engaging science

Climate Change

Using technology to involve students in the environment

An integrated unit in science and technology

H.R. MacMillan Space Centre

Science World British Columbia

Vancouver Aquarium

engaging science

Engaging Science
tel: 1-888-211-1822
e-mail: escience@vanaqua.org
web site: www.engagingscience.org

This project was funded by the Climate Change Action Fund, CA Net, and the British Columbia Information, Science and Technology Agency (ISTA).

We gratefully acknowledge the financial support of the Province of British Columbia through the Ministry of Education.

TABLE OF CONTENTS

INTRODUCTION

Climate change is a shift in the "average weather" that a given region experiences. This is measured by changes in all the features we associate with weather such as temperature, wind patterns, precipitation, and storms.

Global climate change means change in the climate of the Earth as a whole, which does occur naturally. However, the climate change we are seeing today differs from previous climate change in both its rate and magnitude. Over the past 200 years, emissions of gases due to human activities have accumulated in the atmosphere. By increasing the amount of these heat-trapping gases, we have "enhanced" the natural greenhouse effect to the point that it has the potential to warm the planet at a rate that has never been experienced in human history!

This program begins with students recording weather over a set period of time to obtain consistent weather data for their local area.

In the next section, students will research historical weather data to compare with their own recorded data.

Finally, based on their weather recording and research, students will summarize the information they have gathered and discuss climate change in relation to their area. Students will then have the opportunity to develop ways in which they, as individuals and part of a community, can help slow down the effects of climate change.

LEARNING OUTCOMES

WM = Weather Measurement
CR = Community Research
WR = Weather Research
PT = Piecing it Together

Climate Change complements the British Columbia K–7 Science Prescribed Learning Outcomes. Listed below are the learning outcomes from the Processes and Skills of Science (PSS), Life Science (LS), Physical Science (PS) and Earth and Space Science (ES) which are covered by the major activities described in this playbook.

Kindergarten

		WM	CR	WR	PT
PSS	use the five senses to make observations	•			
PSS	share with others information obtained by observing	•	•	•	•
LS	describe features of local plants and animals (e.g.,color, shape, size, texture)	•	•		
LS	compare local plants	•	•		
	compare local animals	•	•		
ES	demonstrate the ability to observe their surroundings	•	•	•	•
ES	describe features of their immediate environment		•		•

Grade 1

		WM	CR	WR	PT
PSS	communicate their observations, experiences, and thinking in a variety of ways (e.g.,verbally, pictorially, graphically)	•	•	•	•
PSS	classify objects, events, and organisms	•			
LS	describe the basic needs of local plants and animals (e.g.,food, water, light)	•	•		
LS	describe how the basic needs of plants and animals are met in their environment	•	•		
ES	describe changes that occur in daily and seasonal cycles and their effects on living things	•	•	•	
ES	describe activities of Aboriginal peoples in BC in each seasonal cycle		•		

Grade 2

		WM	CR	WR	PT
PSS	use their senses to interpret observations	•	•	•	•
PSS	infer the probable outcome of an event or behaviour based on observations	•	•	•	•
LS	describe some changes that affect animals (e.g.,hibernation, migration, decline in population)		•		•
LS	describe how animals are important in the lives of Aboriginal peoples in BC		•		
LS	describe ways in which animals are important to other living things and the environment	•	•	•	•
ES	describe physical properties of air, water, and soil	•		•	
ES	distinguish ways in which air, water, and soil interact	•		•	
ES	explain why air, water, and soil are important for living things	•		•	

Grade 3

		WM	CR	WR	PT
PSS	ask questions that foster investigations and explorations relevant to the content	•	•	•	
PSS	measure objects and events	•	•	•	•
LS	describe ways in which plants are important to other living things and the environment		•		

Grade 4

		WM	CR	WR	PT
PSS	make predictions, supported by reasons and relevant to the content	•			•
PSS	use data from investigations to recognize patterns and relationships and reach conclusions	•			•
LS	compare the structures and behaviours of local animals and plants in different habitats and communities	•	•		
LS	demonstrate awareness of the Aboriginal concept of respect for the environment		•		•
LS	determine how personal choices and actions have environmental consequences	•	•	•	•
ES	measure weather in terms of temperature, precipitation, cloud cover, wind speed and direction	•		•	
ES	analyse impacts of weather on living and non-living things	•	•	•	•

Grade 5

		WM	CR	WR	PT
PSS	evaluate fairness in a given experiment	•		•	•
PSS	describe the steps in designing an experiment	•	•	•	
ES	analyse how BC's living and non-living resources are used		•		
ES	identify methods of extracting or harvesting and processing BC's resources		•		
ES	analyse how the Aboriginal concept of interconnectedness of the environment is reflected in responsibility for and caretaking of resources		•		
ES	describe potential environmental impacts of using BC's living and non-living resources		•		•

Grade 6

		WM	CR	WR	PT
PSS	manipulate and control a number of variables in an experiment	•		•	
AS	apply solutions to a technical problem (e.g., malfunctioning electrical circuit)	•		•	
ES	explain obstacles unique to exploration of a specific extreme environment			•	
ES	assess technologies used for extreme environments			•	

Grade 7

		WM	CR	WR	PT
PSS	test a hypothesis by planning and conducting an experiment that controls for two or more variables	•	•		
PSS	create models that help to explain scientific concepts and hypothesis	•			•
LS	assess the requirements for sustaining healthy local ecosystems				
LS	evaluate human impacts on local ecosystems		•		

PROJECT ONE: WEATHER MEASUREMENT

The terms climate and weather are often used interchangeably, but their meanings are quite different. "Weather" is term referring to the temperature, precipitation (rain, snow, etc.), humidity, sunshine, and wind that occurs at a particular time at a specific location. The "climate" of that location is a summary of the past weather events that have occurred. A description of the climate of a certain place would include the averages and extremes of such things as temperature and rainfall amounts, which can be determined from past weather records.

Canada is one of the most climate-conscious, weather-conversant countries in the world. Why are we so conscious of the weather around us? Canada is a land of climatic contrasts and extremes, and the diversity of the climate influences many aspects of our lives.

The diversity of Canada's climate is evident is the number and variety of Canada's climatic landscapes — permanently frozen ice-caps, windswept treeless tundra, luxuriant Pacific rainforests, hot semi-arid scrub lands, polar deserts, and sun-drenched grain fields.

Canadian climates are somewhat unpredictable on a short-term basis. No season or year can be counted on to give an accurate indication of what the next one will be like. Cool summers may follow warm winters or vice versa. Whereas some regions benefit from timely rains, extra warmth, and a late freeze, a not-too-distant region may endure severe drought, disastrous hailstorms, or a surprise snowfall, and their situations may be reversed with bewildering suddenness. Only through the study of weather over many years can we have enough data to begin to understand global climate change and its affects on us locally.

Adapted from David Phillips, The Climates of Canada*, Environment Canada:1990.*

Have students measure and record local weather conditions over a set period of time. This information will be used in Project Three and Project Four to compare current weather with weather in the past.

What will happen

Students will:

- identify the climate zone in which they live and the characteristics of that zone;
- build weather stations to make measurements over a 1 – 2 month period (this can be extended to last the whole year);
- measure and record temperature, precipitation, and humidity, wind speed and direction, air pressure, cloud cover, type of clouds;
- use resources to help them predict daily weather;
- work with a weather person(s) (individual or organization) within the community as a mentor and resource through the project.

NOTE:

Activities on how to make your own weather measuring devices can be found in Appendix B

What you need

- Canadian Climate Zones map (provided)
- thermometer
- rain gauge/ruler
- weather chart (sample provided in Appendix A)
- barometer (air pressure)
- weather vane (wind direction)
- map of Canada or BC
- bucket/container to catch precipitation
- cloud chart (provided)
- hygrometer (humidity)
- anemometer (wind speed)

What to do

1. Have students identify on the map (e.g. shade in climate zones in different colours) the different climate zones in Canada (see the map of Canadian Climate Zones provided) and indicate which climate zone they are located in. Have them identify some of the main features of their zone.
2. Now that they have some background on their climate zone, have students set-up "weather stations" (see "Setting up a Weather Station" activity below) around the school to record the following weather factors: temperature, precipitation, humidity, air pressure, wind speed and direction, cloud cover, and cloud types.
3. Over the period of one to two months (one month minimum) record at the same time each day the weather factors listed above. At the same time, have students predict the next day's weather (see "Weather Prediction" activity below).
4. Once a week have students average their data (if there is more than one weather station) and enter the data in the weather chart.
5. At the end of the month create a large summary chart of their measurements (based on individual weather charts). Look for patterns. This information will be used in Project Three to compare current weather to weather in the past.

Hint: Find a local weather person or organization who/that is willing to work as a resource/mentor for the class during this project. This person could be very helpful in organizing field trips, providing materials, and helping find historical weather data in Project Three.

ACTIVITY: SETTING UP A WEATHER STATION

What you need

- 1 1/4 metre X 2 metre sheet of paper for bulletin board
- metre stick
- crayons/markers

What to do

1. Using either commercial or self-built (see Appendix B) instruments to record the weather, plan a 30-day chart to record it (make more than one if you are recording for 2 or more months). Refer to the sample weather chart (Appendix A) as a starting point.
2. Environment Canada uses standard symbols to indicate weather conditions. Either have the class learn these symbols or make up their own, then create a key for the symbols on the weather chart (see the example key on the sample weather chart in Appendix A).
3. Make sure you include the four extra columns at the end to record weather predictions (see "Weather Prediction" activity).

HINT: Use a rectangular shape for your weather chart. The sizes of the columns and the symbols listed in the key are suggestions. The official weather symbols are much more complicated and usually unnecessary for use for a short period of time. The chart in the example provides for 15 days. This minimum time recommended for this project is 30 days, in order to provide for a more accurate comparison. You may want to record the weather a) individually (each student has his/her own weather chart), b) in groups (each groups keeps a weather chart, or c) as a class (create a large weather chart). Whatever option you choose, at the end of Project One, you will want to combine all of the data into one large class weather chart.

ACTIVITY: WEATHER PREDICTION

What you need

- cloud chart (provided)
- weather instruments constructed by students (Appendix B)
- commercial weather instruments
- The Old Farmers Almanac
- a professional source for weather reporting, such as a newspaper, television, radio, or Environment Canada

weather chart from “Setting up a Weather Station” activity (Appendix A)

What to do

1. Have the class work in their weather charting groups (or individually).
2. Discuss with the class the different tools used to help predict weather.

   a. The weather instruments constructed in Appendix B can be used to record weather quite accurately.

   b. Commercial weather instruments for home use are sold in many stores. They usually consist of a thermometer, aneroid barometer, and hygrometer.

   c. A professional source: try to locate a “weather person” with whom you can work through the program. This person can become an excellent resource and may be able to assist by providing materials and arranging field trips.

   d. The Old Farmers Almanac is available at many bookstores and magazine outlets. It has been in continuous publication for nearly 200 years. The entire publication, including the ads and special articles, is informative and entertaining.

   Meteorologists depend a lot on clouds and cloud charts to help them predict weather: cloud type, height and movement, etc. Have the students use the cloud chart provided to help them predict the weather.

3. Over the course of the weather recording activities, allow the groups to meet briefly each day to study the information they have collected from their source for the day and record their prediction on what tomorrow’s weather will be on their chart.
4. At the end of each week, compare each of the four predictions with actual weather as it occurred. If predictions are not accurate, discuss ways of improving predictions.

Hint: Meteorologists say that using the clouds is probably the easiest and most practical way for children to attempt to predict the weather.

At the end of Project One (Weather Measurement), have your class answer the following culminating questions.

- Did you find that your self-built weather measuring devices worked well? As well as the commercial devices? Describe your experiences.
- How accurate were your daily weather predictions? Did you find you predicted more accurately as you became more experienced?
- Were you surprised at any of your weather measurements? Explain.

HINT: Be sure to discuss with the students that weather prediction is difficult even for meteorologists. Tell them not to get discouraged if their predictions are not accurate. Meteorologists suggest to have try to predict no more than 6-12 hours ahead. Note that, in the winter, things move twice as fast. The main objective of this activity is to help students become aware of the many factors that exist in any attempt to predict weather accurately.

Complete the following information from your weather chart:

- number of days of sun
- number of days of rain
- highest temperature
- lowest temperature
- strangest weather occurrence

IN YOUR CLASSROOM – OPTIONAL ACTIVITIES

Appendix B contains some suggested activities for building a weather station in your classroom with self-made weather measuring devices, or to just practice weather measuring skills. Based on the objectives you set for your students in this project, pick the activities that meet the needs of your classroom.

IN YOUR CLASSROOM – RESOURCES

Print resources

- *Earth Science Activities for Grades 2-8*, Marvin N. Tolman and James O. Morton, Parker Publishing Company Inc, New York: 1986.

  Many of the weather activities in this section were adapted from activities in this book
- *The Science Book of Weather*, Neil Ardley, Gulliver Books, Harcourt Brace Jovanovich, Publishers, New York: 1992.
- *Weather and Earth Science for Every Kid*, Janice Van Cleave, John Wiley & Sons, Inc, Toronto: 1995 & 1991.
- *Weather*, Eyewitness Books, Brian Cosgrove, Dorling Kindersley Ltd, London: 1991.

  B.C. Ministry of Education Recommended Learning Resource
- *The Climates of Canada*, Environment Canada, David Phillips, Minister of Supply and Services Canada: 1990.

  B.C. Ministry of Education Recommended Learning Resource

Websites

- Weathersense (www.weathersense.com)

  a catalogue of weather measurement devices and resources available for purchase (Canadian)

- On-Line Cloud Chart (www.scienceclass.com/dayscape/pages/main.htm)

  a cloud chart with colour pictures and descriptions of cloud types

PROJECT TWO: COMMUNITY RESEARCH

The stories of early explorers of the BC Coast tell us many things. These stories include travel, adventure, new and unexplored territory, and tales of seemingly unlimited natural resources. Can you imagine seeing so many salmon in a stream that you could walk across it? These stories, and the diaries the explorers wrote, can be used to make a rough estimate of the natural resources in the places they visited. We can make educated guesses about the types of plants and animals that were in an area and how many there were.

Information about natural resources in the past is being brought to our attention by scientists and researchers. A project at the University of British Columbia involves interviewing Native elders to learn more about fish resources in the province. This shows how different traditions of knowledge, like First Nations storytelling and science, can communicate and work together to learn more about our past to help us make informed decisions about our future.

Listening to people's stories can help us learn many things about our family, community, and environment.

Reference: Back to the Future: Reconstructing the Strait of Georgia Ecosystem. *Fisheries Centre Research Reports. 1998. Volume 6: Number 5. University of British Columbia*

What will happen

Students will:

- generate a list of questions related to climate change;
- interview "elders" in the community;
- organize and interpret data;
- consider if local plants and animals have changed;
- consider how change related to climate is perceived within the community;
- develop a local history – observations and changing attitudes.

What you need

- interview forms (included in Appendix A with a list of sample questions, themes, focus areas)
- community contacts to interview
- optional: tape recorder, video camera, camera

What to do (introduction to climate change)

1. Brain storm:

- What is climate change?
- Where have you heard about climate change?
- Are there ways we can tell that climate change is happening?
- How has your local environment been affected by climate change?
- Are we being affected by climate change?

2. Key points about climate change:

- Clarify points about Global Climate Change and the Greenhouse Effect.
- See the poster "Climate change: what's going on in our Greenhouse."

Keep in mind...

Climate change is a very complex topic.

The interview questions that you develop with students may reflect small-scale changes in the local environment. Climate change and its indicators occur on a very large scale and are difficult to observe over a short time period.

This project allows students to talk to people in the community and discuss perceptions, observations and attitudes about the local environment. It is not intended to document evidence of climate change.

Hint: The Engaging Science Playbook activity "Just Drifting Around" includes activities the lead into encouraging students to think like scientists and understand how water, and other substances like carbon, move in a continuous cycle.

What to do (interviews) – see sample interview form (Appendix A)

1. Students work in groups to generate a list of questions about climate and changes in the local environment and community. These questions will be used with a list of standard questions to gather information.
2. Go over the questions and come up with a list of questions as a class. Also generate a list of people the students know to interview.

   People to consider interviewing:

   Family members, teachers, neighbours, local senior citizens, librarians, farmers, fisheries employees, forestry employees, local park staff, volunteers at local conservation/parks/science centres e.g. Vancouver Aquarium, Science World, H.R. MacMillan Space Centre.
3. Have students interview each other to practice interview skills and gather information from the class that can be included with the information gathered from the interviews on the web site.
4. Working individually or in pairs, students interview an "elder" in the community. Methods for recording information from the interviews might include a traditional interview with paper and pencil, a tape recorder, or a video camera.
5. Students can also be asked to collect more information from the person being interviewed to learn more about the individuals' stories. For example: pictures, pamphlets, photos, diary, newspaper clippings.

What to do

1. Have students collect all the community research data-questions and documents.
2. Add all the responses to get a class total. (Summarize the information from the "standard questions" using the format included with package.)
3. Working in groups of 3 – 4, students look for similarities and differences between their interviews and the class results.
4. Create a summary of information collected during the interviews. (Answers to the first 11 questions on the sample questionnaire). How many "YES" and "NO" responses?
5. As a class, discuss some of the most interesting stories you heard.
6. From the information you have collected and discussions in class, do you think our climate is changing? Why or why not?

What to do next

Ways to lean more about the past in the present:

1. After completing the interviews and looking at the data, students can discuss whether or not they think that climate change is occurring in the area. Have students support their answers, why or why not, and compare this to the answer they gave on their interview. Have their attitudes or opinions changed?
2. Allow students time in class to share interesting stories they heard from the person they interviewed.
3. Look at historical photographs of the area. Historical photographs can tell us if an animal or plant was found in an area. Have students look at photographs and discuss what clues they offer about whether or not certain plants and animals are found in the area.
4. Students can draw the plants and animals that were discussed during the interview. Students can collect, press and identify plants using local field guides as a reference. (Pojar, J.and A. MacKinnon et al. 1994. Plants of Coastal BC. Lone Pine Publishing: Vancouver, BC.)
5. Students can create their own story or storybook describing their community in the past.

IN YOUR CLASSROOM—RESOURCES

Below are some resources to develop more activities that can be done in your classroom to supplement the main activity above. Based on your grade level and the topics your students will be researching, pick the activities best suited to the needs of your classroom.

1. Aerial photographs

   Students can use aerial photoglasses, if available, to see a two-dimensional picture in three dimensions.

   Consider looking at pictures of volcanoes, flooded cities, deserts, rivers, faults, glaciers, “magic-eye” diagrams.

   Students can try and see in three dimensions and learn what an advantage it would be for a geologist to have photos of an area that they have never been to.

   Link research by geologists to some of the “scientific data” we have access to about climate change.

   Reference: Simon Fraser Earth Sciences workshop.

2. RADARSAT – Canadian Space Agency

   Satellite in orbit 798 km above the Earth; moving 25,200 km/hr; launched in 1995 by NASA.

   Images from this satellite will help NASA scientists study the movement of Antarctic ice sheets and their impact on global climate change.

   In 1997 emergency response teams use RADARSAT to monitor progress of Red River Flood in Manitoba to pinpoint accessible rescue routes.

   Canada has two receiving stations, one in Quebec, the other in Saskatchewan.

   The images are available to everyone. (http://radarsat.space.gc.ca)

2. Monitoring the Environment

- River Works (www.riverworks.org)

- Vancouver Aquarium

  Restoration of aquatic habitats in the Fraser River Estuary.
  Community groups can gain skills to restore, monitor, and inventory local areas in the Fraser River Delta.
  The Great Canadian Shoreline Clean Up (www.vanaqua.org/cleanup/mediaroom/)
  Co-ordination of clean-up crews across the country

- EMAN project, The Ecological Monitoring and Assessment Network • www.eman-rese.ca/

  Information on native plant species in BC
  Ecological region map on website

- Frog watch Ontario (www.naturewatch.ca/english/frogwatch/on/)

  Toronto Zoo, EMAN project
  Monitoring Ontario's wetlands

- Plant Watch (www.naturewatch.ca/english/plantwatch)

  University of Alberta Devonian Botanical Garden
  Look at how the weather affects the times that plants bloom in your area.

- Lady Beetle Survey, Canadian Nature Federation (www.cnf.ca/ladybeetle/index.html)

  Started in 1995 to look at when beetles become active as weather gets warmer and the species of lady beetles in the garden.
  All data can be entered on a web site.

- Song Bird Project (www.songbirdproject.ca/)

  The Gardens of Babylon – an ongoing project connecting community, ecology and the arts.
  Offers hands-on activities that promote nature within the city and within nature.
  Find out how to create habitat for birds on balconies in urban settings.

PROJECT THREE: WEATHER RESEARCH

Our daily weather reports and forecasts often include the current temperature, as recorded at a local weather office. This weather office may be located at an airport and maintained by the Ministry of the Environment, or may be simply located at the radio or TV station from which the station is reporting. These weather measurements are often very accurately recorded, with attention given to the consistency of the recording procedures. These measurements are made at the same time each day, and the weather data is often archived for future reference. The British Columbia Ministry of Forests also records weather data throughout the province, as part of its forest fire monitoring program. This data may be seasonal (March through October), but includes weather stations for many more areas than those covered by Environment Canada. In this activity section, you and your students are going to examine old weather records to try and determine how your local climate has changed over time.

To compare current weather conditions with those from the past, it is necessary to access archives. There are a number of places you can look to find old weather data. Start by calling your airport or the Environment Canada General Enquiries number. You should also try contacting Environment Canada or the British Columbia Ministry of Forests. You will find both numbers in the blue pages section (government phone numbers) of your phone book. Local media outlets (radio, TV, or newspaper) may also keep old records that you could access. If you have found a local meteorologist or climatologist to assist you in this program, they may also be able to help you find old weather records.

What will happen

Students will:

- Obtain historical weather data from the local weather office;
- Compare this information to the weather measurements they collected in Project One (Weather Measurement) and to information gathered through the interviews in Project Two (Community Research).

What you need

- Your own weather data from Project One (Weather Measurement)
- Old weather records from Ministry of Environment, BC Ministry of Forests or other local weather stations

What to do

1. Historical data

   a. Contact your local weather office and obtain as lengthy an archive as possible. Ideally this will be at least 20 years in length, although some regions may be able to obtain records of close to 100 years.

   b. Have your students decide how much data they think they need in order to get an accurate picture of how weather patterns may be changing. Can climate change be predicted from five years of data?

   c. Calculate the average monthly temperature for the month of August. Make graph using these monthly averages.

   d. Select two other months that include the data you have collected with your classroom. Calculate the monthly averages and prepare graphs of this data. How does your data (this year) compare to previous years? How can you explain any differences between your data and the historic data?

   e. Are there any particularly cold or hot summers or winters in your records? Could these extreme seasons have affected any local plants or animals or the crops in your area? Think back to the information you collected in Project Two (Community Research) of this unit.

2. Extreme weather! Gather information about weird weather facts.

   Try to find the answers to the following questions:

- How hot was the hottest day in your region?
- Which day received the single largest rainfall?
- What was the hottest day last year?

3. At the end of Project Three (Weather Research), have your class answer the following culminating questions and supply a graph of monthly average temperatures:

- Do you see any trends that would suggest the climate in your area is warming or cooling?
- How does this year's weather compare to the weather for the past five years? ten years? fifteen years?
- Can you explain the differences between your weather data and that collected by the local weather office for the past few years?
- Do the weather records help explain any changes in the local plant and animal communities?
- What interesting information did you find about "extreme" weather in your area?

What to do next

Depending on the conclusions your class has arrived at regarding weather and climate changes, some of the 'What to do next' activities in Project Two (community Research) also apply to this Project.

IN YOUR CLASSROOM – RESOURCES

Websites

- British Columbia Ministry of Forests Home page (www.for.gov.bc.ca)
  This home page has contact information for regional branch offices.

- Forest protection Branch of BC Ministry of Forests (www.for.gov.bc.ca/protect)
  Daily precipitation, temperature and humidity maps for the province of British Columbia.

- Rain or Shine Weather (www.rainorshine.com)
  Satellite images, Nexrad radar images and short-and long-range weather forecasts.

- Environment Canada Home page (www.ec.gc.ca)
  Links to Climate Change, Clean Air, Clean Water, Nature and Weather and Environmental Predictions.
  On-line educational resources.

PROJECT FOUR: PIECING IT TOGETHER (PAST, PRESENT, AND FUTURE)

What will happen

Students will:

- Use the information they have gathered to look at the effect of climate change on their area;
- Develop a project that summarizes what they have learned about weather and climate change;
- Use what they have learned to make a prediction about what will happen in the future in their area.

What you need

- Canadian Climate Zones map
- Paper
- Paints, felts, crayons, etc.
- Recipe cards or other firm paper
- Data from Projects One to Three

Hint: students can do this individually, in groups, or as a class (e.g. class mural)

What to do

1. Look at the Canadian Climate Zone map from Project One, review which zone you are located in and its main characteristics.
2. Have students select a local site to focus on. For example, places people spoke of in their interviews and/or local rivers, streams, animals and plants (Project Two).
3. Using the site they have chosen, have students create pictures to describe that area in the past (50 years ago), present, and the future (50 years from now). Have students consider the information they have obtained in Projects One to Three.

   Past: information from the interviews and historical weather data.

   Present: observed weather data for the area using class weather stations.

   Future: what changes are occurring as a result of climate change (students should use the information above to create their own predictions about what will happen in the future).

PAST	PRESENT	FUTURE

4. Once students have completed their three pictures, have them write a summary of the information (e.g. on a recipe card to go with the pictures). Include the following information:

- Location (the site selected in step 2);
- Climate zone (from map);
- Main characteristics (of their zone);
- Average temperature (for the month);
- Average precipitation (for the month).
- Have the students share their predictions for the future (e.g. presentations to class or display).

Hint: If the pictures that the students draw for the futures seem negative, focus discussions on ways in which they can "change the picture" by helping in the community, at school, or at home to reduce the impact of climate change in their area. If the pictures that the students draw are positive, discuss how the students think they might help the positive "picture" become a reality.

What to do next

1. Find out about local agencies and programs already working to reduce our impact on climate change.
2. Bring in a guest speaker from a local agency or program of your choice and have them speak to the students about what they're doing. This person can suggest ideas on how the students can be involved at home or at school.
3. Have the class volunteer for a day or develop a class project to help reduce the impact of climate change (e.g. use less energy; use car less; recycling; planting trees; etc.). Refer to the "A Change in Our Climate" and other pamphlets provided.
4. Have students submit a summary of the interesting or surprising things they learned in the project.
5. After sharing their findings, students can continue the discussion to address climate change and what they can do, or have done, to make a difference in their community.

IN YOUR CLASSROOM – RESOURCES

- Wild BC (www.hctf.ca/wild.htm)
  (Project Wild and Project Wet – great related activities)

APPENDIX A (SAMPLES)

INTERVIEW FORM (SAMPLE)

1.	How old are you? (Circle one)	1-25	26-45	46-65	66-85	85+
2.	How many years have you lived in this area?					
3.	Have you noticed a local river or stream that has more water or less water than in the past?				Yes	No
4.	What is the name of the river or stream?					
5.	Have you noticed more flooding in the springtime than in the past?				Yes	No
6.	Have you noticed lower water levels in the fall than in the past?				Yes	No
7.	Do you think that there is more or less rain (precipitation)?				Yes	No
8.	Do you think that the weather patterns have become more extreme-rain, snow and cold, sun and heat?				Yes	No
9.	Have you noticed a type of plant that you can find more of now than in the past?				Yes	No
	What type of plant?					
10.	Have you noticed different birds in the springtime that in the past?				Yes	No
	What type of bird?					
	Has the time they arrived changed?					
11.	Have the types of local fruits and vegetables you can buy and the quality changed?				Yes	No
12.	Do you think that the climate has changed?				Yes	No

Other areas to consider:

1. Have you ever visited a glacier? Has the size of the glacier changed over the years?
2. What “weather events” do you remember as a child?
3. What problems that may affect the community are related to changing climate?
4. What is going on in the community to take steps to reduce the impacts of climate change?

Hint: Use the questions from the sample questionnaire. This will make it easier to put data on the web site and compare numbers. It would be great to include long answer questions that the students generate as well.

SUMMARY OF HISTORIC WEATHER DATA

Month:

Weather Station Location:

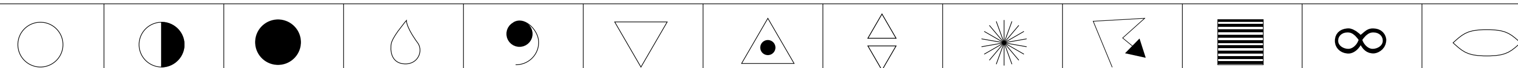
YEAR	AVERAGE TEMPERATURE

WEATHER CHART

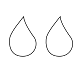
Date	Time	Temperature	Precipitation	Humidity Direction	Wind Speed	Wind Pressure	Air Cover	Cloud Clouds	Type of Weather	Today's Forecast	Tomorrow's ?

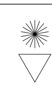
WEATHER SYMBOLS KEY (not an official key)

Symbol



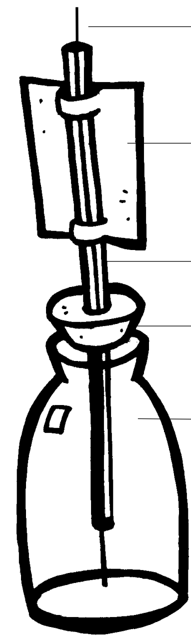
Condition Sky	Clear Cloudy	Partly	Cloudy	Rain	Drizzle	Showers	Sleet	Hail	Snow Storm	Thunder	Fog	Haze	Smoke?

 more symbols = stronger conditions

 symbol above symbol = mixed conditions

APPENDIX B (PROJECT ONE ACTIVITIES)

ACTIVITY 1: MAKING A THERMOMETER



What you need

- commercial thermometer
- clear, thin plastic tubing 30 cm long
- 1-hole rubber stopper or cork with hole drilled through the center
- warm water or rubbing alcohol (if using outside, so it won't freeze)
- red food colouring
- flask or small-mouthed glass bottle (e.g. cough medicine bottle)
- straight coat-hanger wire 30 cm long
- 3″x5″ index card
- candle wax or sealing wax (optional)

What to do

1. Fill the bottle with warm water. Add several drops of red food colouring.
2. Insert the plastic tube through the stopper or cork and fit the stopper tightly in the bottle (if you use a cork, you may need to use candle wax or sealing wax to seal the opening between the tubing and the hole in the cork). Water should be forced into the tube as you press the stopper into place.
3. Insert the coat-hanger through the tube for support.
4. Adjust the water level so the water will rise nearly halfway up the tube.
5. Make a slit near the bottom on the index card and another near the top, and slide it behind the tube.
6. Wait about an hour for the water to reach room temperature.
7. Consult the commercial thermometer and mark the present temperature with a line on the index card.
8. Each morning and afternoon, compare the commercial thermometer with the one you have made. Make new lines to show changes in temperature. Once your thermometer is calibrated, you can use it instead of the commercial thermometer.

What will happen

With this water/alcohol thermometer, the water or rubbing alcohol expands because the molecules move more rapidly and push against each other as they are heated. As water cools, the molecules move more slowly and require less space, so the water contracts. Therefore, water level will move up and down according to the temperature.

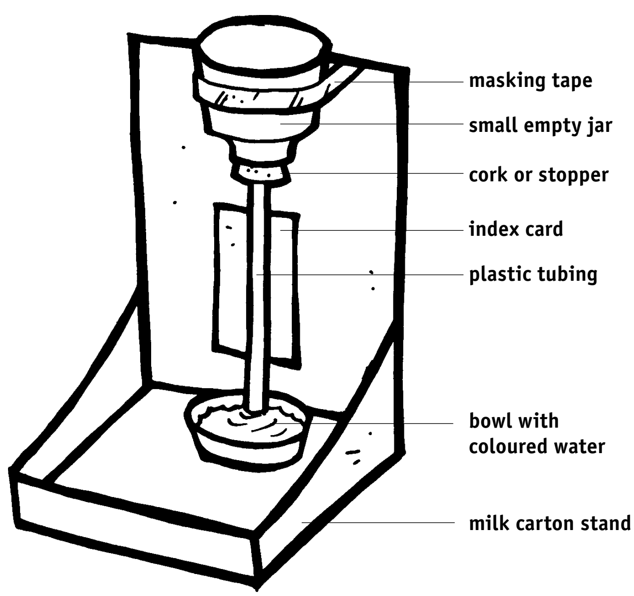
ACTIVITY 2: ANOTHER TYPE OF THERMOMETER

What you need

- same materials as in Activity 1
- masking tape
- small bowl
- milk carton cut as support (see diagram below)

What to do

1. Insert the plastic tube in the cork or stopper just as described in Activity 1.
2. Fit the cork in the bottle but do not add water.
3. Warm the jar by putting it near a heater or in warm water.
4. Fill the bowl with red coloured water.
5. Place the bowl in the milk carton support.
6. Turn the warmed, empty jar upside down with the plastic tube all the way down in the bowl. You may need to use masking tape to hold the jar against the side of the carton.
7. Put an index card on the support behind the tube.
8. Watch what happens as the warm jar cools to room temperature. Use a commercial thermometer to mark or calibrate your upside-down thermometer, just as explained in Activity 1.



ACTIVITY 3: MEASURING RAINFALL

What will happen

Have students set up a container with which they will measure precipitation. Making sure that the same container is always used will ensure accurate results through the course of the project.

What you need

- straight-sided water glass or pan at least 20 cm tall
- metric ruler or metre stick
- paper
- pencil

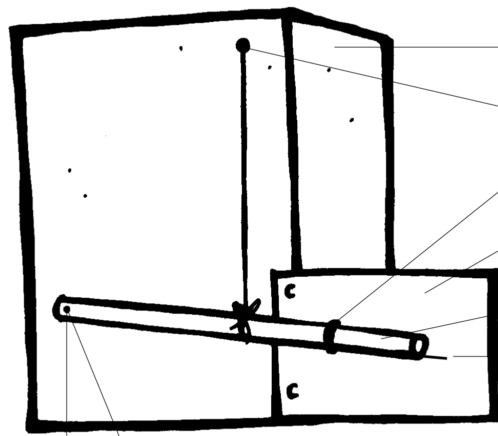
What to do

1. Take the can or glass outside to the spot where you are going to set up your weather station. Be sure that it is not a covered area, and that there are no buildings, walls, trees, or other obstructions nearby.
2. At the same time each day, use the ruler to measure the amount of water in the container. Record your rainfall in centimetres and empty the container.
3. Record the daily amount of rainfall on a recording sheet.
4. If you are studying the weather at a time when most of the precipitation is snow, you can measure snow depth with the metre stick if you are in an open area OR collect the can/glass, bring it into a warm place to melt, and measure the water content. Different types of snow contain varying amounts of water per centimetre.
5. If a slight amount of rain falls, but is not measurable, it should be recorded as a “trace”.

ACTIVITY 4: BUILDING A HYGROMETER

What you need

- empty milk carton with top cut off
- glass bead with holes
- drinking straw
- glue
- small metal washer
- ruler
- 5″ X 7″ index card
- toothpick
- one freshly washed human hair 20 cm long
- pencil
- pins and thumbtacks



What to do

1. Stick a pin through the end of the drinking straw and then through the bead. Near one edge of the carton, measure up from the bottom 10 cm and stick the pin into the carton.
2. Reach inside the carton and put glue around the pin to hold it firmly in place (the back from a pierced earring or a tie pin may be used instead of glue).
3. Attach the small metal washer to the straw just beyond the opposite edge of the carton.
4. Use a pin or thumbtack and glue to attach the hair to the top of the carton near the same edge as the washer. Tie and glue the hair to the straw at a point directly below.
5. Use two thumbtacks to attach the index card to the carton so it extends beyond the length of the straw. Glue a toothpick in the end of the straw as a pointer.
6. When you finish, make sure the model looks like the one in the diagram below.
7. This is a hair hygrometer. Make a pencil mark on the index card where the end of the straw is pointing.

What will happen

Hair absorbs moisture and becomes longer in humid air. In dry air hair contracts. The straw with the bead behind it, acting as a bearing, moves up and down, depending on the changes in the length of the hair attached to it and the top of the milk carton. The washer attached to the straw provides extra weight and can be eliminated if the straw moves up and down without it. The toothpick and index card will make small movements easier to measure.

Hint: Be sure to make several hygrometers using different colours and textures of clean hair. If there are differences, research why.

ACTIVITY 5: BUILDING A WET-DRY BULB HYGROMETER

What you need

- two identical commercial thermometers
- shoelace (with tips cut off) 20 cm long
- two rubber bands
- board 30 cm long X 15 cm wide
- small glass full of water at room temperature

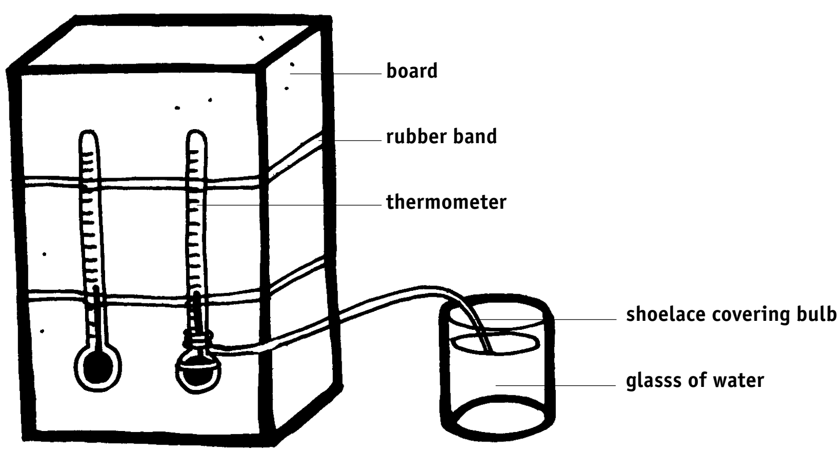
What to do

1. Use the rubber bands to fasten the two thermometers side by side on the board about 10 cm apart.
2. Moisten the shoelace and wrap one end around the bulb of the thermometer. Put the other end of the shoelace in the glass of water.
3. After several minutes, compare the temperature of the thermometers.
4. What happened? Can you think of a way to explain this? Discuss this with the class.

What will happen

After a few minutes, the wet bulb will have a lower temperature. This instrument is called a wet-dry bulb hygrometer. Students will often assume that the water is colder than the air and is making the wet bulb cooler. Actually, it is being cooled by the evaporation of moisture in the air.

Humidity is usually reported in percentages. One hundred per cent is a total amount of moisture air can contain. The less moisture the air contains, the greater amount it can absorb. As the ability to absorb water increases, the temperature drops in a direct ratio. Therefore, the greater the difference in temperature between the wet and dry bulbs, the lower the humidity.



ACTIVITY 6: COMPARING THE WET-DRY BULB AND HAIR HYGROMETERS

What you need

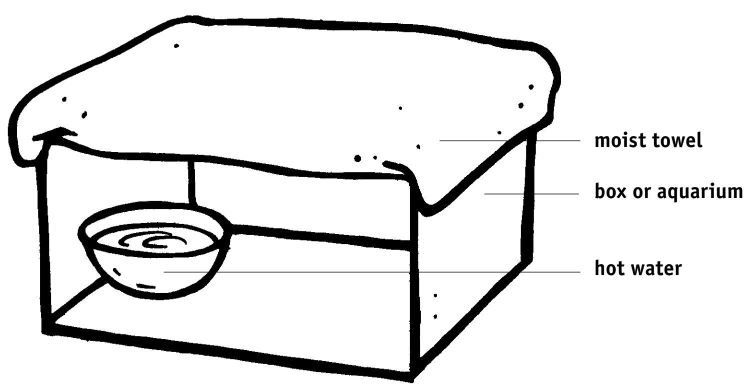
- hygrometers from Activities 4 & 5
- empty aquarium or large cardboard box lined with plastic garbage bags
- pan of hot water
- warm, moist bath towel
- paper
- pencil

What to do

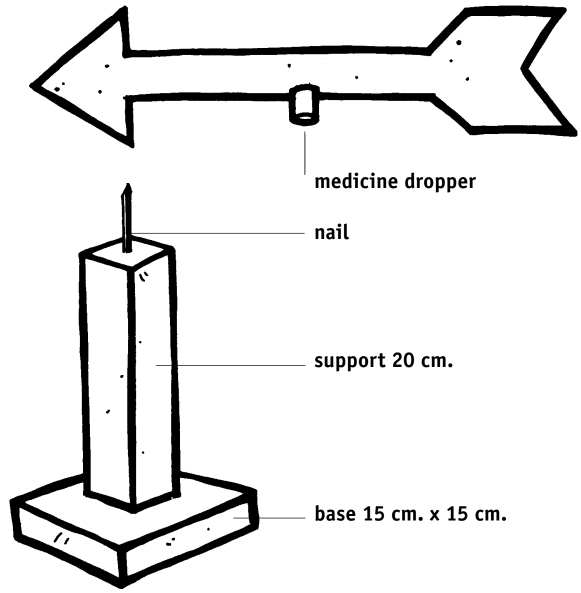
1. Mark the position of the straw on the card of the hair hygrometer.
2. Compare and record the temperatures and differences in the wet-dry bulb hygrometer.
3. Put an open pan of hot water in the aquarium or box.
4. Carefully lower the hair hygrometer into the box and cover the top with the warm, moist towel. What do you think is happening inside the container? Can you predict what will happen to the hygrometer?
5. After waiting five minutes, gently remove the hygrometer from the box and on the index card mark the place where the straw is pointing.
6. Repeat steps 3, 4 and 5 exactly, using the wet-dry bulb hygrometer, except at the end, record the temperatures and the difference between them.
7. What king of environment (conditions) did you create inside the container?
8. What can you say about the reactions of your hygrometers?

What will happen

If possible, do this on a "normal" day for your climate. The pan of hot water and moist towel will create a very humid environment. The hair should lengthen and show a measurable difference on the card. The temperature of the wet bulb thermometer should increase more then that of the dry bulb, with little difference (both will go up some). The normal readings at the beginning of the activity, plus the moist reading at the end, should give students the beginning of a scale upon which they can record daily "readings" of humidity.



ACTIVITY 7: WIND DIRECTION



What you need

- two strips of heavy cardboard 45 cm long X 15 cm wide
- one piece of wood 15 cm X 15 cm X 3 cm thick
- one piece of wood 5 cm X 5 cm and 20 cm long
- pencil
- utility knife or scissors
- awl (optional)
- glass portion of medicine dropper or very thin glass bottle of about the same size
- one eight-penny finishing nail
- strong glue
- waterproof paint
- paintbrush
- metre stick

What to do

1. On one strip of cardboard, draw an arrow with a small point, thin shaft, and wide tail.
2. With a utility knife or scissors, cut the first arrow out and use it as a pattern to make a second arrow. Glue the two arrows together.
3. To find the exact center, balance the arrow across the edge of a metre stick. Put a mark at that point.
4. Use a pointed object (pencil or awl) to make a hole through the shaft of the arrow at the balance point and glue the medicine dropper or bottle in it. This is the bearing upon which the arrow will turn.
5. Stand the 20 cm long piece of wood on end in the center of the 15 cm square base and glue it in place.
6. Make a hole in the top center of the 20 cm piece of wood and glue an eight-penny nail (point up) in it.
7. Put the glass bearing in the arrow over the nail in the base. The arrow should turn freely in all directions.
8. When the glue has dried, use waterproof paint on everything but the glass bearing and nail.
9. When finished, your weather instrument should look like the above diagram.

What will happen

Weather vanes have been popular for centuries. Often they are beautiful intricately designed works of art used to decorate barns, houses, churches, and public buildings.

Tubular pieces of cloth called windsocks are often used at small airports. They are designed to turn in the direction of wind and fill as the speed increases. As an extension activity, a windsock could be constructed from a coat hanger frame and a nylon stocking with the foot cut out.

ACTIVITY 8: HOW TO USE A WEATHER VANE

What you need

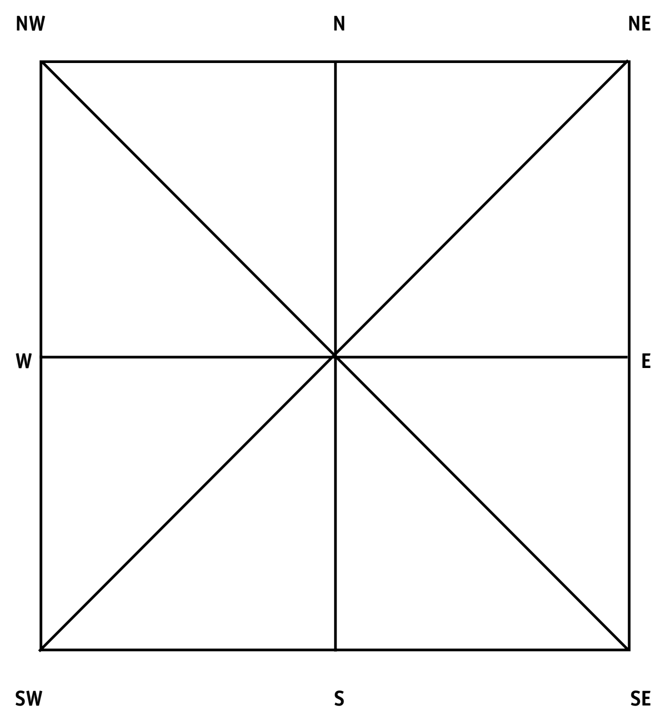
- 30 sheets of paper 30 cm X 30 cm
- weather vane from Activity 7
- directional compass
- ruler
- pencil

What to do

1. Measure down 15 cm on each edge of your paper and draw lines that will divide it into quarters.
2. Draw straight lines through the center to opposite corners of your paper.
3. Put the ruled paper under the directional compass. Locate magnetic north and turn your paper so the line on one edge points north. Write "N" on that line and fill in the rest of your chart as shown on the diagram below.
4. Ask your teacher to make 30 additional copies of your diagram so you can keep future records.
5. Go outside and find an open area where the wind blows in all directions. Use the compass to determine north, align your paper properly, and put your weather vane on it.
6. Return to the same place and repeat steps 5 four times a day. Each time, draw a line to mark the time of day and the wind direction on your sheet.

What will happen

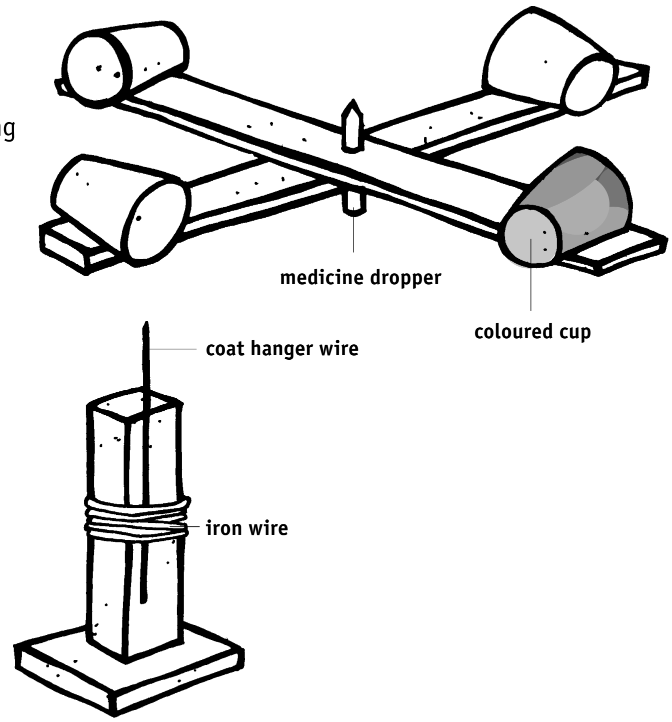
Depending on your climate and the time of year, wind direction may not change frequently. Twice a day may be sufficient to obtain necessary information.



ACTIVITY 9: BUILDING AN ANEMOMETER TO MEASURE WIND SPEED

What you need

- material in Activity 7 to construct a support base
- two strips of lath (thin piece of flexible wood) 40 cm long
- one piece of coat-hanger wire 20 cm long
- four 4-ounce paper cups
- file
- thumbtacks
- glass medicine dropper or very thin glass bottle
- strong glue
- small 2 cm nails
- hammer
- drill
- brightly coloured paint
- paintbrush
- thin tie wire



What to do

1. Find the middle of each latch, make them into the shape of a cross, and glue them together. Use four small nails to hold them securely.
2. The teacher or an adult should drill a hole in the exact center of the cross large enough to accommodate the medicine dropper or bottle.
3. Construct a supporting base as shown in Activity 7, but do not use an eight-penny nail on top. Instead, file one end of the coat-hanger wire to a point. Use the tie wire to securely bind the coat-hanger wire, point up, to the upright column of the base.
4. Glue a 4-ounce paper cup to each of the four ends of the cross. Use thumbtacks, too, for extra strength. Be sure the open ends of all the cups face in the same direction. Paint one cup a bright colour.
5. Put the medicine dropper in the cross over the pointed wire in the support base. When completed, the cross and cups should spin freely.

What will happen

This instrument is called an anemometer, and it's used to measure wind speed. It is very important that the anemometer be balanced and spin freely. The next activity will help students use the anemometer to measure wind speed fairly accurately.

ACTIVITY 10: MEASURING WIND SPEED

What you need

- anemometer constructed in Activity 9
- stopwatch or watch with second hand
- paper
- pencil
- masking tape

What to do

1. Take the materials to an open area outside where the wind can blow in all directions.
2. Put the anemometer on a flat surface where it will spin freely. Put a strip of masking tape on the flat surface under the cups so they will pass over it each time they spin around.
3. Use the coloured cup as a counter and mark each time it passes over the strip during a 60-second period.
4. Divide the number of times the coloured cup passes over the strip by ten and you will have the approximate speed of the wind.
5. Repeat steps 1-4 each day at the same time.

What will happen

Friction can be an important factor in the accuracy of the anemometer. You can calibrate the accuracy to some degree if on a very calm day you hold the anemometer out the window of a car at various speeds while timing the number of spins. If the car is driven for one minute at 5, 10 and 15 miles per hour, you should have enough data to compare with the stationary recordings. The anemometer must be held far enough away from the car so air currents caused by the car do not disturb it.

ACTIVITY 11: MEASURING AIR PRESSURE

What you need

- wide-mouthed 1-quart glass jar
- string or thick rubber band
- straw
- milk carton (to cut into a strand)
- scissors
- round balloon
- commercial barometer
- index card
- glue
- pencil

What to do

Hint: Be careful not to force extra air trapped in the balloon into the bottle.

1. Cut the narrow neck off a balloon and stretch the balloon very tightly over the mouth of the glass jar.
2. Hold the balloon in place by wrapping and tying string below the threads of the jar.
3. Glue the straw to the center of the balloon in a horizontal position.
4. Attach the index card to the horizontal stand and bring it near the balloon.
5. Make a mark on the index card in the place where the straw points.
6. Consult your commercial barometer or call the local weather station to determine today's barometric pressure. Write the number beside the mark on the index card.
7. Repeat steps 5 and 6 everyday for a week. What is happening? Discuss with the class.

What will happen

Before discussing the barometer, you may want to review the characteristics of air.

Resource: Earth Science Activities for Grades 2–8*, Marvin N. Tolman and James O. Morton.*

Atmospheric pressure varies and is one indicator of weather conditions. Generally, lower barometric pressures accompany storm fronts, while higher pressures indicate fair weather.

When the balloon is stretched tightly over the bottle, the pressure inside the bottle will be the same as that of the atmosphere in the room.

As the atmospheric pressure increases or decreases, it will change the amount of pressure on the balloon and cause the straw to move up or down. Because some air will pass through the balloon diaphragm, the air should be balanced by untying and retying the balloon about every three days. Air temperature should be kept constant, as changes will affect comparative readings.

OTHER WEATHER TOPICS TO DISCUSS IN THE CLASSROOM

- What makes rain?
- What is it like before it rains?
- What is a cold front?
- What does a high-pressure system mean?
- What does a low-pressure system mean?
- Types of clouds and what they mean.
- What makes clouds?

More activities for building your own weather measuring devices can be found on the Environment Canada website. (http://www.ec.gc.ca)