### Outcomes

*Students will be expected to*

5.01 define atmosphere

5.02 list the major functions of Earth's atmosphere. Include:

- (i) protects from harmful solar radiation
- (ii) traps heat
- (iii) provides an energy circulation system (e.g. wind and pressure systems)
- (iv) maintains necessary gases for life

5.03 identify the major layers of the atmosphere. Include:

- (i) troposphere
- (ii) stratosphere
- (iii) mesosphere
- (iv) thermosphere

### Elaborations—Strategies for Learning and Teaching

Teachers could have students create a mind map for this unit. After each lesson, students could add new information to their mind map. The center of the mind map should be labeled “atmosphere”.

Teachers should ensure students understand that the term “atmosphere” refers to much more than the thin layer in which we live.

Students will already have learned about the various layers and functions of the atmosphere. This section is intended to provide a brief review of the language and terminology for later use in discussion of atmospheric pollution and changes.

Teachers should use the analogy of the atmosphere as an insulating blanket that protects Earth from extremes of temperature, solar radiation (e.g. UV), etc. It is possible that the “blanket” can retain too much heat. During such time Earth undergoes a warming period.

The atmosphere is also a vehicle by which energy, precipitation, and gases circulate Earth.

Students could add a “functions” branch to their mind map.

As students will have addressed this topic in previous science courses, (eg. Science 1206) teachers could remind students the features that distinguish the layers. For example:

Temperature changes

Gaseous composition

Relative thickness

Location

Teachers should highlight that water vapor is unique to the troposphere, whereas ozone gas is unique to the stratosphere. Aside from these two layers, the gaseous composition of all four layers is basically constant; (e.g. oxygen, carbon dioxide, and nitrogen are found in all four layers)

Students could add a branch called “layers” to their mind map.

## Introduction to the Atmosphere

### Tasks for Instruction and/or Assessment

#### *Portfolio*

Complete the first two columns of the K-W-L chart below. Complete the third column at the end of the unit.

What You <b>K</b> now About Earth's Atmosphere	<b>W</b> hat You Would Like to Know About Earth's Atmosphere	What You <b>L</b> earned About Earth's Atmosphere

#### *Paper and Pencil*

- 1) What does the atmosphere protect Earth's surface from?
- 2) Why is air necessary for life on Earth?
- 3) What are the three main gases that make up the atmosphere?
- 4) Of the five remaining gases, which one is the most important in the heating of our atmosphere?
- 5) What do clouds consist of?
- 6) Name the three reasons why water vapor is important?

#### *Journal*

Students could respond to the statement "What if Earth increased by 5° C?"

### Resources/Notes

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## Interactions in the Atmosphere

### Outcomes

*Students will be expected to*

5.04 identify natural interactions that affect Earth's atmosphere. Include:

- (i) plants/animals
- (ii) water
- (iii) combustion

5.05 identify the anthropogenic interactions that affect Earth's atmosphere. Include:

- (i) combustion
- (ii) industrial
- (iii) domestic

### Elaborations—Strategies for Learning and Teaching

Teachers should address this as a review only, as all of these interactions will have been touched upon in previous science courses. The aim of this section is to provide students with a common vocabulary upon which to build an understanding of the impacts that may result due to human activities.

Students could add this information to their mind map by adding a new branch called “natural interactions”.

When addressing potential interactions that affect the atmosphere, teachers should include a discussion on photosynthesis, respiration, transpiration, nutrient cycling and the water cycle. Teachers should include some examples of natural combustion such as forest fires caused by lightning.

Since most of the anthropogenic interactions will have been touched upon in previous science courses, the aim of this section is to provide students with a common vocabulary upon which to build an understanding of the impacts that may result due to human activities.

The effect of aerosols may be new to many students. Aerosols are minute particles suspended in the atmosphere. When these particles are sufficiently large, we notice their presence as they scatter and absorb sunlight. Their scattering of sunlight can reduce visibility (haze) and redden sunrises and sunsets.

Teachers should address the fact that combustion of fossil fuel/fire wood releases CO<sub>2</sub> and other gases that can impact the ozone layer and contribute to the Greenhouse Effect.

Industrial sources from burning fuels and the gases released from production can also affect the ozone layer.

Domestic sources also include propellants used in aerosols. Propellants may contain CFC's, herbicides, pesticides, etc. Which affect the ozone layer.

Students could add a “human effects” branch to their mind map.

Students could be divided into groups, with each group responsible for either a natural or anthropogenic (human-induced) interaction. The groups would research their “interaction” and present the information to the class.

## Interactions in the Atmosphere

### Tasks for Instruction and/or Assessment

#### *Presentation*

Create a Venn diagram to show the similarities and differences between natural and anthropogenic interactions.

#### *Performance*

Create a poster or multimedia project, using the terms below, to distinguish between natural and anthropogenic interactions.

Airplane smoke	Volcanic ash	Fireplace smoke
Pollen	Ship smoke	Biomass burning
Forest fire smoke	Factory smoke	Desert dust
Sea salt spray		

#### *Journal*

Which human interaction with the environment do you feel is of the greatest concern? Explain.

### Resources/Notes

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## Interactions in the Atmosphere (continued)

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### Outcomes

*Students will be expected to*

- 5.05 identify anthropogenic interactions that affect Earth's atmosphere. Include:
- (i) combustion
  - (ii) industrial
  - (iii) domestic

**(continued)**

### Elaborations—Strategies for Learning and Teaching

Students could be creative in how they present (e.g. use drama, diagrams, song, etc) as long as they cover the main points. Each group will take turns presenting and at the end, the teacher could lead the class in a summary which they could use to fill their mind map.

Teachers could have students engage in a Think-pair-share and ask them to consider which human interaction has the greatest negative impact on the atmosphere. Students would then pair with a student next to them and explain which they think is most detrimental and why.

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## Interactions in the Atmosphere (continued)

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### Tasks for Instruction and/or Assessment

#### *Journal*

Students could use the “What?, So What?, Now What?” format to create a journal entry on the effects of human interactions on the atmosphere.

### Resources/Notes

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## Air Quality

### Outcomes

*Students will be expected to*

5.06 List the factors that can affect air quality. Include:

- (i) particulate matter
- (ii) critical air contaminants (CAC's)
- (iii) smog
- (iv) persistent organic pollutants (POP's)
- (v) ozone

5.07 define particulate matter.

### Elaborations—Strategies for Learning and Teaching

Teachers could address this topic by asking students to define what they mean by “clean air” or “good air”. Teachers could draw upon discussions of “air quality” with reference to schools. Students could do research to determine the air quality standards applied to their school, home, work places, etc. Students could investigate the impacts of poor air quality on humans and other living things.

Teachers should ensure students understand that the amount of particulate matter and various gases in the air will directly affect its quality. For example, a high amount of carbon dioxide gas or a high amount of dust will result in air being of lower quality.

In a later section, students will be introduced to a more quantitative measure of air quality. For the purposes of this discussion, it is sufficient to use a more qualitative or relative measure of air quality.

Students could start a new mind map called “Air Quality” or add this as a branch to their “atmosphere” mind map.

Teachers should include several categories of particulate matter including pollen, mold and dust.

It is not necessary to fully define the components of pollens, molds, and dusts. However, teachers should highlight aspects of particulate matter that influence human health. For example, teachers could include a discussion of the role of dust mites (dust mite feces is a component of household particulate matter) or pet dandruff (dander) in the determination of household air quality. Older or poorly ventilated buildings often have high moisture which supports the growth of molds and mildews. The spores of these organisms may be toxic or trigger allergic reactions. Some people have allergic reactions to various pollens.

Teachers could begin a discussion about the various allergic reactions that may have been experienced by the students or members of their families. Teachers could ask students to share the causes and effects of their various allergies. This can be related to respiratory health (i.e. asthma) and the impact of our environment on our health.

## Air Quality

### Tasks for Instruction and/or Assessment

#### *Presentation*

Create a Power Point presentation on how the various factors effecting air quality impact human health.

#### *Paper and pen*

Complete the following table

Component	Source	Health Impact	Environmental Impact	Method of reduction
PM				
CAC				
SMOG				
POP				
OZONE				

#### *Journal*

Students can respond to the suggestion that older houses are better for your health by drawing comparisons to energy efficient or R2000 houses.

### Resources/Notes

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Page 597-598

## Air Quality and Airborne Pollutants

### Outcomes

*Students will be expected to*

- 5.08 describe critical air contaminants effects on air quality. Include:
- (i) sulfur oxides (SO<sub>x</sub>)
  - (ii) nitrogen oxides (NO<sub>x</sub>)
  - (iii) particulate matter
  - (iv) volatile organic compounds (VOCs)
  - (v) carbon monoxide (CO)
  - (vi) ammonia (NH<sub>3</sub>)
  - (vii) ground level ozone (O<sub>3</sub>)

### Elaborations—Strategies for Learning and Teaching

Teachers should ensure students understand that the subscript “x” indicates that there are multiple compounds. For example, SO<sub>2</sub> and SO<sub>3</sub> are both oxides of sulfur. NO, NO<sub>2</sub>, NO<sub>3</sub> are all oxides of nitrogen. Each compound has its own physical and chemical properties but all are considered to be air pollutants. It is important for teachers to note that an in depth discussion of the chemistry of these substances is not required.

Since most students will have covered these compounds as pollutants in other courses, as an enrichment activity, students could create a list of the sources of these contaminants and briefly research their list for validity.

Students could add a branch to their mind map called “criteria air contaminants” and a sub-branch called “examples”.

Teachers should include a brief discussion of the composition of smog. Smog can be composed of particulate matter, ground level ozone, and other pollutants ( e.g. SO<sub>2</sub>, NO<sub>x</sub>, CO, H<sub>2</sub>S).

Teachers should clarify that the type of smog will vary from location to location. The actual amounts and types of materials present will determine how dangerous the smog is to humans.

## Air Quality and Airborne Pollutants

### Tasks for Instruction and/or Assessment

#### *Presentation*

Create a collage of sources of pollution in NL and sources of pollution in Canada. Use a Venn diagram to compare the sources of pollution in both collages.

#### *Paper and Pencil*

Complete the table below to show the differences in the components of smog.

Component	Source	Health Impact	Environmental Impact	Methods of Reduction
SO <sub>2</sub>				
NO <sub>x</sub>				
CO				
H <sub>2</sub> S				

### Resources/Notes

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## Air Quality and Airborne Pollutants (continued)

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### Outcomes

*Students will be expected to*

5.09 describe how smog affects air quality.

### Elaborations—Strategies for Learning and Teaching

As enrichment, teachers could have students create a chart that would summarize this outcome and those that follow.

Students could add a new branch to their mind map and label it “smog” and add a sub-branch called “composition” that will then branch into the six components listed above (e.g. PM, ozone, SO<sub>2</sub>, etc.)

Teachers should clarify that while most of the smog experienced in Newfoundland and Labrador in the summer originates outside our province and is carried here by prevailing winds, we do contribute to the problem. Sources of smog in this province are emissions from vehicles, woodstoves, chemical solvents, oil-generated electricity, diesel generators, and industrial activities.

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## Air Quality and Airborne Pollutants (continued)

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### Tasks for Instruction and/or Assessment

#### *Presentation*

Research the sources of POPs in Newfoundland and Labrador. Include local sources. Present the results of your research with the class as a newspaper article, poster, or multimedia presentation.

Research the methods used to limit the amounts of dioxins and furans emitted to the environment and how government and industry are responding to this issue. Present your information as information brochures and posters to educate community members of the sources, risks, and mechanisms by which to reduce the emission of dioxins and furans.

#### *Journal*

Write a letter to local and provincial politicians, newspaper editor, or industry representatives expressing your concerns about the emission of dioxins and furans.

### Resources/Notes

Page 599-601

## Persistent Organic Pollutants

### Outcomes

*Students will be expected to*

- 5.10 describe how persistent organic pollutants affect air quality. Include:
- (i) sources in Newfoundland and Labrador
  - (ii) Grasshopper Effect
  - (iii) bioaccumulation and biomagnification in the ecosystem

### Elaborations—Strategies for Learning and Teaching

When discussing the Grasshopper Effect teachers should explain this process as a factor of seasonality, temperature, and state of matter. For example, in warmer climates, liquids will tend to evaporate more readily (i.e. change into a gas) and hence are easily transported in the atmosphere. Since prevailing winds tend to transport gases towards the poles, these gases will experience a cooling effect as they travel further north. As a result, they will precipitate out of the air and enter the liquid parts of the northern ecosystems. When the northern ecosystem warms up (eg. in summer) some of the substances will re-enter a gaseous phase and travel further northward. Since northern climates tend to be cooler there is a greater chance that the substances will not evaporate and thus will remain in the liquid state. Over time, continued deposition results in a build up of the substance in the cooler northern areas.

Teachers should make students aware that bioaccumulation is a buildup or increase in concentration of a substance within an organism. Biomagnification is the build up or increase in concentration of a substance through the trophic levels (food chain). Organisms at each successive level of the food chain will have greater concentrations of the substance than in previous levels.

Generally, substances that bioaccumulate in an organism are fat soluble (i.e. dissolve in fat). As a result, these substances become concentrated in the fatty tissues. Because these substances are not water soluble, they are not easily excreted from the body.

The low temperature combustion of garbage in incinerators provides an ideal site for the formation of dioxins and furans. The large number of “teepee” incinerators in NL has resulted in NL being the largest producer of dioxins and furans in Canada. Backyard burning of leaves also produces dioxins and furans. Burning of plastic products release large amounts of dioxins.

## Persistent Organic Pollutants

### Tasks for Instruction and/or Assessment

#### *Presentation*

Create a collage of sources of pollution in NL and sources of pollution in Canada. Use a Venn diagram to compare the sources of pollution in both collages.

#### *Paper and Pencil*

Using different colors, indicate the areas on the map where the grasshopper effect has the greatest impact.



Students could research the bioaccumulation and biomagnification of methylmercury or other toxins (DDT, lead, dioxins, furans) throughout the world. Present the results of your research with the class as a newspaper article.

#### *Performance*

Create an audio-visual presentation of one persistent organic compound and explain how it follows the Grasshopper Effect.

### Resources/Notes

Page 599-602

## Sources of Airborne Pollutants

### Outcomes

*Students will be expected to*

- 5.11 identify the sources of contaminants that degrade air quality. Include:
- (i) fuel combustion
  - (ii) industry
  - (iii) natural sources

### Elaborations—Strategies for Learning and Teaching

Teachers could ask students to list various sources of air contaminants. This list should include: vehicle emissions, electricity generation, wood stoves, chemical solvents, diesel generators, forest fires, and industrial sources (e.g. emissions from smoke stacks).

Often people in this province believe that because we have less vehicular traffic and lower levels of industrial activity than other areas in North America, that our air is relatively free from pollutants. However, because of the prevailing air currents, large quantities of airborne pollutants (gaseous and particulate) make their way to us from the eastern seaboard of the US and central Canada. To demonstrate this, a brief explanation of the jet stream and its effect on our weather could help students visualize this effect.

Teachers could have students identify the sources of local (provincial) air pollutants. Students should realize that although our province is less industrialized than other places, we still contribute a significant amount of pollutants (e.g. wood smoke, vehicles, boat motors, ATV, chain saws, dust, etc).

Teachers should clarify that the source of most of the pollutants that affect our air quality originates outside the province and is covered here on prevailing winds.

Students could add another sub-branch to their mind map called “sources”. They could then add branches to this for the various resources (e.g. vehicle emissions, electricity generation, etc).

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## Sources of Airborne Pollutants

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### Tasks for Instruction and/or Assessment

#### *Presentation*

Create a map that shows the source of pollutants from areas of Canada and the U.S. that affect NL.

#### *Performance*

Develop a pie chart to show other students the percentage of contaminants that degrade the air in your area.

### Resources/Notes

Page 602-606

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## Air Quality and Human Health

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### Outcomes

*Students will be expected to*

5.12 describe the affects of poor air quality on human health

### Elaborations—Strategies for Learning and Teaching

Teachers should include a discussion on the effects of poor air quality on respiratory system and cardiovascular system. In Canada, the leading causes of hospitalization are diseases of the respiratory and cardiovascular systems.

When we inhale pollutants, the health effects can range from difficulty in breathing to coughing and wheezing, to more significant effects such as impaired lung function and aggravation of cardiac and respiratory conditions (e.g. asthma).

Teachers should refrain from covering an indepth coverage of specific health conditions resulting from individual contaminants.

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## Air Quality and Human Health

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### Tasks for Instruction and/or Assessment

#### *Performance*

Create a web quest with other students for one of the diseases of the respiratory or cardiovascular systems that is affected by poor air quality. Summarize the information gathered as a newspaper article.

#### *Presentation*

Research how poor air quality affects human health. Present your findings in a visual format (collage, poster, multimedia) or a written format (newspaper article, poem, song, short story).

#### *Journal*

Develop a personal action plan with actions you or family members can take to help inform others about the affects of poor air quality on human health.

### Resources/Notes

Page 604-605

## Improving Air Quality

### Outcomes

*Students will be expected to*

5.13 identify ways to improve air quality. Include:

- (i) individual
- (ii) community
- (iii) provincial
- (iv) national
- (v) international

5.14 identify methods to improve air quality. Include:

- (i) cleaner burning fuels
- (ii) end of pipe technology
- (iii) catalytic converters

### Elaborations—Strategies for Learning and Teaching

Teachers should help students identify ways to improve air quality at various societal levels. These should include methods individuals could perform (e.g. wise consumer purchases, proper disposal choices, car pooling etc.), actions at the community level (e.g. “green” projects, increasing green spaces, upgrade bicycle paths, etc.), actions at the provincial level (e.g. close down incinerators at landfill sites, etc.), and actions at the National/International Levels (e.g. ‘Kyoto’ accord.)

Students could do the case study “The Effects of Urban Density on Transportation”.

Teachers could use the following chart which can be used to summarize government and industry actions that can be taken to reduce poor air quality.

Action	Government/Industry
Protocols/Agreements	
Voluntary Actions	

This information can be added to their mind map.

Teachers should discuss that air quality is affected by the burning of fossil fuels. To reduce the gasses that cause poor air quality, vehicles can use biofuels such as ethanol or hydrogen. All vehicles are presently equipped with catalytic converters to reduce air emissions. Industry uses a similar technology with scrubbers and electrostatic precipitators installed on exhaust stacks.

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## Improving Air Quality

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### Tasks for Instruction and/or Assessment

#### *Presentation*

Research how individual actions can affect air quality. Present your findings in a visual format (collage, poster, multimedia) or a written format (newspaper article, poem, song, short story).

Research how industry actions can affect air quality. Present your findings in a visual format (collage, poster, multimedia) or a written format (newspaper article, poem, song, short story, etc).

Research how individual actions can reduce air pollution. Present your findings in a visual format (collage, poster, multimedia) or a written format (newspaper article, poem, song, short story).

#### *Journal*

Develop a personal action plan you can take to help improve air quality in your community.

Imagine you are the C.E.O. of a local paper mill; develop an action plan your company can take to help improve air quality in your community.

Develop a personal action plan you or family members can take to help reduce air pollution.

#### *Performance*

Create a web quest with other students for one of the impacts of UV-B exposure. Summarize the information gathered as a newspaper article.

### Resources/Notes

Pages 606-612

Page 606-612, 611-612

## Acid Precipitation

### Outcomes

*Students will be expected to*

5.15 describe acid precipitation.

Include:

- (i) natural sources
- (ii) anthropogenic sources
- (iii) effects on aquatic ecosystem
- (iv) effects on terrestrial ecosystems

### Elaborations—Strategies for Learning and Teaching

While many books and articles refer to acid “rain” it is more accurate to think in terms of acid precipitation or acid deposition as these are more inclusive terms.

Teachers could provide students with a brief review of the pH scale at this point. Recall that the scale is such that each unit increases by a factor of 10. In other words, pH 4 is 10 times more acidic than pH 5.

Teachers should inform students that even “clean” precipitation is acidic. Naturally occurring  $\text{CO}_2$  combines with atmospheric moisture to produce carbonic acid. This can be demonstrated by blowing air (using a drinking straw) into a bromothymol (or bromthymol) blue solution (bromothymol blue turns yellow in the presence of acid).

Teachers should make students aware that anthropogenic acid precipitation is caused by gases of  $\text{NO}_x$  and  $\text{SO}_x$ .

Recognize that  $\text{NO}_x$  and  $\text{SO}_2$  react with moisture in the atmosphere to increase the acidity of precipitation.

A branch called “sources of gases” that produce acid precipitation could be added to the mind map. Further sub-branches could be created

	$\text{SO}_2$	$\text{NO}_x$
Local Source	Vehicles, fossil fuel-fired electric generation	Vehicles
Long Range Source	Industrial sources “down wind” in eastern seaboard and central Canada	Industrial sources “down wind” in eastern seaboard and central Canada
Impact on Aquatic Systems	Lowers pH killing sensitive plants and animals	Lowers pH killing sensitive plants and animals
Impact on Terrestrial Systems	May affect reproductive structures, causes heavy metals to be released from soil	May affect reproductive structures, causes heavy metals to be released from soil
Economic Impact	Lowers plant production (e.g. slows growth, etc)	Lowers plant production (e.g. slows growth, etc)
Methods of Reduction	Reduce fossil fuel use; scrubbers on exhaust pipe/smokestacks	Reduce fossil fuel use; scrubbers on exhaust pipe/smokestacks

## Acid Precipitation

### Tasks for Instruction and/or Assessment

#### *Presentation*

Research a specific economic impacts of poor air quality as related to your community or NL. Present the results of your research with the class as a newspaper article, poster, or multimedia presentation.

#### *Paper and Pencil*

Using flash cards, organize the chemical compounds below as components of smog and components of acid rain.

$\text{NO}_x$ ,  $\text{VO}_x$ ,  $\text{SO}_2$ ,  $\text{CO}$ ,  $\text{H}_2\text{S}$ ,  $\text{N}_2\text{O}$ ,  $\text{H}_2\text{O}$ ,  $\text{SO}_2$ ,  $\text{H}_2\text{O}$ .

Using a Venn diagram, organize the chemical compounds below as components of smog and components of acid rain.  $\text{NO}_x$ ,  $\text{VO}_x$ ,  $\text{SO}_2$ ,  $\text{CO}$ ,  $\text{H}_2\text{S}$ ,  $\text{N}_2\text{O}$ ,  $\text{H}_2\text{O}$ .

As enrichment, students could generate a list of the various types of precipitation and then, with text and other resources, determine which would be expected to be more acidic. Then, students could test various water samples like bog water, tap water, pond water and rain water to compare pH levels.

### Resources/Notes

Page 606-607, 611-612

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## Acid Precipitation (continued)

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### Outcomes

*Students will be expected to*

5.15 describe acid precipitation.

Include:

- (i) natural sources
- (ii) anthropogenic sources
- (iii) effects on aquatic ecosystem
- (iv) effects on terrestrial ecosystems

**(Continued)**

### Elaborations—Strategies for Learning and Teaching

for sulphur dioxide and nitrous oxides. Teachers could ask students to continue to expand the mind map into long range sources, local sources, etc.

Teachers should include a discussion on the environmental impacts of acid precipitation. This should include a discussion on the detrimental effects on aquatic ecosystems, reduction in soil nutrient availability, plants and animals, and reduced biodiversity.

## Acid Precipitation (continued)

### Tasks for Instruction and/or Assessment

#### *Journal*

Questions to ponder.....

1. Are there salmon rivers in your community that might be affected by acid precipitation?
2. Would a reduction in tourists in your community affect any businesses?
3. Are there outfitters in the area who depend on a healthy and stable local ecosystem?
4. Are there historical buildings or stone structures that may be damaged?
5. Do the headstones in your community provide evidence of acid precipitation?
6. What would be the cost of replacing electrical towers or other metal structures in your community?
7. Who would pay the associated costs? How would this affect consumers?

#### *Presentation*

Research a specific industry that produces acid precipitation. Present the results of your research to the class.

#### *Performance*

Create a newspaper article, poster, or multimedia presentation that describes the economic or ecological impacts of acid precipitation on your community or on NL in general.

### Resources/Notes

Page 612-615

## The Ozone Layer and UV Radiation

### Outcomes

*Students will be expected to*

- 5.16 describe stratospheric ozone depletion. Include:
- (i) effects on ecosystems
  - (ii) effect on human health
  - (iii) effect on human structures

### Elaborations—Strategies for Learning and Teaching

Teachers should briefly describe the function of stratospheric ozone before they discuss on how ozone depletion occurs. For example, the kids zone section of Environment Canada’s website will allow other students to investigate functions of stratospheric ozone, the mechanism by which stratospheric ozone is destroyed, sources of ozone-depleting chemicals, impacts of UV-B exposure, and subsequent actions that can be taken by individuals, industry and countries.

Teachers should narrow their discussion of UV(B) radiation on the ecosystem to the effects of this radiation to slowing plant growth. In addition, increased exposure may cause changes in the genetic structure of plants and animals.

Most students will have heard about ozone thinning. This was first noticed 1974 by Sherry Rowland and Mario Molina, chemists at the University of California, Irvine, who published the first scientific paper warning that human-generated chlorofluorocarbons (CFCs) could cause serious harm to Earth’s protective ozone layer. CFCs combine with ozone molecules and destroy them. After many years of ozone destruction, recent studies have shown that the levels of ozone have begun to increase in areas where it was first noticed to be thinning. This is one example of how consumer choice, government regulation, and industrial cooperation all worked to address a major environmental problem.

Ultraviolet radiation can be divided into three groups based on wavelength. UV-A is not absorbed by ozone. UV-B is mostly absorbed by ozone, although some reaches the Earth. UV-C is completely absorbed by ozone and normal oxygen. The following tables could be incorporated into a web quest. Teachers could create a chart that students could use to summarize the impacts of UV-B exposure.

Impact	Description
Environmental	
Human Health	
Building Structures	

Students can add this information to their mind map.

Teachers could have students do a think-pair share to discuss what they have learned about the impacts of increased UV-B exposure.

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## The Ozone Layer and UV Radiation

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### Tasks for Instruction and/or Assessment

#### *Paper and Pencil*

Consumer choice, government regulation, and industrial cooperation have all worked together to address the problem of a depleting ozone layer. Provide examples of how similar actions can be used to address other major environmental problems.

Create a crossword puzzle for the sources of CFCs. Share your puzzle with the class.

#### *Performance*

Create a web quest with other students for one of the impacts of UV-B exposure. Summarize the information gathered as a newspaper article.

#### *Presentation*

Research how individual actions can reduce the depletion of stratospheric ozone. Present your findings in a visual format (collage, poster, multimedia) or a written format (newspaper article, poem, song, short story).

Research how government agencies and industries can reduce the depletion of stratospheric ozone. Present your findings in a visual format (collage, poster, multimedia) or a written format (newspaper article, poem, song, short story).

#### *Journal*

Develop a personal action plan you or family members can take to help reduce the depletion of stratospheric ozone.

Imagine you are the C.E.O. of a local paper mill; develop an action plan you can take to help reduce the depletion of stratospheric ozone.

### Resources/Notes

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## Climate Change

### Outcomes

*Students will be expected to*

- 5.17 identify that climate change can have a catastrophic affect on Earth. Include:
- (i) natural sources of greenhouse gasses
  - (ii) anthropogenic sources of greenhouse gases

### Elaborations—Strategies for Learning and Teaching

Students will have encountered this in either Science 1206 or Science 2200. Therefore treatment of this outcome should be brief. Students could start a new mind map with the term “climate change” at the center.

Teachers should be careful to differentiate climate change from other atmospheric terms like global warming and greenhouse effect. Climate change is commonly used interchangeably with “global warming” and “the greenhouse effect”, but is a more descriptive term. Climate change refers to the longterm changes in the “average weather” in a given region. This can lead to causing changes in weather patterns on a global scale. The effects include changes in rainfall patterns, sea level rise, potential droughts, habitat loss, and heat stress. The greenhouse gases of most concern are carbon dioxide, methane, and nitrous oxides. If these gases in our atmosphere double, Earth could warm up by 1.5 to 4.5 degrees by the year 2050, with changes in global precipitation having the greatest consequences. Teachers should ensure that students are aware that there is no link between ozone depletion and climate change, other than the fact that ozone is a “greenhouse” gas. Many students have the misconception that holes in the ozone layer allow more radiation to get through, thereby causing Earth to warm.

Teachers should have students do the Core Lab: “Greenhouse Gases from Human Activity”.

Teachers should make students aware that the term “global warming” is a specific case of the more general term “climate change” (which can also refer to “global cooling”, such as occurs during ice ages). In principle, “global warming” is neutral as to the causes. “Global warming” generally implies a human influence. The UN Framework Commission on Climate Change uses “climate change” for human-caused change. In this course, the term “climate change” should be used.

Teachers should ensure that students understand that there are contradictory viewpoints to this issue. Students may have seen Al Gore’s movie “An Inconvenient Truth” which explains the anthropogenic side of the story. Teachers should ensure that students know that there may be a natural cyclic event on Earth causing global warming. Some sources include volcanic activity, ocean currents, solar variability, Earth’s orbit and tilt, plate tectonics and biological evolution.

Students could research the methods used by scientists to determine past climates and predict future climates.

## Climate Change

### Tasks for Instruction and/or Assessment

#### *Journal*

The Precautionary Principle states, “When an activity raises threats of harm to human health or the environment, precautionary measures should be taken even if some cause and effect relationships are not fully established scientifically.” Provide examples from your life where this principle applies. If it doesn’t apply, explain why.

Which personal lifestyle changes are you willing to make to reduce greenhouse gas emissions? Explain. Consider the statement, “Climate change, greenhouse gas emissions, and global warming are interchangeable scientific terms.” Research and take one side of this issue and debate it with another student with an opposing viewpoint.

What does climate change mean to you personally? How can you make a difference?

#### *Performance*

Not all scientists agree on the science surrounding climate change. Some scientists are skeptical and believe that climate change is a natural, cyclic process. Research and try to find opposing arguments to climate change. Take one side of the issue and debate it with another student with an opposing viewpoint.

Students could evaluate and discuss the myths and misconceptions related to climate change and present their findings to the class.

#### *Presentation*

As a member of a group, research a specific impact of climate change on different facets of life in Canada and in your own community. Present your findings in a visual format (collage, poster, multimedia) or a written format (newspaper article, poem, song, short story).

Describe the relationship between climate change, global warming, and greenhouse effect in a visual format (collage, poster, multimedia) or a written format (newspaper article, poem, song, short story).

Write or perform a movie review of “The Day After Tomorrow” or “An Inconvenient Truth”, highlighting fact, fiction, real possibilities, and misconceptions from the movie.

Research how you as an individual can reduce the effects of climate change. Present your findings in a visual format (collage, poster, multimedia) or a written format (newspaper article, poem, song, short story).

### Resources/Notes

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Core Lab “Greenhouse Gases from Human Activity” Page 625-627

## Climate Change Impacts

### Outcomes

*Students will be expected to*

- 5.18 describe the impacts of climate change in Canada on wildlife and natural ecosystems. Include:
- (i) types of vegetation
  - (ii) shifting ecosystem boundaries
  - (iii) biodiversity of species
  - (iv) adaptation of species

- 5.19 describe the impacts of climate change in forests.

### Elaborations—Strategies for Learning and Teaching

Teachers should note that students will have encountered the natural greenhouse effect in previous courses. Students could create a mind map to identify possible natural impacts on climate change. For example, students could identify seasonal changes due to the Earth's tilt; solar variability of the sun's output; the movement of Earth's plates and the shifting of land masses; volcanic activity; and the photosynthetic processes of living organisms.

Students will have covered this material in Science 1206 and a brief review is required here.

Recorded historical data would mostly include temperature records. This could also include migration patterns, plant distributions, etc (i.e. paleoclimatic data). Teachers and students could bring in tree cookies (x-section tree trunk pieces) and examine the variability in the rings that may illustrate growth conditions at different times indicative of past weather, etc.

Teachers could bring in pollen from different plant species and have the class examine the samples under microscope to look for variation in the types of pollen. Then mention that core pollen samples are extracted from ancient lake sediments to make inferences about past climates.

Have students brainstorm about how historical weather data may have been observed and recorded by examining old newspaper clippings, older relatives and storybooks.

Outcomes 5.19 - 5.24 all address the various impacts of climate change on different facets of life in Canada. Teachers could assign students to groups and each group could address an outcome. As members of a group, students could create a visual product (e.g. collage, poster, website) or a written product (e.g. an article for a newsletter, poem, song, short story, etc) in which they examine the impacts of climate change. Where possible students should research possible concerns in their own local area. Each group would make a presentation to the class. The teacher would help summarize the findings for inclusion in the students' mind maps and portfolios.

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## Climate Change Impacts

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### Tasks for Instruction and/or Assessment

#### *Presentation*

As a member of a group, research a specific impact of climate change on different facets of life in Canada and in your own community. Present your findings in a visual format (collage, poster, multimedia) or a written format (newspaper article, poem, song, short story).

With a small group, survey students on how humans can reduce the impacts of climate change in their community. Present your findings to the class in the form of a multimedia presentation.

#### *Performance*

Working in a group, investigate the potential impacts of climate change on one of the forest ecoregions in Canada. Report your findings to the class .

### Resources/Notes

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## Climate Change Impacts (continued)

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### Outcomes

*Students will be expected to*

- 5.20 describe the impacts of climate change in Canada on agriculture. Include:
- (i) length of growing season
  - (ii) extreme weather events
  - (iii) types of crops
  - (iv) precipitation variability
- 5.21 describe the impacts of climate change in Canada on fishery. Include:
- (i) water temperature effects
  - (ii) species distribution
  - (iii) growth rates
- 5.22 describe the impacts of climate change in Canada on coastal zones (sea level changes and areas of human habitat). Include:
- (i) coastal erosion
  - (ii) flooding due to expansion of ocean water caused by melting ice
  - (iii) tectonic subsidence to
  - (iv) Newfoundland and Labrador locations at risk

### Elaborations—Strategies for Learning and Teaching

Students could visit provincial and federal government websites to assist them developing a presentation to class as suggested in elaboration 5.19.

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## Climate Change Impacts (continued)

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### Tasks for Instruction and/or Assessment

#### *Presentation*

As a member of a group, research a specific impact of climate change on different facets of life in Canada and in your own community. Present your findings in a visual format (collage, poster, multimedia) or a written format (newspaper article, poem, song, short story).

Create a public awareness product (e.g. collage, poster, website, newsletter, or brochure) that describes the potential impacts of climate change and possible solutions. You may wish to aim the product at a local or provincial concern.

Students could further explore the impacts on home construction. With a potential for increased numbers of hurricanes there is an increased demand on building materials and thus an increase in the costs of building homes locally.

Students could research how local communities are planning and preparing for climate change issues like flooding. Further to this, students could think about the impacts of climate change on economic issues like lost productivity, business repair costs, and decreased consumer sales.

### Resources/Notes

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## Climate Change Impacts (continued)

### Outcomes

*Students will be expected to*

5.23 describe the impacts of climate change in Canada on extreme weather events..

Include:

- (i) frequency
- (ii) intensity
- (iii) vulnerable areas in Newfoundland and Labrador

5.24 describe the impacts of climate change in Canada on human health. Include:

- (i) heat stress
- (ii) migration of diseases

### Elaborations—Strategies for Learning and Teaching

For the topic of flooding, teachers should refer back to previous sections which address this.

Teachers should stress that severe weather events have always existed, however scientists believe that climate change will increase the frequency and intensity of severe weather events. Students could investigate the effects of a local severe weather event and determine its effect on the local community (economy, education, health, social, etc.). For example Stephenville and Badger flooding events; downed power lines from Churchill Falls.

Teachers could have students discuss the relative preparedness of rural versus urban communities (generators, wood stoves, water supply, food availability). Classes could contact a school in another area to compare relative preparedness. Teachers could contact schools in areas that have experienced severe weather events and arrange for their students to “talk” to their peers about their experiences via email

Students could investigate what would be needed by a family to prepare for a disaster. All provinces have information on what should be contained in an emergency preparedness kit.

Teachers could bring newspaper or magazine articles to class to show recent events of heat stress on the death of elderly people.

## Climate Change Impacts (continued)

### Tasks for Instruction and/or Assessment

#### *Performance*

Participate in a blog created by your teacher. Share an experience with the class where you describe your memories of the most severe weather you've experienced (in or out of province). If possible, add website, graphic, and video links.

Have students perform short drama skits or role playing what they would do during a severe weather event (ex. trapped in a car during a blizzard; playing soccer during a thunderstorm; flooding event at home, etc.)

#### *Interview*

Interview an elderly relative, community resident, or parent about their memories of extreme weather events in their youth. They could report back to the class and include this in a journal entry.

Interview a meteorologist from Environment Canada about the procedures used to forecast weather in NL. Present your findings in a visual format (collage, poster, multimedia) or a written format (newspaper article, poem, song, short story).

#### *Presentation/Performance*

Create a visual product (e.g. collage, poster, multimedia presentation), a written product (e.g. an article for a newsletter, poem, song, short story, etc) or a drama that describes the preparedness of individuals/communities for natural disasters, or the impacts severe weather events have had on individuals, families, or communities.

Students could make a list of the items they think should be included in a disaster preparedness kit and then use the Red Cross webpage (<http://www.redcross.ca/>) to compare their list with that of the Red Cross.

Students could contact their municipal council to determine community plans in case of a natural disaster.

Students could develop a personal action plan with actions they can take to prepare for a severe weather event in their local community. Students could share this plan with members of their family. They could add their plan to their portfolio.

Students could have a story sharing session where they tell their memories of the most severe weather they've experienced (in or out of province).

### Resources/Notes

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Page 649-651

## Actions to Address Climate Change

### Outcomes

*Students will be expected to*

5.25 describe efforts made to address climate change

Include:

- (i) individual
- (ii) industries
- (iii) provincial governments
- (iv) federal governments
- (v) international agreements such as the Rio Declaration and the Kyoto Protocol.

### Elaborations—Strategies for Learning and Teaching

Teachers could challenge their class to a “One Less Tonne Challenge”. This will serve to highlight individual/family efforts to conserve resources and become better stewards of the environment. Students could also access the “one less tonne tool” (a web calculator that shows how changes in certain actions will reduce greenhouse gases).

Students could design a school or community based project to reduce greenhouse gas emissions. For example become a “Cool School” for a day by reducing air temperature by 1-2 °C to reduce emissions (consult with Administration beforehand!). Create posters to promote this idea and distribute around the school. Then calculate how much GHGs and money were saved on that day. Upon completion examine whether this activity would be worthwhile over the long term. Encourage students to try this in their own home and consult with other family members on the benefits and drawbacks. Alternatively, students could promote “Walk to School Days” and “Anti-Idling Campaign” for school buses and parent vehicles on school property. Create posters to promote this activity in your school and community.

Students could investigate the success of the Kyoto Protocol in various countries to date, specifically, students could investigate Canada’s approach to reducing GHGs. Students could use the Internet to research this topic and summarize one article to include in their portfolio.

Students could discuss which of these measures would be more likely to encourage people/industry to reduce emissions. Examples such as taxes on fossil fuels (e.g. price of gasoline Europe vs. North America); subsidies for purchasing fuel efficient vehicles or upgrading homes; restrictions placed by government on industry (e.g. cap and trade) - as a product of public pressure; more incentives for development of alternate energy resources.

Teachers could have students complete the Core Lab: “Home Energy Audit”

Teachers could have students choose which of the strategies would be most successful in Newfoundland and Labrador. Students could then share their thoughts with a partner. After pairing and sharing has been completed, the teacher could ask students to report something that one of their partners said that impressed them, or caused them to think, or change their opinions. Students could then make a journal entry about which of these is the most valuable to the citizens of Newfoundland and Labrador. This could be included in their portfolio.

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## Actions to Address Climate Change

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### Tasks for Instruction and/or Assessment

#### *Performance*

Create posters to encourage other students to reduce GHG emissions in their own homes with other family members and in school with classmates. Stress the benefits of such actions. For example, promote “Walk to School Days” and “Anti-Idling Campaign” for school buses and parent vehicles on school property.

#### *Presentation*

Create a visual product (e.g. collage, poster, website) or a written product (e.g. an article for a newsletter, poem, song, short story, etc) to describe the various strategies that can be used to reduce GHG emissions both domestically and internationally.

#### *Journal*

Write letters to various politicians, newspapers, industry representatives to express concerns and views on current GHG emissions and why more efforts are needed to reduce such levels.

### Resources/Notes

Page 652-665

Page 661-665 Core Lab “Home Energy Audit”

## Alternate Energy Sources

### Outcomes

*Students will be expected to*

5.26 identify alternate sources of energy. Include:

- (i) wind
- (ii) tidal
- (iii) solar
- (iv) biomass fuel
- (v) nuclear

### Elaborations—Strategies for Learning and Teaching

Teachers could have students discuss the benefits and restrictions involved with each alternative energy source.

Teachers could summarize this outcome by developing a table, such as the following.

Alternate Sources	Pros	Cons
Wind	Unlimited	Vaup with intensity and location
Tidal	Unlimited	May prevent fish movement
Solar	Unlimited	Variability by location and time of day
Biomass	Renewable	C0 <sup>2</sup> Emissions
Nuclear	No GHG'S or pollutants released	Radioactive waste and disposal and waste

Solar is a clean energy source that requires the installation of solar panels to generate electricity or to heat water that can be stored for future use. Solar energy is only effective as an alternate energy, source if there are ample solar days to make the economic investment feasible.

Teachers could have students refer to the Land and Sea episode entitled, “The Mighty Churchill”. This episode reveals the history of the development and maintenance of a facility that uses the water from the Churchill River to produce electricity. The production of hydroelectricity should be viewed as a main source of electricity, that despite not being on alternate source of energy produces very low levels of greenhouse gasses. Therefore, it should be viewed as an enviromentally friendly source of electricity/energy.

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## Alternate Energy Sources

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### Tasks for Instruction and/or Assessment

#### *Performance*

- Research the various alternative means by which energy can be produced.
- Choose one alternative energy source and identify the benefits and problems associated with it. Present your findings to the class.
- Create a poster or collage that describes various alternative energy sources.

### Resources/Notes

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Land and Sea Episode “The  
Mighty Churchill”