

The Canada Science and Technology Museum
presents

**Weather Wise:
A Virtual Exploration Guide
to
Weather and Climate Change**

Section 1: About This Guide



Introduction

This Virtual Exploration Guide is written for Grades 4 to 7; it consists of four sections. There is a logical sequencing between the sections, but each stands alone and can be used independently. You can freely choose the sections that are most appropriate for your students and your classroom objectives.

What this Exploration Guide can do for you

We hear it everyday on the radio and television, and read it in the newspapers. One of the most pressing problems facing us today is the warming of the planet due to an increase in man-made greenhouse gases. This warming will cause many alterations to our environment, due to various climate changes. This Guide will bring to your students an understanding of what is becoming apparent today, why this is so and what will happen in the future. Through activities, web searches and worksheets, they will learn how we monitor weather, why the global temperature is increasing and what the consequences will be.

Blank worksheets and detailed explanations can be freely reproduced to use in your classroom. Our activities are modular and can be completed independently. Teachers may request an answer package for more detailed Activity Sheets by e-mailing virt_prog@technomuses.ca. Please allow at least a week for us to reply.



Navigating through the Exploration Guide

Each section can be downloaded as a separate Adobe PDF file, allowing you to select those you want to use. Alternatively, you can download the entire guide as a single Adobe PDF file. The content is identical in either case.

Section	Topic
1	Introduction (This Module)
2	Weather Weather elements Weather instruments Forecasting and the weather network
3	Global Warming Average temperature of the Earth over time The greenhouse effect and its enhancement Greenhouse gases and the link to fossil fuels
4	Climate Change and Our Responsibility Effects of climate change Consequences of climate change Alternative energy Personal choices

Throughout the Exploration Guide, distinctive icons indicate features in the text. These help you find your way through the Exploration Guide quickly and efficiently.



Classroom activity



Discussion or essay topic



Deeper study



Site to visit

Curriculum Links

The Guide is cross-curriculum, introducing elements from various curriculum divisions: Mathematics, Social Studies, Geography, Language Arts, and Science and Technology.

Links to the Pan-Canadian Common Framework

Learning Outcomes Grades 4 to 6

Science, Technology, Society and the Environment	108
Skills	204; 205; 206; 207
Knowledge	300-13; 301-13; 301-14; 302-11; 303-30
Attitudes	410; 419

Learning outcomes Grades 7 to 9

Science, Technology, Society and the Environment	110-7; 113-1; 113-6; 113-9
Skills	209-5; 210-2; 210-6; 211-2
Knowledge	311-12
Attitudes	431; 432; 433; 435

Ontario Mathematics Curriculum

Grades 4 to 5	• Measurement
Grades 4 to 7	• Data Management and Probability

Ontario Social Studies Curriculum

Grade 4: Canada and World Connections	• Canada's Provinces, Territories and Regions
Grade 5: Canada and World Connections	• Aspects of Citizenship and Government in Canada
Grade 6: Canada and World Connections	• Canada's Link to the World

Ontario Geography Curriculum

Grade 7: The Themes of Geographic Inquiry	• Patterns in Physical Geography
	• Natural Resources

Ontario Language Arts Curriculum

Grades 4 to 7

- Reading, Writing, Oral Communication, Media Literacy

Ontario Science and Technology Curriculum

Grades 4, 6, 7: Life Systems

- Habitats and Communities
- Diversity of Living Things
- Interactions with Ecosystems

Grades 5, 7: Earth and Space Systems

- Weather
- The Earth's Crust

Grades 5, 6, 7: Energy and Control

- Conservation of Energy
- Electricity

Quebec Curriculum

Environmental Awareness and Consumer Rights and Responsibilities:

- To encourage students to develop an active relationship with their environment while maintaining a critical attitude towards exploitation of the environment, technological development and consumer goods

Geography, History and Citizenship Education

- To interpret change in a society and its territory

Science and Technology

- To propose explanations for or solutions to scientific or technological problems
- To communicate in the languages used in science and technology

English Language Arts

- To read and listen to literary, popular and information-based texts
- To write self-expressive, narrative and information-based texts
- To use language to communicate and learn

Cross-Curricular Competencies

- To use information and communications technologies (ICT)
- To cooperate with others
- To communicate appropriately

Resource Information

Books on Weather

Cullen, Katherine. **Weather and Climate: The People Behind the Science**, New York: Facts on File, 2005. ISBN 0-816054-66-4

Davis, Barbara J. **Air and Weather**, Milwaukee: Gareth Stevens Pub., 2007. ISBN 0-836877-60-1

Elsom, Derek M. **Weather: An Accessible Guide That Really Explains the Elements**, London: Marshall Pub. 1998. ISBN 1-840281-58-8

Howell, Laura. **The Usborne Internet-linked Introduction to Weather & Climate Change**, London: Usborne, 2004. ISBN 0-794506-29-1

Jennings, Terry J. **Atmosphere and Weather**, North Mankato, MN: Smart Apple Media, 2006. ISBN 1-583407-25-1

Mehling, Randi. **Weather, and How It Works**, New York: Chelsea House, 2006. ISBN 0-791090-53-1

Stein, Paul. **MacMillan Encyclopedia of Weather**, New York: MacMillan Reference Books, 2001. ISBN 0-028654-73-7

Books on Climate Change

Hawkes, Nigel. **Climate Crisis. (Saving our World)**, London: Watts, 2003. ISBN 0-749650-96-6

Jennings, Terry J. **Changing Climates**, North Mankato, MN: Smart Apple Media, 2006. ISBN 1-583407-28-6

Silverstein, Alvin. **Weather and Climate**, Brookfield, Conn.: Twenty-First Century Books, 1998. ISBN 0-761332-23-5

Spilsbury, Louise. **Changing Climate: Living with the Weather**, Chicago, Ill.: Raintree, 2006. ISBN 1-410911-12-8

Unwin, Mike. **Climate Change**, Chicago, Ill.: Heinemann Library, 2007. ISBN 1-403482-16-0

Books on Global Warming

David Laurie. **The Down-to-Earth Guide to Global Warming**, New York: Orchard Book, 2007. ISBN 0-439024-94-5

Donnelly, Karen J. **Rising Temperatures of the Past and the Future**, New York: PowerKids Press, 2003. ISBN 0-823962-14-8

Lim, Cheng Puay. **Our Warming Planet**, Chicago, Ill.: Raintree, 2004. ISBN 0-739870-14-9

Morgan, Sally. **Global Warming**,
Chicago, Ill.: Heinemann Library, 2003. ISBN 1-403403-24-4

Parks, Peggy J. **Global Warming**,
San Diego, Calif.: Kidhaven Press, 2004. ISBN 0-737718-22-6

Silverstein, Alvin. **Global Warming**,
Brookfield, Conn.: Twenty-First Century Books, 2003. ISBN 0-761322-56-6

Books on Greenhouse Effect

Edmonds, Alex. **The Greenhouse Effect**,
Mankato, Minn.: Stargazer Books, 2005. ISBN 1-932799-85-0

Johnson, Rebecca L. **The Greenhouse Effect: Life on a Warmer Planet**,
Minneapolis, Minn.: Lerner Publications, 1993. ISBN 0-822525-09-7

Rockwell, Anne F. **Why Are the Ice Caps Melting?: The Dangers of Global Warming**, New York: Collins, 2006. ISBN 0-060546-69-7

Books on Temperature

Frisch, Joy. **Temperature**,
Mankato, Minn.: Smart Apple Media, 2003. ISBN 1-583401-59-0

Lafferty, Peter. **Heat and Cold**,
Tarrytown, NY: Benchmark Books, 1996. ISBN 0-761400-33-8

Rodgers, Alan. **Temperature**,
Chicago, Ill.: Heinemann Library Hardbacks, 2007. ISBN 0-431038-52-X

Wiese, Jim. **Heat and Temperature**,
Toronto, Ont.: ITP Nelson, 1997. ISBN 0-176057-82-X

Books on Transportation

Dowswell, Paul. **Transportation**,
Chicago, Ill.: Heinemann Library, 2002. ISBN 1-588102-16-5

Gilpin, Daniel. **Transportation Solutions**,
North Mankato, Minn.: Smart Apple Media, 2005. ISBN 1-583405-99-2

Herbst, Judith. **The History of Everyday Transportation**,
Minneapolis, Minn.: Lerner, 2006. ISBN 0-822524-96-1

Pollard, Michael. **Transportation**,
New York: Chelsea House Publishers, 1995. ISBN 0-791027-68-6

Richards, Jon. **Transport**
North Mankato, Minn.: Smart Apple Media, 2005. ISBN 1-593891-96-2

Steins, Richard. **Transportation Milestones and Breakthroughs**
Austin, TX: Raintree Steck-Vaughn, 1995. ISBN 0-811449-35-1

Useful Web Sites

Notice Regarding Internet Sites

These Internet links are provided as a convenience only. We have taken care to suggest web sites that are stable and are appropriate for education but we cannot guarantee the content of any sites not under the direct control of Canada Science and Technology Museum. These sites provide information for the activities presented in this Virtual Guide but performing subject searches will show up many more, also one of the objectives of this guide.

Since the Internet has a very dynamic nature, web addresses can change without warning.

Canada Science and Technology Museum- Meteorological apparatus
<http://www.sciencetech.technomuses.ca/english/collection/meteo.cfm>

Environment Canada Weather Radar
http://weatheroffice.ec.gc.ca/radar/index_e.html

Meteorological Service of Canada
http://www.msc.ec.gc.ca/index_e.cfm

National Radar Program
http://www.msc-smc.ec.gc.ca/projects/nrp/faq_e.cfm

Satellite images
http://www.weatheroffice.gc.ca/satellite/index_e.html

Envirozine — Information on Clouds
http://www.ec.gc.ca/EnviroZine/english/issues/66/feature1_e.cfm

Environment Canada — Great Lake Kids (video – Forecasting Your Weather)
<http://www.on.ec.gc.ca/greatlakeskids/glk-video-e.html>

United States Environmental Protection Agency
<http://www.epa.gov/climatechange/kids/greenhouse.html>

BBC News — Guide to Climate Change
http://news.bbc.co.uk/1/shared/spl/hi/sci_nat/04/climate_change/html/greenhouse.stm

NASA Exploration
<http://liftoff.msfc.nasa.gov/academy/space/greenhouse.html>

The Discovery of Global Warming
<http://www.aip.org/history/climate/co2.htm>

Environment Canada — Greenhouse Effect
http://www.msc.ec.gc.ca/education/scienceofclimatechange/understanding/greenhouse_gases/index_e.html
http://www.ec.gc.ca/climate/overview_greenhouse-e.html

Environment Canada — Frequently Asked Questions
http://www.weatheroffice.gc.ca/mainmenu/faq_e.html#satellite3



World Wildlife Fund — Climate Change in the Arctic

http://www.panda.org/about_wwf/where_we_work/europe/what_we_do/arctic/what_we_do/climate/index.cfm

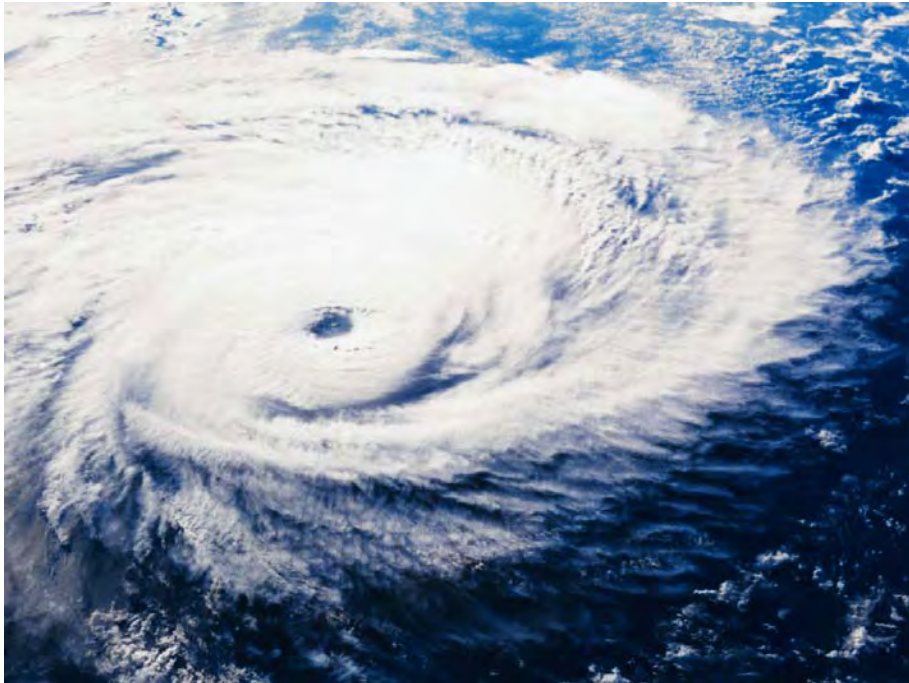
CBC News

<http://www.cbc.ca/news/background/climatechange/>

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Section 2: Weather



Introduction

Before beginning this unit, the students should be familiar with the basic elements of the atmosphere: temperature, wind, the water cycle, precipitation, humidity, air pressure, cloud cover.

Here are a few brief descriptions.

Water Cycle

Water circulates from the land to the sky and back. This is called the water cycle.

The heat of the Sun causes water to evaporate from lakes, rivers and oceans into the atmosphere. The atmosphere carries this water vapour over land where it condenses to form tiny droplets in clouds. Water falls from the clouds to the Earth as precipitation (rain, hail, snow). Rivers and underground systems carry this water back to the lakes and oceans, where the evaporation begins again.

Clouds

As warm air rises, it cools. This causes the invisible water vapour to condense and become visible, forming a cloud. There are many ways to make the air rise, cool and form clouds. Mountains force air upwards. When the air is forced up over the mountains it cools and form clouds. Sometimes a moving cold air mass lifts the air in front of it, forming clouds. Often, the Sun heats air which rises, cools and then forms clouds.

Humidity

The atmosphere always has some water in the mixture. Relative humidity is the amount of water vapour in the air, expressed as a percentage of the maximum humidity possible for the conditions (temperature).

Air Temperature

Air temperature is the measure of how quickly the atoms and molecules of the atmosphere are moving (the amount of energy in the air).

Air Pressure

The atmosphere is a thin layer around the Earth. It extends about 80 kilometres above us. Air pressure is caused by the mass of air above the surface of the Earth pressing down.

Wind

As the sun shines on the Earth it heats up its surface, which then heats the surrounding air. Because surface areas over the equator heat more quickly than polar areas, the atmosphere heats up unevenly. As the air molecules warm up, they move further apart. Warm air is less dense (low pressure) than cold air (high pressure). Air flows from high pressure to low pressure, causing wind. Its direction is influenced by the Earth's rotation.

Weather Elements

What is weather?

It affects us all and especially our outdoor activities – we need snow for skiing, wind for kite flying, cold weather for skating, and hot weather for swimming. Before we plan our weekends, we usually check the weather. And all through the week, we need to know how we should dress to stay comfortable.

Weather describes the elements of the air and the sky at a particular time and place.

We can get some idea of what's coming in the weather by looking at the clouds. If they are large and dark, it could mean rain. If they are white and fluffy it usually means fine weather. But if we want to look further ahead, we turn to the weather forecasters to guide us. Sometimes the forecast is wrong but most of the time, it is right.

In order to forecast the weather, we gather all sorts of information about the atmosphere.

Activity 2.1 Discovering Weather Elements and How We Measure Them

(Recommended for Grades 4 to 7)

Students will become more aware of the elements that make up the weather.

Have the students watch the weather channel at home or read the newspaper and list in the Activity Sheet 2.1 the elements we measure, and the instrument we use to measure each element. Have them bring in their list to class.

Discuss these charts with the students and explain what each element means. Have them fill in any element they missed.

Teacher's Note:

If you'd like a package of answer sheets, send your request by e-mail to: virt_prog@technomuses.ca. Please allow at least a week for us to reply.

Name: _____

**Activities 2.1 and 2.2
Weather Measurements**

Please tick the weather element of home or school. Use newspaper for the weather elements for weather. Describe the instrument used to measure each weather element.

Element	Where	Instrument	Historical Instrument and How it Works

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TECHNOMUSES
MUSEUM Curriculum



Activity 2.2 Find Historical Measuring Instruments

(Recommended for Grades 5 to 7)

Students will realize we have been measuring the elements of weather for many decades. The instruments we used may have been a little different than those of today.

Depending on the access your class has to computers either at home or in the classroom, have students, or teams of students find examples of historical weather instruments on Canada Science and Technology Museum site:

<http://www.sciencetech.technomuses.ca/english/collection/meteo.cfm>



Have the students read through the instruments and, for the elements in their charts, find the historical instrument that measured each element. They should add the instrument name and “how it works” to their chart.

Did the students miss any weather elements on their chart? Have them add the omissions.

For older students with some computer skills:

Have your students make the chart in a spread sheet format and add the images of the instruments on the website to their charts.

Activity 2.3 Charting Temperature and Precipitation

(Recommended for Grades 5 to 7)

Students will learn how to collect data over a period of time.

Assign to each student, or team of students, a Canadian city.

Using Activity Sheet 2.3 (shown here as a thumbnail), have them chart the daytime high temperature and precipitation for that city over a month, by watching the weather channel on TV or reading the newspaper. (Students could take turns bringing in a newspaper.)

At the end of the month, have them calculate the average temperature and precipitation for the month for that city (i.e. the sum of all readings divided by number of readings *actually* made), and the range of temperatures (i.e. the highest temperature minus the lowest)

Have the students use adhesive notes to post the data for the month to a large class map of Canada. Discuss where the largest ranges occurred.

We cannot measure the climate of an area, but only the individual elements of the atmosphere. Altogether, these elements specify the climate of a given place, for a particular period of time. Temperature is the most commonly measured element.



Name: _____

Activity 2.3: Keeping Weather Records

Chart the daytime high temperature and the precipitation for your assigned city for one month. Watch the weather channel or read the newspaper for your data.

Day	High Temperature	Precipitation
Jan 1		
Jan 2		
Jan 3		
Jan 4		
Jan 5		
Jan 6		
Jan 7		
Jan 8		
Jan 9		
Jan 10		
Jan 11		
Jan 12		
Jan 13		
Jan 14		
Jan 15		
Jan 16		
Jan 17		
Jan 18		
Jan 19		
Jan 20		
Jan 21		
Jan 22		
Jan 23		
Jan 24		
Jan 25		
Jan 26		
Jan 27		
Jan 28		
Jan 29		
Jan 30		
Jan 31		
Total		

CANADIAN SCIENCE TECHNOLOGY EDUCATION SOCIETY

Canada

Weather Instruments

Activity 2.4 Make a Weather Vane or Anemometer

(Recommended for Grades 4 to 7)

Students will gain experience in following instructions and develop skills in constructing instruments that measure the weather.

Have half the class make a weather vane and half make an anemometer. You could group them into teams and have them share the tasks.



Did You Know?

Energy can be produced from the movement of the wind. If you are contemplating using a wind turbine to generate electricity, you need a reliable wind at an average speed of 22 km/h. Wind farms, where a large number of wind turbines are grouped together, are located in windy spots. In Canada, there are over 70 operating wind farms, including those on Cape North P.E.I; Pubnico Point, Nova Scotia; Baie-des-Sables, Quebec; and McBride Lake (Fort McLeod), Alberta.

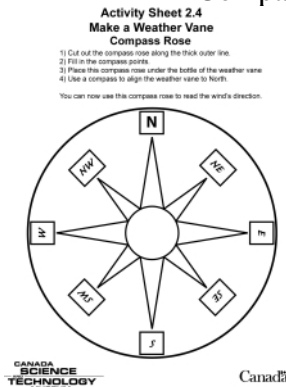
Activity 2.4a Make a Weather Vane:

(Print this page and give to students if appropriate.)



Equipment:

- Arrow template (see Activity Sheet 2.4)
- Scissors
- Light cardboard (manila file folder or paper plate)
- 2 Drinking straws
- Large straight pin
- Narrow necked bottle (Have students bring in their own; small water bottles are good.)
- Small piece (6 cm x 6 cm) of aluminum foil
- Pan or small aluminum pie plate with stones.
- Compass rose (see Activity Sheet 2.4)



Have the students cut out the triangles from Activity Sheet 2.4 (arrow head and tail) and use them to cut out cardboard



ones (paper plate or a file folder). Attach these to each end of a drinking straw, as shown. Balance the arrow on your finger to find the balance point and insert a straight pin vertically through this point. Cover the top of the bottle with a small piece of aluminum foil, make a hole with a pencil at the centre of the foil and insert the second straw through this hole into the bottle.

Insert the pin into the open end of the second straw. The arrow should spin freely on top of the bottle. Place the bottle in the pan full of stones. The stones should hold the bottle up. If not, pour water into the bottle to hold it upright. Then place the wind vane outside. The arrow will point in the direction from which the wind is coming.

Mark the compass directions on the compass rose. (See Activity Sheet 2.4) Place it under the bottle or pan of stones. Align it with the North using a compass and determine the direction of the wind.

Activity 2.4b Make an Anemometer

(Print this page and give to students if appropriate.)



Equipment:

- 5 small paper cups
- 2 straight plastic straws
- A pin
- Paper punch
- Stapler
- Sharp pencil with eraser
- Bright coloured marker

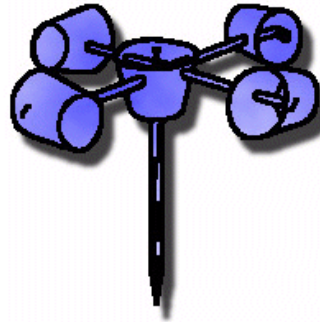


Image courtesy The Franklin Institute Resources for Science Learning.
From "Wind: Our Fierce Friend." www.fi.edu/tfi/units/energy/wind.html

With the paper punch, punch one hole in four of the cups about 1.5 cm below the rim. With the fifth cup, punch four equally spaced holes (at North, South, East and West). If you can, punch a hole through the centre of the bottom of the cup.

Take a cup with one hole punched in it and push the straw from the outside of the cup through the hole until it reaches the opposite inside of the cup. Fold over the end of the straw and staple it to the inside of cup. Repeat this with another one-hole cup and another straw.

Slide the straw from one of these assemblies through two opposite holes in the cup with four holes. Attach another one-hole cup to the end of this straw in the same fashion, making sure the cup faces the opposite direction from the first cup.

Repeat with the other straw assembly and the last one-hole cup.

Align the cups so their open ends will all face in the same direction as the centre cup turns. Centre the straws over the middle cup and push a pin through their intersection. Push the eraser end of the pencil through the bottom hole of the centre cup. If you couldn't punch a hole in the bottom of the cup, use the point of the pencil to make a centre hole. Push the pin into the top of the pencil eraser as far as you can.

Mark one of the cups with a bright coloured marker.

Take the anemometer outside and watch it spin. Count the number of times the marked cup passes by in 30 seconds. Double this and you have the speed in RPM (revolutions per minute). If you multiply this by the circumference of the circle through which the cups spin ($2\pi r$ where " r " is the radius in metres and $\pi = 3.1416$) you will have the velocity of your anemometer in metres per minute, which is an approximation of the velocity of the wind. Try calculating the velocity in kilometres per hour.

Forecasting and the Weather Network

Forecasting the Weather

Today scientists use technology, science and advanced mathematics to forecast the weather. The first step is to take accurate readings of the weather data. All around the world, twice a day weather balloons are launched to collect this data.

These carry instruments that measure and transmit back to Earth information on the temperature, pressure, and humidity in the atmosphere. Radar can track these balloons and determine wind speed and direction at different altitudes. Radar can also look inside clouds at the rain or snow.

All of us have seen weather satellite pictures on TV. Satellites allow meteorologists to look down at the Earth and clouds from space.

The data collected from weather balloons, satellite images and radar, is fed into computers which then, based on certain conditions, calculate and produce weather maps. Meteorologists look at these maps and forecast tomorrow's weather.

Activity 2.5 Radar and Satellite Imagery

(Recommended for Grades 6 and 7)

Students will interact with radar and satellite imagery in real time to measure the weather.

Depending on the access your class has to computers, either at home or in the classroom have students (or teams of students) go to the **Environment Canada Radar** site at http://weatheroffice.ec.gc.ca/radar/index_e.html and click on the weather stations to find a city in Canada where it is raining. If there are several places, different teams can take different towns.

Record the nearest city and the precipitation (mm/hr) by using the scale on the upper right. Use Activity Sheet 2.5, shown here as a thumbnail. Have some students from each team check the map every 20 minutes. How far has the rain disturbance moved? In which direction? Has the precipitation increased or decreased?

Continue to monitor the disturbance for the rest of the day.

These images are from the National Doppler Weather Radar network. This new network will enable meteorologists to provide better forecasts of significant weather events. Areas threatened by heavy rainfall can be identified more precisely and estimates of the maximum precipitation intensity given more accurately.

For more information, consult the Environment Canada National Radar Program Frequently Asked Questions web page at http://www.msc-smc.ec.gc.ca/projects/nrp/faq_e.cfm



Name: _____

Activity 2.5
Radar and Satellite Imagery: Rainfall

Go to the Environment Canada Radar site and find a city in Canada where it is raining.
City _____ Date _____

National Doppler Radar: visit
http://weatheroffice.ec.gc.ca/radar/index_e.html

Time	Amount (mm/hr)

Satellite Images for North America: visit
http://www.weatheroffice.ec.gc.ca/satellite/index_e.html

Questions:
What is the name of the satellite transmitting the data?

On the infrared view, what do the reds mean? (Check the Frequently Asked Questions page at http://www.msc-smc.ec.gc.ca/projects/nrp/faq_e.cfm)

Environment Canada
SCIENCE TECHNOLOGY



There are also **satellite images** available on Environment Canada – Satellite Images web site at:

http://www.weatheroffice.gc.ca/satellite/index_e.html

Have the students click on the left hand menu (Satellite Imagery) to see an animated satellite image of North America. Use small or medium formats.

Set display images (bottom of map) to “all,” click on play and watch the weather pattern as it happened over the last 48 hours. It will take a bit of time to download, but then you will be able to see the weather moving across North America.

- What is the name of the satellite that is transmitting this data?
- On the infrared view, what do the colours mean?

Check out the Frequently Asked Questions page at

http://www.weatheroffice.gc.ca/mainmenu/faq_e.html

Explore this site for more information on satellites: Meteorological Services – Satellite images

http://www.weatheroffice.gc.ca/mainmenu/faq_e.html#satellite3



Activity 2.6 History of Forecasting

(Recommended for Grades 6 and 7)

Students will realize that the science of forecasting is relatively young.

Have the students find the following site on their computers at home. If this is not practical, download the information and distribute it to your class.

<http://earthobservatory.nasa.gov/Library/WxForecasting/wx2.html>



They should answer the following questions on Activity Sheet 2.6, shown here as a thumbnail.

- What are the names of the three men who invented the first weather instruments?
- Which elements were measured by the first three weather instruments?
- What communications tool first allowed the routine transmission of weather observations across the globe for compilation into weather maps? What year was this invented?
- What is a radiosonde?

Name: _____

Activity 2.6
History of Weather Forecasting

Visit: <http://earthobservatory.nasa.gov/Library/WxForecasting/wx2.html>
to access these questions.

Questions	Answers
What are the names of the three men who invented the first weather instruments?	1. _____ 2. _____ 3. _____
Which elements were measured by the first three weather instruments?	1. _____ 2. _____ 3. _____
What communications tool first allowed the routine transmission of weather observations across the globe for compilation into weather maps? To what year was this invented?	_____
What is a radiosonde?	_____
When did continuous meteorological data recording begin?	_____
When were the earliest meteorological records in Canada made?	_____




See also

<http://www.virtualmuseum.ca/Exhibitions/Heirs/index.html>

Have students click on the Timeline and find the date when continuous meteorological records began in Canada. (Hint: see the years 1800 –1899.)



Name: _____

Activities 2.1 and 2.2 Weather Measurements

From watching the weather channel at home, or reading the newspaper, list the weather elements we measure. Describe the instrument used to measure each weather element.

Element	Modern Instrument	Historical Instrument and How It Works

Name: _____

Activity 2.3: Keeping Weather Records

Chart the daytime high temperature and the precipitation for your assigned city for one month. Watch the weather channel or read the newspaper for your data.

City _____ **Month** _____

Day	High Temperature (°C)	Precipitation
Day 1		
Day 2		
Day 3		
Day 4		
Day 5		
Day 6		
Day 7		
Day 8		
Day 9		
Day 10		
Day 11		
Day 12		
Day 13		
Day 14		
Day 15		
Day 16		
Day 17		
Day 18		
Day 19		
Day 20		
Day 21		
Day 22		
Day 23		
Day 24		
Day 25		
Day 26		
Day 27		
Day 28		
Day 29		
Day 30		
Day 31		
Total		
Average (Total/Days)		

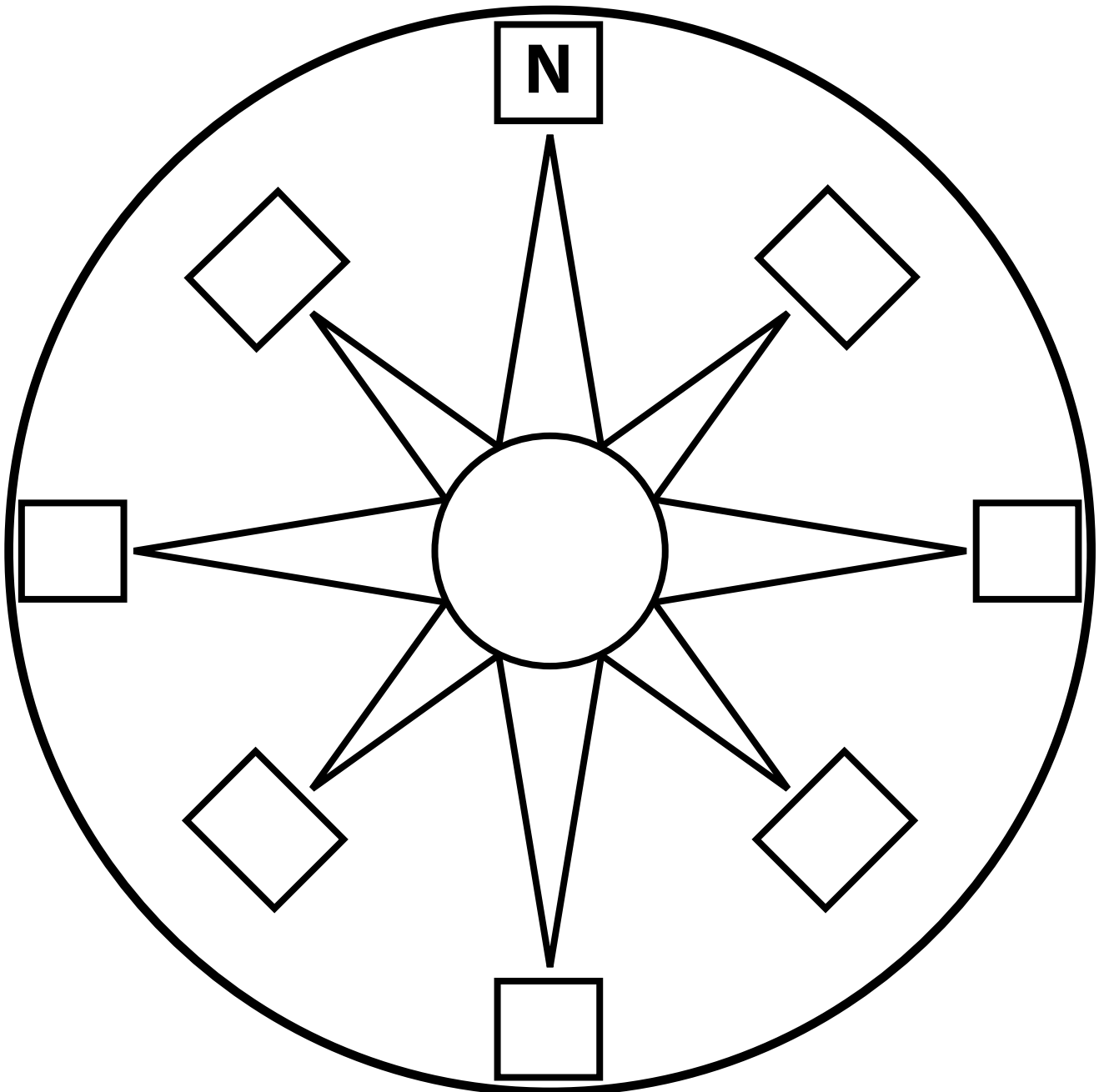
Activity 2.4

Make a Weather Vane

Compass Rose

- 1) Cut out the compass rose along the thick outer line.
- 2) Fill in the compass points.
- 3) Place this compass rose under the bottle of the weather vane
- 4) Use a compass to align the weather vane to North.

You can now use this compass rose to read the wind's direction.

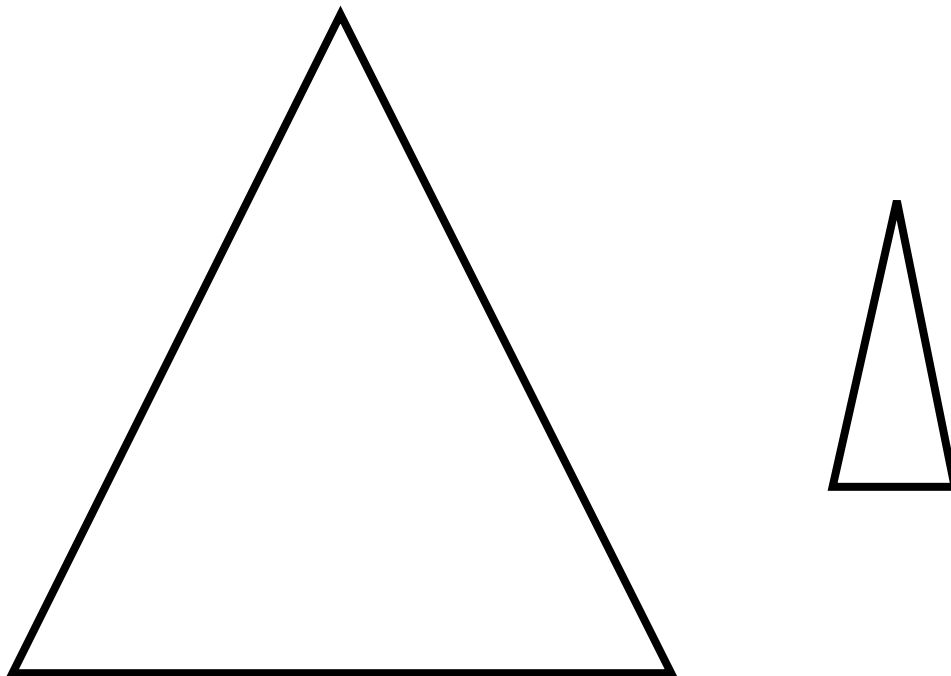
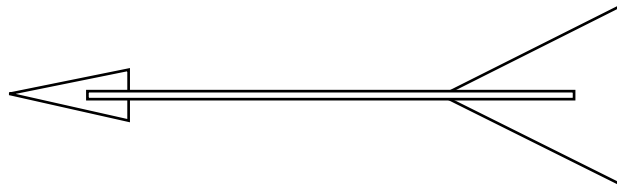


Activity 2.4

Make a Weather Vane

Wind Vane

- 1) Cut out these large vane and smaller pointer.
- 2) Tape these parts to a drinking straw, as shown in the drawing.



Name: _____

Activity 2.5 Radar and Satellite Imagery: Rainfall

Go to the Environment Canada Radar site and find a city in Canada where it is raining.

City _____ Date _____

National Doppler Radar: visit

http://weatheroffice.ec.gc.ca/radar/index_e.html

Time	Rainfall (mm/hour)

Satellite Images for North America: visit

http://www.weatheroffice.gc.ca/satellite/index_e.html

Questions:

What is the name of the satellite transmitting the data?

On the Infrared view, what do the colours mean? (Check the Frequently Asked Questions page at http://www.weatheroffice.gc.ca/mainmenu/faq_e.html#satellite)

Name: _____

Activity 2.6 History of Weather Forecasting

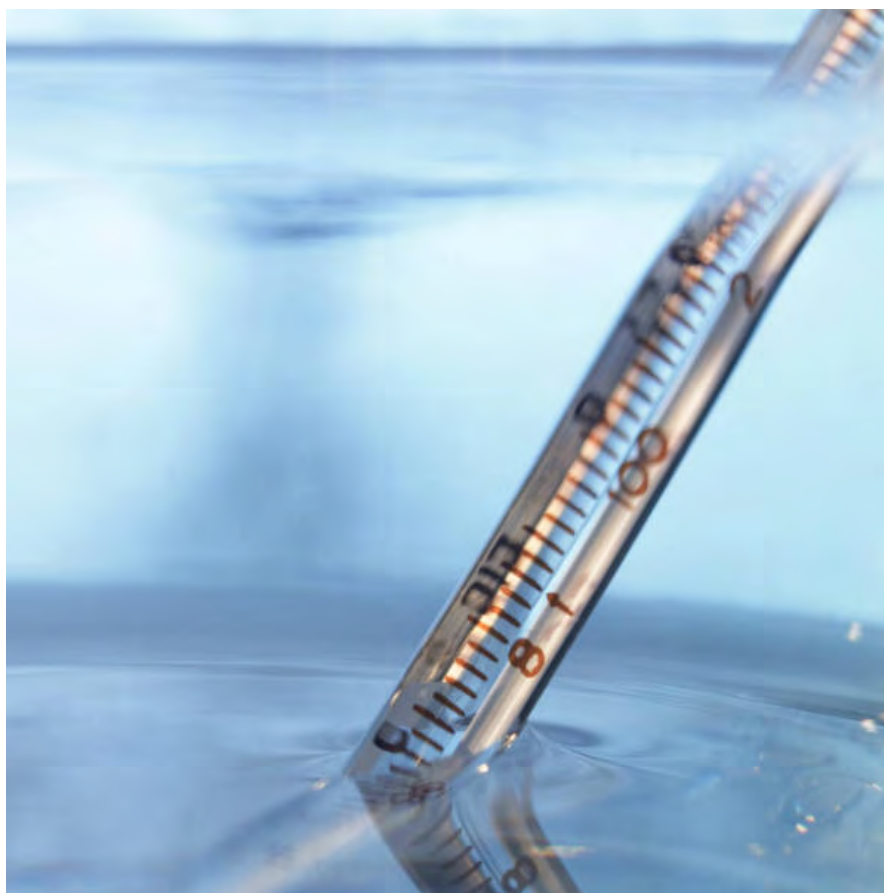
Visit: <http://earthobservatory.nasa.gov/Library/WxForecasting/wx2.html>
to answer these questions.

Questions	Answers
What are the names of the three men who invented the first weather instruments?	1.
	2.
	3.
Which elements were measured by the first three weather instruments?	1.
	2.
	3.
What communications tool first allowed the routine transmission of weather observations across the globe for compilation into weather maps?	
In what year was this invented?	
What is a radiosonde?	
When did continuous meteorological data recording begin and when were the earliest meteorological records in Canada made?	

The Canada Science and Technology Museum
presents

**Weather Wise:
A Virtual Exploration Guide
to
Weather and Climate Change**

Section 3: Global Warming



Introduction

Is our planet really warming up?

Discuss with the class the concept of global warming. What have they learned from watching television and reading the newspaper? The following activities will help them understand the term “global warming.”



Average Temperature of the Earth Over Time

Activity 3.1 The Earth’s Average Surface Temperature

(Recommended for Grades 4 to 7)

Students will realize that the world’s average surface temperature is rising.

Have the students use Activity Sheet 3.1 to plot what has happened to the planet’s temperature against time. These figures represent the difference between the average temperature for a specific year and the average temperature over 40 years from 1961 to 1990 — called “departures in temperature from the 1961 to 1990 average” since 1860. They can also draw the curve. If necessary, label the axes for them.



Discuss the trend. It is likely that the 1990s have been the warmest decade and 1998 the warmest year of the millennium.

For more detailed information see the graph at the web site “Variations of the Earth’s Surface Temperature” at

http://www.grida.no/climate/ipcc_tar/wg1/figspm-1.htm

Why is the Earth’s temperature rising?



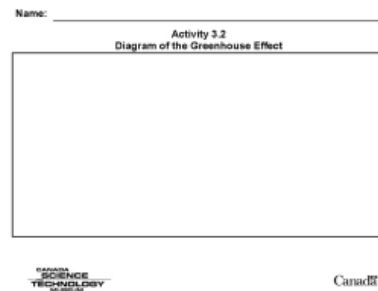
The Greenhouse Effect and Enhancement

Activity 3.2 The Greenhouse Effect

(Recommended for Grades 4 to 7)

Students will understand the basic principle of the greenhouse effect.

If students have access to computers, have them search for a Greenhouse Effect site and draw for themselves a labeled graphic of the process on Earth. If not, print out the enlarged graphic from the site below and distribute several or have various students draw parts of it on the board, while the class describes it.



Environment Canada — The Greenhouse Effect

http://www.msc.ec.gc.ca/education/scienceofclimatechange/understanding/greenhouse_gases/index_e.html

The greenhouse effect has allowed life on Earth for millennia as we know it. The natural greenhouse effect keeps the average surface temperature of the Earth at 15°C. Without the greenhouse effect the temperature would be -18°C. But what has happened over the last 200 years? We seem to be experiencing an enhanced greenhouse effect.

What is happening to the greenhouse effect?

Print out and have the students read the following definitions and hold a discussion as to why we are experiencing an enhanced greenhouse effect. (Industrial Revolution, industrial processes, coal fired electricity generation, advent of automobiles, advent of aircraft, burning of forests, etc)



A Glossary for Global Warming

The text below is from NOVA – Science in the News.

<http://www.science.org.au/nova/016/016glo.htm#greenhouse%20effect>



Greenhouse Effect:

The trapping and build-up of heat in the lower atmosphere near a planet's surface. Some of the heat flowing back towards space from the Earth's surface is absorbed by water vapour, carbon dioxide, methane and other gases in the atmosphere. If the atmospheric concentrations of these gases rise, then theory predicts that the average temperature of the lower atmosphere will gradually increase. The greenhouse effect in part explains the temperature differences of Mars, Venus and Earth.

Enhanced Greenhouse Effect:

An increase in the natural process of the greenhouse effect brought about by human activities, whereby greenhouse gases such as carbon dioxide, methane, chlorofluorocarbons and nitrous oxide are being released into the atmosphere at a far greater rate than would occur through natural processes and thus their concentrations are increasing. Also called anthropogenic greenhouse effect or climate change.

Global Warming:

An increase in the average temperature of the Earth's surface. Global warming is one of the consequences of the enhanced greenhouse effect and will cause worldwide changes to climate patterns.

Activity 3.3 Demonstration of the Greenhouse Effect

(Recommended for Grades 4 to 6)

Students will see the effect of trapped solar energy.

Place two thermometers in the sunlight or under a sunlamp. Place a large transparent jar over one. Have different students record the temperatures every ten minutes. Use Activity Sheet 3.3 provided. Discuss the observations.

Other sites discussing global warming:

The following site has an excellent animation explaining the greenhouse effect that you may want to share with your students.

United States Environmental Protection Agency – greenhouse warming animation.

<http://www.epa.gov/climatechange/kids/greenhouse.html>

BBC News – Guide to Climate Change – another greenhouse warming animation

http://news.bbc.co.uk/1/hi/english/static/in_depth/sci_tech/2000/climate_change/greenhouse/anim/ghouse_4.stm

World Wildlife Fund Canada — The Greenhouse Effect

<http://www.wwf.ca/AboutWWF/WhatWeDo/ConservationPrograms/GlobalWarming.asp>

NASA Exploration

<http://liftoff.msfc.nasa.gov/academy/space/greenhouse.html>

From the United Nations Intergovernmental Panel on Climate Change came the following report in February 2007:

“It is very likely that [man-made] greenhouse gas increases caused most of the average temperature increases since the mid-20th century.”



Name: _____

Activity 3.3: The Greenhouse Effect

Record the readings on the two thermometers every ten minutes.

Time (min.)	Temperature (°C)	
	Under Glass	In Air
0		
10		
20		
30		
40		
50		
60		

Plot a graph showing temperature vs. time.

A large empty rectangular box intended for plotting a line graph based on the data from the table above.

NATIONAL SCIENCE TECHNOLOGY

Canada



What has caused this increase in CO₂? Scientists confirm that the greatest CO₂ emissions are due to the generation of electricity, followed closely by the transport sector.

Activity 3.6 Electricity Generation in Canada

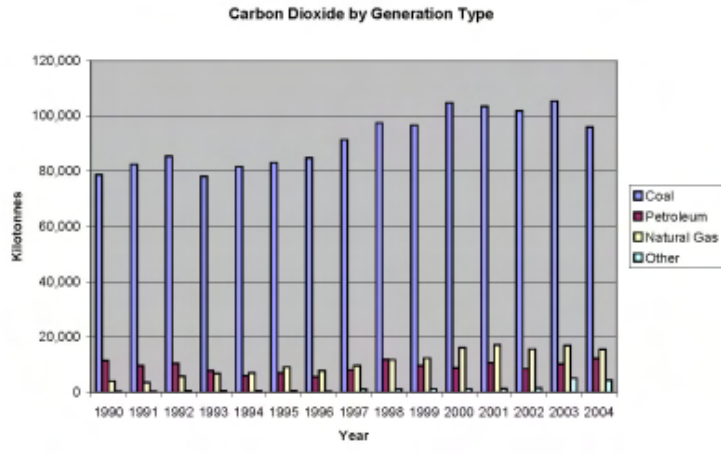
(Recommended for Grade 7)

Students will use math skills to create a bar chart and learn more about the main CO₂ producing activities.



Elicit from the students the methods by which we generate electricity in Canada.

Have them use the data table for Activity Sheet 3.6 to create a multi-clustered bar chart — each source in a different colour — showing the greenhouse gas emissions from each method for each year. A sample of a multiple



bar chart is shown here. For each year, there are several vertical bars. In this case, each of the four bars represents the CO₂ production for four different electrical generation processes.

From Environment Canada - Information on greenhouse gas sources and sinks:

http://www.ec.gc.ca/pdb/ghg/inventory_report/2004_report/ta9_1_e.cfm

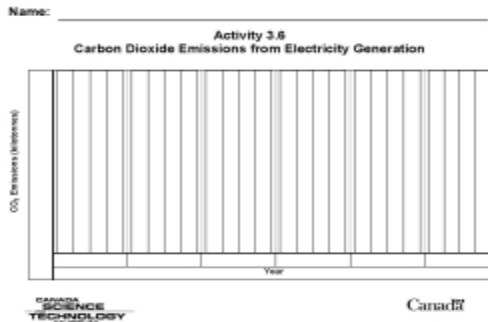
Activity 3.6 Carbon Dioxide Emissions from Electricity Generation

Name: _____

Year	Coal	Petroleum	Natural Gas	Other	Total
1990	78,000	10,000	5,000	2,000	95,000
1991	82,000	10,000	5,000	2,000	99,000
1992	85,000	10,000	5,000	2,000	102,000
1993	78,000	10,000	5,000	2,000	95,000
1994	82,000	10,000	5,000	2,000	99,000
1995	83,000	10,000	5,000	2,000	100,000
1996	85,000	10,000	5,000	2,000	102,000
1997	92,000	10,000	5,000	2,000	109,000
1998	98,000	10,000	5,000	2,000	115,000
1999	96,000	10,000	5,000	2,000	113,000
2000	105,000	10,000	5,000	2,000	122,000
2001	103,000	10,000	5,000	2,000	120,000
2002	101,000	10,000	5,000	2,000	118,000
2003	105,000	10,000	5,000	2,000	122,000
2004	95,000	10,000	5,000	2,000	112,000

* For example, in 1990, electricity produced by coal-fired generators emitted 78,000 kilotonnes of CO₂.

Thumbnails of the data sheet and the graph blank are shown here. Students will have to rule their own horizontal lines and add a Y axis scale. They can add the colour legend at the bottom of the graph.



Notice that the data sheet includes rows for nuclear, hydroelectric, and biomass power sources for electricity production. For the years described by the data, these processes produced negligible amounts of CO₂, so we can omit them from the graph.

Activity 3.7 Transportation

(Recommended for Grade 4 to 5)

Students will learn how transportation has changed over the last century.

Discuss the rise of carbon fuel burning vehicles over last century.

Discuss the common methods of transportation before 1900: walking, horse, bicycle, train. What do we use now? Cars, buses, planes.

Using Activity Sheet 3.7, have the students number the transportation vehicles as to which came first.



Activity 3.8 Transportation Timeline

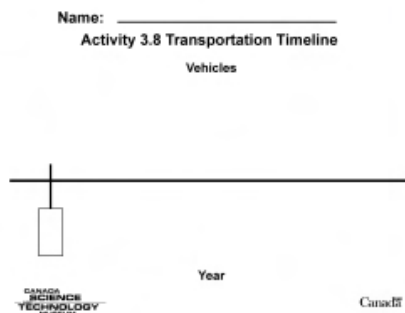
(Recommended for students Grade 5 to 7)

Students will create a transportation timeline and realize automobiles and planes are quite recent and that burning

fossil fuels for transportation is relatively new.

Using Activity Sheet 3.8 have the students draw a timeline from 1600 to today and list the type of transportation vehicles used and the date they were introduced if appropriate. They should use references books on transportation in the school library. Some might want to do Internet searches. Make sure they include on the timeline the Industrial Revolution, which changed manufacturing enormously.

Multiple copies of the timeline blank can be taped together to form a long timeline.



Some suggested books on transportation:

Dowswell, Paul. **Transportation**,
Chicago, Ill.: Heinemann Library, 2002. ISBN 1-588102-16-5

Gilpin, Daniel. **Transportation Solutions**,
North Mankato, Minn.: Smart Apple Media, 2005. ISBN 1-583405-99-2

Herbst, Judith. **The History of Everyday Transportation**,
Minneapolis, Minn.: Lerner, 2006. ISBN 0-822524-96-1

Pollard, Michael. **Transportation**,
New York : Chelsea House Publishers, 1995. ISBN 0-791027-68-6

Richards, Jon. **Transport**,
North Mankato, Minn. : Smart Apple Media, 2005. ISBN 1-593891-96-2

Steins, Richard. **Transportation Milestones and Breakthroughs**,
Austin, TX: Raintree Steck-Vaughn, 1995. ISBN 0-811449-35-1

Extra Activities for More Advanced Students:



Activity 3.9 A Timeline of Transportation Technologies

If your students have access to computers they might create a transportation timeline web page and use images from clip art on the Internet for entries.

Activity 3.10 The World's CO₂ Emitters

Using the Internet, students should discover which countries are the major CO₂ emitters.

Suggested sites:

Environment Canada — Comparison of Global Emissions

http://www.ec.gc.ca/pdb/ghg/inventory_report/global_emissions_e.cfm

BBC — Climate Change — the Big Emitters

<http://news.bbc.co.uk/1/hi/sci/tech/3143798.stm>

List of Countries by CO₂ Emissions

http://en.wikipedia.org/wiki/List_of_countries_by_carbon_dioxide_emissions

Union of Concerned Scientists — Global Warming

http://www.ucsusa.org/global_warming/science/each-countrys-share-of-co2-emissions.html

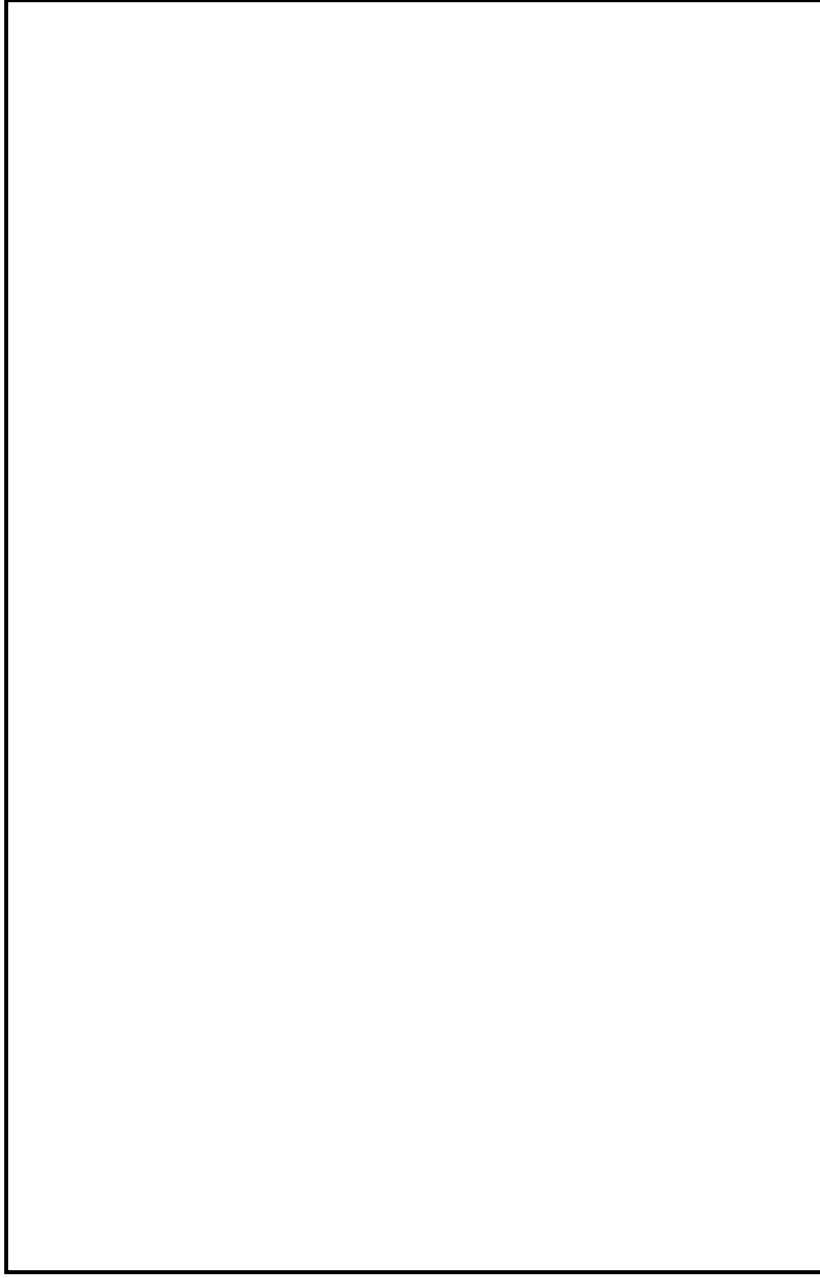


Name: _____

Activity 3.1 Variations in Earth's Surface Temperature

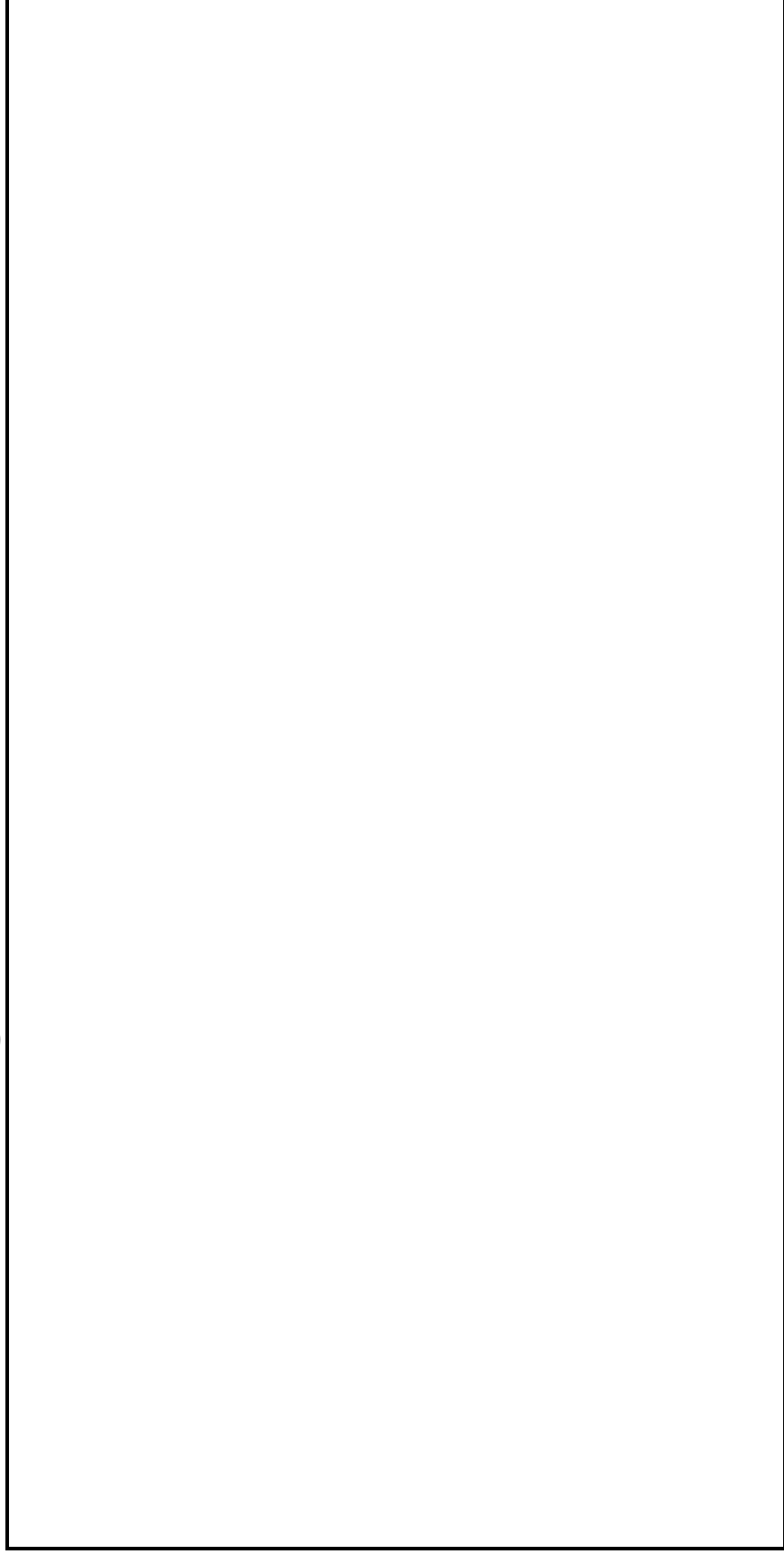
Using the data provided, make a graph plotting "Departure in Temperature From the 1961 to 1990 Average" versus "Time."

Year	Departure in Temperature (°C)
1860	-0.4
1870	-0.2
1880	-0.2
1890	-0.3
1900	0
1910	-0.4
1920	-0.3
1930	-0.3
1940	-0.1
1950	-0.2
1960	-0.1
1970	-0.1
1980	0
1990	+0.2
2000	+0.3



Name: _____

Activity 3.2
Diagram of the Greenhouse Effect



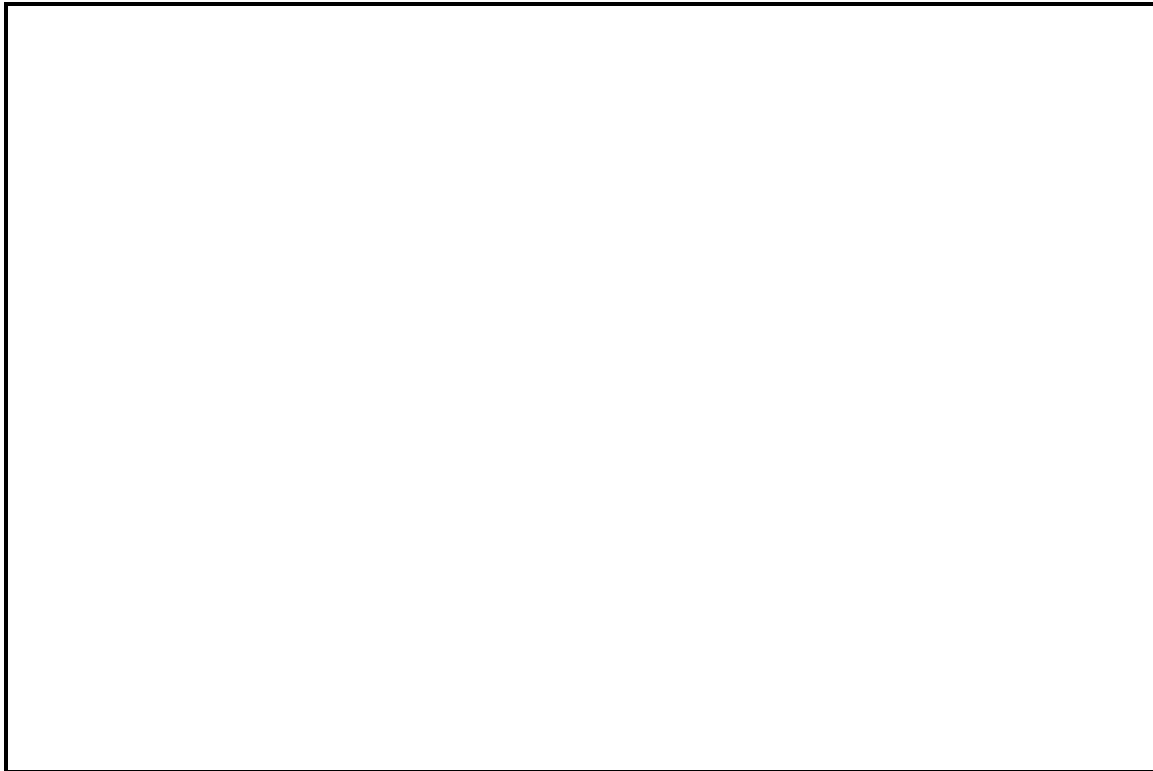
Name: _____

Activity 3.3: The Greenhouse Effect

Record the readings on the two thermometers every ten minutes.

	Time (min.)	Temperature (°C)	
		Under Glass	In Air
1.			
2.			
3.			
4.			
5.			
6.			
7.			

Plot a graph showing temperature vs. time.



Name: _____

Activity 3.4 Greenhouse Gases

From articles you have read or from research on the Internet, list the major greenhouse gases.

1.

2.

3.

4.

5.

6.

Name: _____

Activity 3.5 Production of Carbon Dioxide

Read the following paragraph and create the chart (“Figure 1”) described here.

“The growth in anthropocentric [human produced] emissions of CO₂ over the past 250 years has been dramatic. Figure 1 displays estimates of global CO₂ emissions from 1750 to 2000 measured in millions of metric tons of carbon. Ice core data suggest that [in 1750] annual, global ...human-related carbon emissions were on the order of 3 million metric tons. By 1850, these annual emissions had grown ten-fold to about 54 million tons. By 1950, they had grown by an additional two orders of magnitude to approximately 1,630 million tons. And in 2000, global carbon emissions were estimated to be five times larger at 6,611 million metric tons.”

(Note: 1 million metric tons = 1 megaton)

CO ₂ Emissions (megatons)					
	Year				

Activity 3.6 Carbon Dioxide Emissions from Electricity Generation

Name: _____

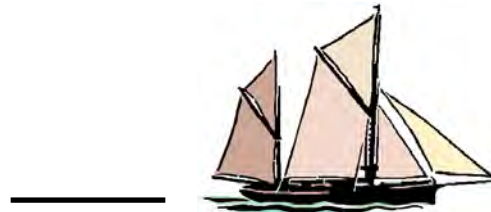
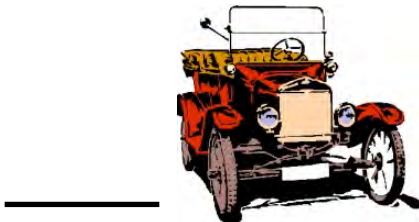
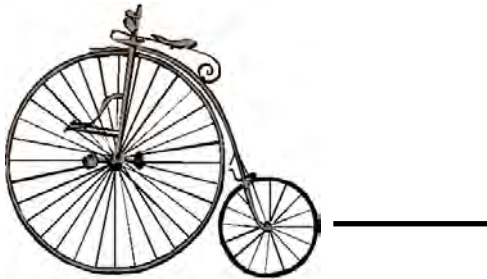
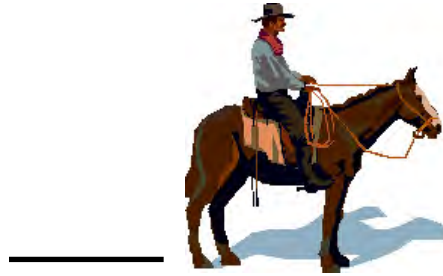
Greenhouse Gas Emissions															
<i>Kilotonnes of Carbon Dioxide (CO₂) equivalent*</i>															
Sources	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Coal	78,800	82,500	85,400	78,200	81,700	83,100	84,800	91,400	97,500	96,700	104,800	103,400	101,900	105,400	96,000
Refined Petroleum Products	11,400	9,590	10,500	7,780	6,040	6,990	5,620	8,110	11,900	9,600	8,800	10,600	8,500	10,300	12,300
Natural Gas	4,050	3,530	5,850	6,860	7,020	9,150	7,770	9,670	11,800	12,400	16,100	17,100	15,600	17,000	15,500
Nuclear	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Hydro	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Biomass	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Others	404	428	512	462	652	522	346	1,100	1,080	1,230	1,260	1,380	1,470	5,090	4,340
Total	94,700	96,000	102,300	93,300	95,400	99,800	98,500	110,300	122,300	119,900	131,000	132,500	127,500	137,800	128,100

* For example, in 1990, electricity produced by coal-fired generators emitted 78,800 kilotonnes of CO₂.

Name: _____

Activity 3.7 Transportation

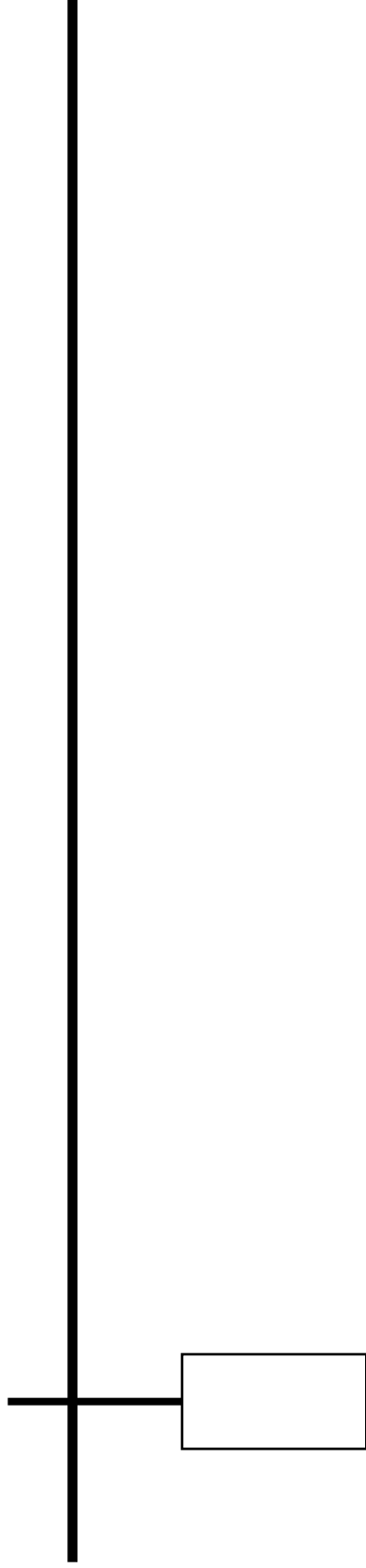
Which came first?



Name: _____

Activity 3.8 Transportation Timeline

Vehicles



Year

The Canada Science and Technology Museum
presents

**Weather Wise:
A Virtual Exploration Guide
to
Weather and Climate Change**

**Section 4: Climate Change
and
Our Responsibility**



Introduction

It is agreed that the global warming that we are now experiencing is being caused by human activity. A report in February 2007 from the United Nations Intergovernmental Panel on Climate Change concluded that man-made greenhouse gas increases are causing the current average temperature increases.

Effects of Climate Change

Since 1900, the average temperature of our planet has increased by about 0.5°C. With increased global warming will come climate change all over the world. Some areas of the world will get warmer, some colder, some dryer, some wetter. Our weather may become more extreme. A warmer atmosphere can hold more moisture. With more evaporation, the planet will be wetter, which will change flood and drought patterns.

Activity 4.1 If the Climate Changes...

(Recommended for Grades 4 to 6)

Students will think about the consequences of climate change.

Discuss the following questions with the students or have them fill out Activity Sheet 4.1 and share their answers in discussion.

- What will happen to the forests if the weather gets warmer?
- What will happen to northern wildlife if the icebergs melt?
- What will happen to the oceans if the icebergs melt?
- What will happen if there is less snow?
- What will happen if summers are warmer?



Name: _____

Activity 4.1: If the Climate Changes...

Answer the following questions.

Question	Answer
What will happen to the forests if the weather gets warmer?	
What will happen to northern wildlife if the icebergs melt?	
What will happen to the oceans if the icebergs melt?	
What will happen if summers are warmer?	
What will happen if there is less snow?	



Activity 4.2 What about the Weather...?

(Recommended for Grades 6 and 7)

Students will think about the consequences of climate change.

Many newspapers and magazines have articles on climate change. Have the students list on Activity Sheet 4.2 the changes they think will happen to the planet because of climate change. If children have access to a computer, have them research on the Internet the consequences of climate change (e.g. floods; melting polar ice caps; rising oceans; flooding of coastal areas; droughts; heat waves; forest fires; destruction of current wildlife habitats; disappearing species).

Also have them list some extreme weather occurrences. Tabulate all these ideas on the board and ask them if they can



Name: _____

Activity 4.2
Consequences of Climate Change

Impact of Climate Change

1	
2	
3	
4	
5	
6	
7	
8	

Extreme Weather Occurrences



think of any more impacts on society (e.g. spread of disease; loss of homes; changes in farming practices, such as growing different crops).

Useful Web Sites:

United Nations Framework Convention on Climate Change

http://unfccc.int/essential_background/background_publications_htmlpdf/climate_change_information_kit/items/281.php

Environment Canada

http://www.ec.gc.ca/climate/overview_science-e.html

Malaspina University College, B.C.

<http://www.mala.bc.ca/~earles/ipcc-tar-feb01.htm>



Consequences of Climate Change

Activity 4.3 Canadian North

(Recommended for Grades 4 to 6)

Students will learn about the changes happening now to Canadians in the Arctic.

Climate change will affect the Arctic and northern settlements the most.

Print and read some of the description of the changing life in the North presented by Kiilinik High School in Cambridge Bay, Nunavut. Find Cambridge Bay on the map of Canada.

Visit the web site for Kiilinik High School at:

<http://www.climatechangenorth.ca/student-exchange/submissions/kiilinik.html>

If you live in the North develop a student project to describe or counter climate change and add it to the site:

http://www.climatechangenorth.ca/student-exchange/G1_Student_Exchange.html

This site also offers a link-up process for northern schools.

Climate change seems to be already happening in certain areas of the globe but there are things we can do to slow it down. Discuss solutions with students before doing the next activity.



Alternative Energy

Activity 4.4 Alternative Energy

(Recommended for Grades 4 to 7)

Students will realize there are alternatives to fossil fuels.

We use fossil fuels to create heat, electricity and energy for transportation. Are there other ways to create energy?

Discuss with the class renewable and non-renewable energy. You will find information at these web sites:

Canada Science and Technology Museum

http://www.sciencetech.technomuses.ca/english/schoolzone/Info_Energy.cfm

Environment Canada

http://www.ec.gc.ca/EnviroZine/english/issues/16/feature1_e.cfm

Using Activity Sheet 4.4, have the students list as many alternative energy sources to fossil fuels as you can. If they have access to a computer, they can search on “alternative energy”. Have them research one alternative energy and write a short essay about it on their activity sheet.

(Solar, wind, thermal, tidal, etc. — what it is, how it works, cost, size)

Activity 4.5 Alternative Energy (for Advanced Students)

(Recommended for Grade 7)

Students will realize there are alternatives to fossil fuels.

Divide students into groups, each group researching one alternative energy source on the Internet. Each group will write an essay on their assigned energy. Ask them to create a spread sheet or a world map indicating the countries heavily using the assigned alternative energy. Develop energy source symbols for your map.

Useful Web Sites:

World Energy Council

<http://www.worldenergy.org/wec-geis/edc/>

CBC

<http://www.cbc.ca/news/background/climatechange/>

National Research Council — Hydrogen and Fuel Cells

http://www.nrc-cnrc.gc.ca/highlights/2007/0704vancouver_e.html

Edugreen — Solar Energy in India

<http://edugreen.teri.res.in/explore/renew/solar.htm>



Name: _____

Activity 4.4
Alternative Sources of Energy

List as many alternative energy sources to fossil fuels as you can. Research one, research and write a short essay (what it is, how it works, cost, benefits, etc.)

1. _____ 2. _____
3. _____ 4. _____
5. _____ 6. _____

My chosen energy source is: _____

Canada Science and Technology Museum Canada



BBC News — Iceland Launches Energy Revolution
<http://news.bbc.co.uk/2/hi/science/nature/1727312.stm>

Israel Ministry of Foreign Affairs
<http://www.mfa.gov.il/MFA/Facts%20About%20Israel/Science%20-%20Technology/Solar%20Energy%20in%20Israel>

Greenpeace — Wind Energy
<http://www.greenpeace.org/international/campaigns/climate-change/solutions/wind>

Environment Canada — Envirozine
http://www.ec.gc.ca/EnviroZine/english/issues/16/feature1_e.cfm

World Energy Resources and Consumption
http://en.wikipedia.org/wiki/World_energy_resources_and_consumption

Natural Resources Canada Technologies and Applications
http://www.canren.gc.ca/tech_appl/index.asp?CaId=5&PgId=121

Personal Choices

How can we save energy and reduce greenhouse gases?

Activity 4.6 Saving Energy

(Recommended for Grades 4 to 7)

Students will be reminded of their responsibility to save energy to reduce greenhouse gases.

Ask students to fill out Activity Sheet 4.6.

With the students, compile a master list on the board of all the ideas they have listed to save energy at home or while traveling. Discuss the things they have already done or are doing.

Then have several students go to the sites below to find out if there is anything else to add to the list.

United States Environmental Protection Agency
<http://www.epa.gov/climatechange/kids/difference.html>

Environmental Youth Alliance - Saving the Planet 101
<http://eya.ca/files/attachments/sp101booklet.pdf>

(This is a very useful site.)

Energy Alternatives
<http://www.energyalternatives.ca/conservation.asp>

Ministry of Energy Ontario
<http://www.energy.gov.on.ca/index.cfm?fuseaction=conservation.tips>



Name: _____

Activity 4.6
Ways To Save Energy

Make a list of the things you are already doing to save energy at home and when traveling.

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____

GRANDES
SCIENCE
TECHNOLOGY
MUSEUM

Canada



- Alternative energy and the auto industry; what is available now; what is forecast for the future?
- Transportation of food, the production of CO₂, the impact on the planet and possible solutions.
- or a topic of their choice.

Students should use reliable sites on the Internet, which can be a good source of information on climate change. Have them credit the site they referenced.

There are also many magazines in the school library that will have articles on these subjects.

Books where you can find information on the subject:

Hawkes, Nigel. **Climate Crisis (Saving our World)**,
London: Watts, 2003. ISBN 0-749650-96-6

Jennings, Terry J. **Changing Climates**,
North Mankato, MN: Smart Apple Media, 2006. ISBN 1-583407-28-6

Silverstein, Alvin. **Weather and Climate**,
Brookfield, Conn.: Twenty-First Century Books, 1998. ISBN 0-761332-23-5

Spilsbury, Louise. **Changing Climate: Living With the Weather**,
Chicago, Ill. : Raintree, 2006. ISBN 1410911128

Suzuki, David & Dressel, Holly. **Good News for a Change**,
Vancouver, B.C.: Greystone Books, 2002. ISBN 0-155054-92-6

Unwin, Mike. **Climate Change**,
Chicago, Ill.: Heinemann Library, 2007. ISBN 1-403482-16-0

With this growing awareness of the fragility of our planet, your students will set examples for the adults in their lives.

Name: _____

Activity 4.1: If the Climate Changes...

Answer the following questions.

Questions	Answers
What will happen to the forests if the weather gets warmer?	
What will happen to northern wildlife if the icebergs melt?	
What will happen to the oceans if the icebergs melt?	
What will happen if summers are warmer?	
What will happen if there is less snow?	

Name: _____

Activity 4.2 Consequences of Climate Change

Impacts of Climate Change

1	
2	
3	
4	
5	
6	
7	
8	

Extreme Weather Occurrences

Name: _____

Activity 4.4 Alternative Sources of Energy

List as many alternative energy sources to fossil fuels as you can. Choose one, research and write a short essay (what it is, how it works, cost, benefits, etc.).

- | | |
|----------|----------|
| 1. _____ | 4. _____ |
| 2. _____ | 5. _____ |
| 3. _____ | 6. _____ |
| _____ | _____ |

My alternative energy source is: _____

Name: _____

Activity 4.6

Ways to Save Energy

Make a list of the things you are already doing to save energy in the home and when travelling.

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____

