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CHAPTER 1

SETTING UP YOUR WEATHER STATION

The full Watchers kit contains a complete suite of weather instruments as well as log sheets for recording your observations. If you have acquired weather instruments from another source, you can still print copies of the log sheets and graph forms from the Teachers' Corner on our Web site which links from the side menu at www.weatheroffice.ec.gc.ca.

This chapter will focus on helping you set up these instruments so that your students can begin taking weather observations right away. The regular observing and reporting of weather will reinforce what they learn in class.

TIPS

At various points through this Guide, you will be given complete instructions for the students to create a home-made equivalent for most of these instruments.

Barometer

The barometer measures air pressure, or the weight of a column of air above a given spot, such as your school. Generally speaking, when the air pressure rises, it means fair weather is approaching and when the air pressure falls, it means unsettled weather is approaching.

But this is not always the case as you will discover during your year as a Sky Watcher. Please use caution in applying the weather terms — stormy, rain, change, fair and very dry — which are written on the barometer. Rely instead on the numeric readings for the day and the trends that you will see in successive readings.

Before you use the barometer for the first time, set it to the mean sea level pressure for your area. You only have to do this once. There are several ways to get the current reading for air pressure in your town or city:

- watch your local television weather broadcast
- listen to Environment Canada's weatheradio broadcast if you are within range of a transmitter, or
- look at the weather report for your area on Environment Canada's Internet site at www.weatheroffice.ec.gc.ca.

Activity:

Ask your students to navigate the Internet site www.weatheroffice.ec.gc.ca and find out what the air pressure is for your city or town that day. From the start-up page, select your province or territory, and then click on your city or select more cities from the menu on the right.

If all else fails or if you have any mechanical problems with your barometer, such as the black needle does not respond properly to pressure changes, please call your Sky Watcher co-ordinator for help.

TIPS

Environment Canada gives air pressure readings in kilopascals. Most barometers, however, measure the air pressure in inches and millibars. To convert kilopascals to millibars, multiply the number in kilopascals by 10. To convert kilopascals to inches divide the number in kilopascals by 3.386.

As soon as you have the mean sea level reading in the correct units for your barometer, set the barometer immediately — the reading will no longer be representative if you wait an hour or two. Turn the barometer over and adjust the small set screw with the markings + and - until the black needle at the front is over the current air pressure. The black needle will move whenever the air pressure changes. Now turn the gold knob on the front of the barometer until the gold needle is over the black needle. The gold needle acts as a reference and will stay put unless you move it. The difference between the two tells you if the air pressure has risen or fallen since you last set it.

Using a nail or screw with a small head, hang the barometer at eye level on a wall indoors, away from direct sunlight, heat or air conditioners. Sunlight and sudden blasts of hot or cold air may affect the readings. Please do not take the barometer off the wall to read it.

To read the barometer, first tap it gently. Wait for a minute or so and take the reading. Convert the reading to kilopascals, if necessary, and record it on your Sky Watchers log sheet. Finally, reset the gold needle by moving it over the black needle.

TIPS

To convert inches to kilopascals multiply by 3.386 and to convert millibars to kilopascals divide the reading in millibars by 10. For example, a reading of 29.91 inches is 1013.1 millibars or 101.31 kilopascals.

Thermometer

The thermometer included in the Sky Watchers kit measures not only the current temperature but also the minimum or lowest temperature and the maximum or highest temperature since last reset. This type of thermometer normally relies on either a column of alcohol or a metal coil to react to temperature changes. It isn't necessary to have a maximum/minimum thermometer to participate in the Sky Watchers program, though. If your thermometer measures only current temperature, you may leave the other fields blank when entering your weather observation.

Hang the thermometer at eye level and away from direct sunlight. A shady, secure grassed area on the north side of your school may be the best spot. In setting up your thermometer, try to allow for air to flow across the unit. This will improve the reaction time of the thermometer to changes in air temperature. Those thermometers using a metal coil may be slower to respond to changes than the normal type of liquid-in-glass thermometers. This is due, in part, to the sheer mass of the metal coil, and in part, to the fact that the air flow over the coil is reduced because it's recessed.

TIPS

To convert a Fahrenheit temperature to Celsius, subtract 32 from the temperature, then multiply by 5/9. To convert a Celsius temperature to Fahrenheit multiply the temperature by 9/5 and add 32. You may want to ask your students to convert these fractions to decimals as decimals are easier to use in calculations.

Because mercury freezes when the temperature drops below -38°C Environment Canada uses alcohol thermometers and thermisters, which are electronic versions, to record the temperature when it is that cold.

If you do not have a secure area for permanent instrument exposure, then store the thermometer in the classroom and hang it up outside about 30 minutes before you take the daily reading. If you do this, though, you will only be able to take a reading for the current temperature. If the thermometer stays outside all the time, then you can record the current temperature as well as the maximum and minimum temperatures.

Some thermometers are calibrated in both Celsius and Fahrenheit degrees. The Celsius scale is the one you will enter on your log sheet for Sky Watchers.

Maximum/minimum thermometers should be reset after each observation.

Activity:

Using the conversion formulas, ask your students to convert the highest and lowest temperatures ever recorded in Canada. Both records were set before the metric system was introduced in Canada. The highest temperature was 107°F at Yellow Grass and Midale in Saskatchewan in 1937. The lowest recorded temperature was -81°F at Snag in the Yukon on February 3, 1947. You may want to ask your students to find these communities on maps of the Yukon and Saskatchewan. (The answers, by the way, are 45°C and -63°C respectively)

Sling Psychrometer

This instrument will allow you to determine dew point temperature and relative humidity. The sling psychrometer contains 2 alcohol thermometers. The bulb on the end of one thermometer is covered with cloth, which you will moisten prior to use. This thermometer is called a wet-bulb thermometer. Because heat is required for evaporation, the wet-bulb thermometer will register a decrease in temperature as water evaporates from the cloth. The other thermometer is called a dry-bulb thermometer. Since there is no water and hence no evaporation on this one, the dry-bulb thermometer will show the actual air temperature.

The difference in temperature on the 2 thermometers is an indication of the amount of water vapour in the air. In dry air, the water will evaporate quickly and cause a large drop in the wet-bulb temperature. This makes the difference in readings on the 2 thermometers greater. If the air is moist, little water will evaporate from the wet-bulb and the temperature decrease — and the resulting difference in readings — will be small.

Using this instrument, you can check the relative humidity inside your school and outdoors as well when the temperature is 10°C or higher. It is not suitable for use year-round at colder temperatures. At temperatures below freezing, the water on the wet-bulb will freeze and a different technique is required. For this reason, dew point and humidity will not form part of your daily Sky Watchers weather observation throughout the school year. In the fall and spring, though, calculating the relative humidity on a daily basis will give your students a better understanding of the subject.

To use the sling psychrometer, first moisten the cloth on the end of the wet-bulb with water, being sure to saturate it completely. Be careful not to get water on the dry-bulb thermometer. If you do get moisture on the dry-bulb, dry it thoroughly using a piece of paper towel before taking a reading.

Position yourself in an open area, whether indoors or outdoors, an arms-length away from any objects that you might otherwise hit. Grasp the psychrometer by the wooden handle and swing it vigorously in a circular manner for at least 60 revolutions or until the readings stabilize. Quickly record the temperature in degrees Celsius on each of the thermometers, reading the wet-bulb first. The wet-bulb reading will always be equal to or less than the dry-bulb. Subtract the wet-bulb reading from the dry-bulb. This difference is called the wet-bulb depression.

Using the tables provided, find your observed dry-bulb temperature in the column on the left and the wet-bulb depression in the row across the top. Follow across the row and down the column to the intersection of the 2 readings. At the intersection, you will find the dew point temperature and relative humidity corresponding to those readings. Enter these in the space provided on your log sheet.

The concepts of dew point and relative humidity will be discussed at greater length in Chapter 2.

Rain Gauge

You measure the amount of rain which has fallen with the rain gauge. The Sky Watchers gauge has two scales — one in millimetres and one in inches. As Environment Canada uses the metric system, you record your observations on the Sky Watchers log sheet in millimetres.

To set up the rain gauge, attach it to a post such as a fence post using the metal bracket and screws provided. If there are no posts, sharpen a wooden stake 1 or 1.5 metres high and drive that into the ground. Please be

sure the top of the rain gauge sticks above the post and the post is located away from buildings, trees, rain spouts or any other structures which may interfere with the rain falling into the gauge. When mounting the gauge make sure the opening is level — not tilted — and the metric side faces outwards. That way, you will be able to read the measurements easily.

To take a reading, look at the level of water in the rain gauge and record the amount in millimetres on your Sky Watchers log sheet. Be sure to empty the gauge and dry it thoroughly with a clean cloth after every reading.

TIPS

To convert a measurement in inches to millimetres, multiply by 25.4 and to convert a measurement in millimetres to inches, divide by 25.4

Measuring Snow

Snow is bulkier than rain and so is measured in centimetres instead of millimetres. The usual way of measuring the depth of snow is with a long ruler or a metre stick. Find a patch of undisturbed snow on flat open ground away from any trees or overhanging roofs. Try to avoid areas where the snow has drifted into piles or the wind has blown the fresh snow away.

Keeping the ruler straight, push it into the snow until the ruler hits the ground below. Measure the depth of snow in centimetres. Do this several times in different spots. Then work out the average depth of snow on the ground by adding your measurements together and dividing by the number of measurements you took.

There are 3 ways to discover how much snow fell since your last observation — the last time you measured it.

1. Subtract the amount of snow on the ground recorded at the last reading from the amount of snow on the ground recorded today. The difference will be the amount of new snow which has fallen.

   Caution
   Sometimes the reading for the day will be lower than the previous reading. That will happen when the snow has melted, or the weight of the new snow has compacted the snow beneath it, or the measurements were taken at different spots.

2. Use a snow board. You can make this snow board out of a scrap of plywood or arborite which is about 40 centimetres long and 40 centimetres wide. The snow board has to be light enough to sit on top of the snow but heavy enough to stay in place on windy days.

   Find a spot in the school yard which is away from trees and overhanging roofs but not an area where snow drifts build up. Push the board into the snow until the top is level with the snow's surface. If the forecast calls for a heavy snowfall, mark the board's location with a flag or stick so you can find it the next day. After measuring the amount of snow on the board, clean it off and place it back in the snow.

3. Find an area in the school yard which you can sweep clean of snow after each measurement. This area, like the one for the snow board, should be away from trees, overhanging roofs and areas where snow drifts pile up. After measuring the amount of snow which has fallen, sweep the area clean.

   Caution
   Sometimes your measurements may not jibe with the day's weather. That may happen on those days when stiff winds have blown snow onto your snow board or measuring area. On these occasions, please use the common sense test and ask yourself if it really did snow since the last reading or observation.

Record your measurement of snowfall in centimetres on your Sky Watchers log sheet.

Comparing Rain and Snow

Rain and snow are measured in different units. When you want to compare the two, you work out the water content of the snow. For this, you use the rain gauge and measure the water content in millimetres.

After a snowfall, bring the snow-filled gauge inside and let the snow melt. Then measure the amount of water in the gauge. Generally, 10 centimetres of snow will produce 10 millimetres of water, which is a ratio of 10:1.

There are exceptions. Wet snow falling on a day when the temperature is close to freezing or 0°C, may produce 10 millimetres of water for every 6 centimetres of snow for a snow to water ratio of 6:1. In contrast, the very dry, powdery snow which skiers love may have a snow to water ratio of 30:1. That is 30 centimetres of snow produces 10 millimetres of water.

For the Sky Watchers report, if you have had both rain and snow on the same day, measure the total amount of liquid in the rain gauge in millimetres and enter the figure under Rainfall.

UV Meter

If your school has a UV meter, you will find that activities using the meter are most effective when UV levels are over 3--generally from 11 a.m. to 4 p.m. on sunny days in May or June.

A UV meter will measure the burning effect of UV radiation on human skin and express it using the UV Index. Many meters turn on automatically when exposed to sunlight. Consult the instruction manual to determine if your model should be held flat or on an angle. In either case, hold the meter in the palm of your hand, about 30 cm in front of your body and out of the shade. For best results, move away from buildings that might reflect additional light. Make sure your fingers or other objects do not shade the meter, particularly the sensor window on the front edge of the meter. Try not to touch the sensor window as this may scratch or streak the window and affect the readings.

Once the meter is removed from sunlight, it will lapse into standby mode and then shut down entirely to conserve the battery.

To extend the life of the battery in your meter, you may wish to remove it from the meter completely when the unit is stored during school breaks.

Wind Gauge

The wind gauge, which is also called an anemometer, measures the force or speed of the wind. To use the wind gauge stand in an open spot away from any buildings, hills, walls or trees which may block the wind or change its direction and speed.

First unfold the wind gauge's handle. It is on the left hand side of the gauge as you face the dial. Lock the handle in place by sliding the latch on the bottom of the gauge to the left. Find out where the wind is coming from by checking to see which direction tree branches or flags are blowing. Now hold the wind gauge up and into the wind so that the dial is facing you. Watch the speed on the dial. Slowly turn the gauge a little to the left and then to the right watching to see where the wind speed is the greatest. Make a note of that measurement.

This wind gauge measures speed in miles per hour and metres per second. Environment Canada, however, records wind speed in kilometers per hour. You need to convert the reading to kilometres per hour before entering it on the Sky Watchers log sheet.

Winds of less than 10 kilometres per hour do not register well on this wind gauge. On days when the winds are light, you may want to use the Beaufort Scale to estimate the wind speed. British Rear Admiral Sir Francis Beaufort invented this scale in 1805 as a way of estimating the speed of winds at sea. The scale was later modified so that it could be used on land.

TIPS

To convert miles per hour to kilometers per hour multiply the reading by 1.6. A reading of 10 miles per hour is 16 kilometres per hour. To convert metres per second into kilometres per hour multiply the reading by 3.6.

Activity:

Ask your students to devise their own wind scale based on what they see around them, while recording wind speed for Sky Watchers — flags fluttering, leaves blowing around, etc.

Beaufort Scale

IF	WINDS	SPEED (km/h)	BEAUFORT
Smoke rises straight up	Calm	Less than 1	0
Smoke drifts but weather vanes do not turn	Light air	1 to 5	1
Leaves rustle, weather vanes move, you feel a light breeze	Light breeze	6 to 11	2
Wind extends a little flag, keeps leaves in and small twigs in motion	Gentle breeze	12 to 19	3
Wind raises dust, loose paper and small branches kept in motion	Moderate breeze	20 to 28	4
Wind sways small trees and small waves form on ponds	Fresh breeze	29 to 38	5
Large branches of trees move, telephone wires whistle and it is hard to use an umbrella	Strong breeze	39 to 49	6
Trees bend and walking against the wind is hard	Near gale	50 to 61	7
Twigs break off trees	Gale	62 to 74	8
Houses and roofs are damaged	Strong gale	75 to 88	9
Trees uprooted	Storm	89 to 102	10
Damage is widespread	Violent storm	103 to 117	11
Tremendous damage and loss of life	Hurricane	Above 117	12

WIND, CLOUDS & WEATHER PHENOMENA

For the Sky Watchers program you record the direction the wind is coming from as well as the amount of sky covered by clouds. You also describe the day's weather using one of the terms listed under the title Phenomena on the Sky Watchers instruction sheet. Weather phenomena include haze, blowing snow, thick fog, drizzle, rain showers and snow showers.

Wind Direction

The wind direction is the direction the wind is coming from. A north wind, for instance, blows in from the north. There are two ways to find the direction of the wind. You can make a wind streamer using the instructions on page 8-6, or you can use a compass for reference.

If you decide to use a compass, go outside and with the compass, find north. Then select a landmark such as a hill, building or lake to identify one of the four points on the compass - north, south, east or west. This is your point of reference. To figure out where the wind is blowing from, compare the movement of the flags or tree branches with your point of reference.

If the flags and tree branches are still and you feel no breeze what so ever, then the wind is calm and you record both wind speed and wind direction as "0".

Cloud Cover

The Sky Watchers program uses 4 categories to describe the amount of sky covered by clouds from horizon to horizon.

Clear	No clouds in the sky
A few clouds	Less than half the sky is covered with clouds
Cloudy	More than half the sky is covered with clouds
Overcast	All of the sky is covered with clouds

Types of clouds

There are at least 12 different types of clouds. You may want to identify these too on your Sky Watchers log sheet under Additional Information, even though it is not part of the information you send to Environment Canada. Clouds are explained in the section beginning on page 21.

One Last Point

Your students may begin sending in weather reports at any time. They will gain a greater appreciation of the subject if they follow weather trends through the changing seasons.

If your classroom schedule allows it, you should take your observations every school day around 2 p.m. If you take your readings at the same time every day, then you can compare the readings and observations from day to day and week to week. Further, you can compare your readings with those of other schools in the Sky Watchers program because they also take their readings around 2 p.m. You may send your observations to Environment Canada at any time, but if possible please no later than 3 p.m. each day.

To enter your weather observation into our database, visit our Web site at www.weatheroffice.pyr.ec.gc.ca/skywatchers/index_e.html and follow the links from "Sky Watchers Weather". You will be prompted for your school's observer number and password, so you may wish to record them at the top of each log sheet for reference. If you have any trouble entering your observations, please call your Sky Watchers co-ordinator for help.